



**TITLE: Intraosseous Infusions for Patients Needing Emergency Fluid Resuscitation or Medication Administration: Clinical Benefits, Clinical Harms, and Guidelines**

**DATE:** 01 September 2010

**RESEARCH QUESTIONS:**

1. What are the clinical benefits and harms of intraosseous infusions in patients needing emergency fluid resuscitation and/or medication administration?
2. What are the guidelines for the initiation of intraosseous infusions in patients needing emergency fluid resuscitation and/or medication administration?

**METHODS:**

A limited literature search was conducted on key health technology assessment resources, including PubMed, the Cochrane Library (Issue 7, 2010), University of York Centre for Reviews and Dissemination (CRD) databases, ECRI (Health Devices Gold), EuroScan, international health technology agencies, and a focused Internet search. The search was limited to English language articles published between Jan 1, 2005 and Aug 19, 2010. No filters were applied to limit the retrieval by study type. Internet links were provided, where available.

The summary of findings was prepared from the abstracts of the relevant information. Please note that data contained in abstracts may not always be an accurate reflection of the data contained within the full article.

**RESULTS:**

HTIS reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews, and meta-analyses are presented first. These are followed by randomized controlled trials, non-randomized studies, and evidence-based guidelines.

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The literature search identified six non-randomized studies regarding benefits and harms and three evidence-based guidelines regarding initiation of intraosseous infusions in patients needing emergency fluid resuscitation and/or medication administration. No health technology assessments, systematic reviews, meta-analyses, or randomized controlled trials were identified. Additional articles of potential interest are included in the appendix.

**OVERALL SUMMARY OF FINDINGS:**

The six included non-randomized studies<sup>1-6</sup> examined various population groups, from neonate to adult, and all concluded that intraosseous (IO) infusions were effective, fast, and safe, with only minor complications reported. Two studies specified the type of health care workers inserting the IO infusions. Gerritse et al.<sup>1</sup> studied an emergency medical transport team, while Fiorito et al.<sup>6</sup> examined insertions performed by emergency medical technician-paramedics, emergency medicine physicians, and transport team members. Both studies demonstrated a high success rate for IO placements by all groups. Additional studies involving a variety of health care providers performing IO infusions are included in the appendix. Table 1 provides more detail on the included non-randomized studies.

<b>Table 1: Non-randomized studies</b>			
<b>First author; year</b>	<b>Patient group or setting; IO device</b>	<b>Results</b>	<b>Authors' conclusions</b>
Gerritse; 2009 <sup>1</sup>	40 children and adults in a pre-hospital setting with an emergency medical transport team;  Bone injection gun	Success rate was 71% in children, 73% in adults; no complications for health care providers or patients	The bone injection gun is safe and effective in a pre-hospital setting.
Leidel; 2009 <sup>2</sup>	10 in-hospital adult emergency patients under resuscitation;  EZ-IO	Success rate on first attempt was 90%; mean procedure time 2.3 minutes; failure to obtain access in one patient was the only complication	IO access is reliable for in-hospital adult patients under trauma or medical resuscitation with impossible peripheral IV access, and may improve the safety of these patients compared with central venous catheterization (CVC).
Ngo; 2009 <sup>3</sup>	24 patients in the emergency department (35 IO insertions);  EZ-IO	All IO insertions except one were successful on the first attempt, and all were placed within 20 seconds; complications were minor and included a glove caught in the drill device and extravasation of fluid	The EZ-IO device is fast, easy, and reliable for patients with no venous vascular access, especially in the emergency department.
Paxton; 2009 <sup>4</sup>	29 emergency room patients undergoing resuscitation (30 IO	IO catheter placement was significantly faster than peripheral IV (PIV) or CVC;	IO insertions are significantly faster than PIV and CVC

**Table 1: Non-randomized studies**

First author; year	Patient group or setting; IO device	Results	Authors' conclusions
	insertions); IO device not specified	no major complications; minor complications included placement failure, poor flow, catheter dislodgement, and higher pain scores	placement, although there is increased risk of minor complications; IO access is life saving when conventional methods of vascular access are difficult or impossible.
Horton; 2008 <sup>5</sup>	95 pediatric emergency patients; EZ-IO	Success rate of 94%, with insertion time of ≤10 seconds in 77% of the one-attempt successes; 4 minor, non-significant complications	The EZ-IO device is safe and effective during the resuscitation and stabilization of pediatric patients.
Fiorito; 2005 <sup>6</sup>	47 pediatric patients in pediatric critical care transport to PICU (58 IO insertions); insertions performed by emergency medical technician-paramedics, emergency medicine physicians, and transport team members IO device not specified	Success rate of first attempt was 78%; mean of 1.2 attempts per placement; 7 (12%) of placements had complications (all were local edema or infiltration)	IO infusions are safe and there is a similar rate of successful placement for different provider groups; all of these provider groups should be familiar with IO placement.

CVC=central venous catheterization; IO=intraosseous; IV=intravenous; PICU=pediatric intensive care unit; PIV=peripheral intravenous

The three evidence-based guidelines<sup>7-9</sup> included in this report all recommend the use of IO infusion if vascular access cannot be obtained quickly. All three guidelines agree that use of the IO route is preferred over the endotracheal route for drug administration. The individual guidelines are specific to pediatric and neonatal resuscitation,<sup>7</sup> patients with cardiac or cardiopulmonary arrest,<sup>8</sup> and infants, children, and adolescents.<sup>9</sup>

**REFERENCES SUMMARIZED:**

**Health technology assessments**

No literature identified

**Systematic reviews and meta-analyses**

No literature identified

**Randomized controlled trials**

No literature identified

**Non-randomized studies**

1. Gerritse BM, Scheffer GJ, Draaisma JM. Prehospital intraosseus access with the bone injection gun by a helicopter-transported emergency medical team. *J Trauma*. 2009 Jun;66(6):1739-41. [PubMed: PM19509638](#)
2. Leidel BA, Kirchhoff C, Bogner V, Stegmaier J, Mutschler W, Kanz KG, et al. Is the intraosseous access route fast and efficacious compared to conventional central venous catheterization in adult patients under resuscitation in the emergency department? A prospective observational pilot study. *Patient Saf Surg* [Internet]. 2009 [cited 2010 Aug 31];3(1):24. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2764565>  
[PubMed: PM19814822](#)
3. Ngo AS, Oh JJ, Chen Y, Yong D, Ong ME. Intraosseous vascular access in adults using the EZ-IO in an emergency department. *Int J Emerg Med* [Internet]. 2009 [cited 2010 Aug 31];2(3):155-60. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2760700>  
[PubMed: PM20157465](#)
4. Paxton JH, Knuth TE, Klausner HA. Proximal humerus intraosseous infusion: a preferred emergency venous access. *J Trauma*. 2009 Sep;67(3):606-11. [PubMed: PM19741408](#)
5. Horton MA, Beamer C. Powered intraosseous insertion provides safe and effective vascular access for pediatric emergency patients. *Pediatr Emerg Care*. 2008 Jun;24(6):347-50. [PubMed: PM18562874](#)
6. Fiorito BA, Mirza F, Doran TM, Oberle AN, Cruz EC, Wendtland CL, et al. Intraosseous access in the setting of pediatric critical care transport. *Pediatr Crit Care Med*. 2005 Jan;6(1):50-3. [PubMed: PM15636659](#)

**Guidelines and recommendations**

7. International Liaison Committee on Resuscitation. The International Liaison Committee on Resuscitation (ILCOR) consensus on science with treatment recommendations for pediatric and neonatal patients: pediatric basic and advanced life support. *Pediatrics* [Internet]. 2006 May [cited 2010 Aug 31];117(5):e955-e977. Available from: [http://www.ilcor.org/data/12\\_CoSTR\\_2005\\_Part6.pdf](http://www.ilcor.org/data/12_CoSTR_2005_Part6.pdf) [PubMed: PM16618790](#)

8. 2005 International Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations: Part 4: Advanced life support. *Circulation* [Internet]. 2005 Nov 29 [cited 2010 Aug 31];112(22 Suppl):III-25-III-54. Available from: [http://circ.ahajournals.org/cgi/reprint/112/22\\_suppl/III-25](http://circ.ahajournals.org/cgi/reprint/112/22_suppl/III-25)  
National Guideline Clearinghouse (NGC) summary: <http://www.guideline.gov/content.aspx?id=8482>  
See: Alternative Routes for Drug Delivery
  
9. 2005 International Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations: Part 6: Pediatric basic and advanced life support. *Circulation* [Internet]. 2005 Nov 29 [cited 2010 Aug 31];112(22 Suppl):III-73-III-90. Available from: [http://circ.ahajournals.org/cgi/reprint/112/22\\_suppl/III-73](http://circ.ahajournals.org/cgi/reprint/112/22_suppl/III-73)  
NGC summary: <http://www.guideline.gov/content.aspx?id=8484>  
See: Vascular Access and Drugs for Cardiac Arrest

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**APPENDIX – FURTHER INFORMATION:**

**Non-randomized studies**

10. Frascone RJ, Jensen J, Wewerka SS, Salzman JG. Use of the pediatric EZ-IO needle by emergency medical services providers. *Pediatr Emerg Care*. 2009 May;25(5):329-32. [PubMed: PM19404222](#)
11. Ong ME, Ngo AS, Wijaya R. An observational, prospective study to determine the ease of vascular access in adults using a novel intraosseous access device. *Ann Acad Med Singapore*. 2009 Feb;38(2):121-4. [PubMed: PM19271038](#)
12. Pfister CA, Egger L, Wirthmuller B, Greif R. Structured training in intraosseous infusion to improve potentially life saving skills in pediatric emergencies - results of an open prospective national quality development project over 3 years. *Paediatr Anaesth*. 2008 Mar;18(3):223-9. [PubMed: PM18230065](#)
13. Schwartz D, Amir L, Dichter R, Figenberg Z. The use of a powered device for intraosseous drug and fluid administration in a national EMS: a 4-year experience. *J Trauma*. 2008 Mar;64(3):650-4. [PubMed: PM18332804](#)
14. Frascone RJ, Jensen JP, Kaye K, Salzman JG. Consecutive field trials using two different intraosseous devices. *Prehosp Emerg Care*. 2007 Apr;11(2):164-71. [PubMed: PM17454802](#)
15. Guyette FX, Rittenberger JC, Platt T, Suffoletto B, Hostler D, Wang HE. Feasibility of basic emergency medical technicians to perform selected advanced life support interventions. *Prehosp Emerg Care*. 2006 Oct;10(4):518-21. [PubMed: PM16997785](#)

**Clinical practice guidelines (unclear methodologies)**

16. Simpson S. Intraosseous access [Internet]. London: University College London (UCL) Institute of Child Health; 2009. [cited 2010 Aug 31]. Available from: [http://www.ich.ucl.ac.uk/clinical\\_information/clinical\\_guidelines/cpg\\_guideline\\_00249](http://www.ich.ucl.ac.uk/clinical_information/clinical_guidelines/cpg_guideline_00249)
17. Adult advanced life support [Internet]. London: Resuscitation Council (UK); 2005. [cited 2010 Aug 31]. Available from: <http://www.resus.org.uk/pages/als.pdf>  
See: Assisting the circulation, p. 54
18. Newborn life support [Internet]. London: Resuscitation Council (UK); 2005. [cited 2010 Aug 31]. Available from: <http://www.resus.org.uk/pages/nls.pdf>  
See: Route and dose of adrenaline, p. 103
19. Paediatric advanced life support [Internet]. London: Resuscitation Council (UK); 2005. [cited 2010 Aug 31]. Available from: <http://www.resus.org.uk/pages/pals.pdf>

### Review articles

20. Fenwick R. Intraosseous approach to vascular access in adult resuscitation. *Emerg Nurse*. 2010 Jul;18(4):22-5. [PubMed: PM20662405](#)
21. de Caen AR, Reis A, Bhutta A. Vascular access and drug therapy in pediatric resuscitation. *Pediatr Clin North Am*. 2008 Aug;55(4):909-27. [PubMed: PM18675026](#)
22. DeBoer S, Russell T, Seaver M, Vardi A. Infant intraosseous infusion. *Neonatal Netw*. 2008 Jan;27(1):25-32. [PubMed: PM18232588](#)
23. Buck ML, Wiggins BS, Sesler JM. Intraosseous drug administration in children and adults during cardiopulmonary resuscitation. *Ann Pharmacother*. 2007 Oct;41(10):1679-86. [PubMed: PM17698894](#)
24. Fowler R, Gallagher JV, Isaacs SM, Ossman E, Pepe P, Wayne M. The role of intraosseous vascular access in the out-of-hospital environment (resource document to NAEMSP position statement). *Prehosp Emerg Care*. 2007 Jan;11(1):63-6. [PubMed: PM17169880](#)

### Additional references

25. American Association of Critical Care nurses adds its voice to intraosseous access support through endorsement of infusion nursing society's position paper [Internet]. San Francisco: EMS; 2010 May 17. [cited 2010 Aug 31]. Available from: <http://www.ems1.com/ems-products/medical-equipment/press-releases/819979-American-Association-of-Critical-Care-Nurses-Adds-Its-Voice-to-Intraosseous-Access-Support-Through-Endorsement-of-Infusion-Nursing-Societys-Position-Paper/>
26. Infusion Nurses Society. The role of the registered nurse in the insertion of intraosseous access devices. *J Infus Nurs* [Internet]. 2009 Jul [cited 2010 Aug 31];32(4):187-8. Available from: <http://www.nursingcenter.com/pdf.asp?AID=870525> [PubMed: PM19605994](#)
27. Intraosseous vascular access finds critical role in newly revised advanced cardiac life support guidelines [Internet]. Dallas: redOrbit; 2006 Jan 9. [cited 2010 Aug 31]. Available from: [http://www.redorbit.com/news/health/351034/intraosseous\\_vascular\\_access\\_finds\\_critical\\_role\\_in\\_newly\\_revised\\_advanced/index.html](http://www.redorbit.com/news/health/351034/intraosseous_vascular_access_finds_critical_role_in_newly_revised_advanced/index.html)