

**Date:** May 8, 2013

**Title:** Use of Ultrasound Guidance for Peripheral Intravenous Access in the Pediatric Population

**Clinical Question:**

P	(Population)	Among patients requiring peripheral intravenous (PIV) access,
I	(Intervention)	does the use of ultrasound for PIV catheter insertion,
C	(Comparison)	versus a non-ultrasound technique,
O	(Outcome)	decrease the number of PIV catheter insertion attempts?

[Definitions for terms marked with \\* may be found in the Supporting Information section.](#)

**Target Population for the Recommendation:**

Patients in any setting with a history of difficult venous access\* or who are currently experiencing unsuccessful PIV catheter insertion\*.

**Recommendation:**

It is recommended that the use of ultrasound be considered to obtain peripheral intravenous access for patients with known difficult access history or current unsuccessful attempts to decrease the number of PIV catheter insertion attempts and improve patient satisfaction (Benkhadra 2012 [2a]; Doniger 2009 [2b]; Bair 2008 [2b]; and Costantino 2005 [2b]).

**Discussion/Synthesis of Evidence related to the recommendation:**

There is a moderate body of evidence to support the use of ultrasound guidance when obtaining PIV access in patients with a history or current experience of difficult access to decrease the number of attempts to achieve successful cannulation.

This recommendation is based on the synthesized evidence from seven studies. Of the four studies involving pediatric patients, three were randomized controlled trials (RCTs) focusing on children ten years of age or younger (Benkhadra 2012 [2a]; Doniger 2009 [2b]; Bair 2008 [2b]) and one was a prospective observational study involving infants zero to twelve months of age (Triffterer 2012 [3b]). The remaining studies involved patients older than eighteen years of age (Stein 2009 [2a]; Costantino 2005 [2b]; and Brannam 2004 [4b]). The results from two of the RCTs involving pediatric patients younger than ten years of age showed statistically significant fewer attempts at PIV insertion with use of ultrasound (Benkhadra 2012 [2a]; Doniger 2009 [2b]). Two of the studies (Stein 2009 [2a]; Costantino 2005 [2b]) showed higher patient satisfaction in the ultrasound group.

Of the three pediatric RCT studies, one used a static ultrasound technique (Bair 2008 [2b]) and the other two used real time ultrasound visualization (Benkhadra 2012 [2a]; Doniger 2009 [2b]). The static ultrasound group did not have statistically or clinically significant results. The real time ultrasound groups had statistically significant shorter times to cannulation ( $P < 0.001$ ) (Benkhadra 2012 [2a]) and ( $P = 0.001$ ) (Doniger 2009 [2b]) fewer attempts ( $P = 0.004$ ) (Benkhadra 2012 [2a]; Doniger 2009 [2b]) and fewer needle redirections ( $P < 0.0001$ ) (Doniger 2009 [2b]). Two of these studies were limited by a small sample size (Bair 2008 [2b]; Doniger 2009 [2b]).

**Reference List:**

- Bair, A., Rose, J., Vance, C., Andrada-Brown, E., Kuppermann, N. (2008). Ultrasound-assisted peripheral venous access in young children: A randomized control trial and pilot feasibility study. *Western Journal of Emergency Medicine*, 9(4), 219-224. [2b]
- Benkhadra, M., Collignon, M., Fournel, I., Oeuvarard, C., Rollin, P., Perrin, M., Volot, F., Girard, C. (2012). Ultrasound guidance allows for faster peripheral IV cannulation in children under 3 years of age with difficult venous access: a prospective randomized study. *Pediatric Anesthesia*, 22, 449-454. [2a]

- Brannam, L., Blaivas, M., Lyon, M., & Flake, M. (2004). Emergency nurses' utilization of ultrasound guidance for placement of peripheral intravenous lines in difficult-access patients. *Academic Emergency Medicine*, 11(12), 1361-1363. [4b]
- Costantino, T. G., Parikh, A., Satz, W., & Fojtik, J. (2005). Ultrasonography-guided peripheral intravenous access versus traditional approaches in patients with difficult intravenous access. *Annals of Emergency Medicine*, 46(5), 456-461. [2b]
- Doniger, S. J., Ishimine, P., Fox, J. C., & Kanegaye, J. T. (2009). Randomized controlled trial of ultrasound-guided peripheral intravenous catheter placement versus traditional techniques in difficult-access pediatric patients. *Pediatric Emergency Care*, 25(3), 154-159. [2b]
- Kuensting, L., DeBoer, S., Holleran, R., Shultz, B., Steinmann, R., Venella, J. (2009). Difficult venous access in children: Taking control. *Journal of Emergency Nursing*, 35, 419-424 [5a]
- Stein, J., George, B., River, G., Hebig, A., & McDermott, D. (2009). Ultrasonographically guided peripheral intravenous cannulation in emergency department patients with difficult intravenous access: A randomized trial. *Annals of Emergency Medicine*, 54(1), 33-40. [2a]
- Triffterer, L., Marhofer P., Willschke H., Machata A.M., Reichel G., Benkoe T., & Kettner S.C. (2012). Ultrasound-guided cannulation of the great saphenous vein at the ankle in infants. *British Journal of Anaesthesia*, 108(2), 290-294. [3b]

## IMPLEMENTATION

### Applicability Issues:

- Venous access specific ultrasound equipment may need to be purchased.
- The vascular access team (VAT) or other clinicians inserting PIV catheters would need unlimited access to ultrasound equipment.
- Education in the use of ultrasonography will need to be provided.
- Personnel will need to remain competent in ultrasonography skills.
- VAT and other clinicians inserting PIV catheters would need education regarding assessment of DVA.
- Measurement of access attempts may not be available for comparison of ultrasound to non-ultrasound approaches.

### Relevant CCHMC Tools for Implementation:

- CCHMC Policy Number CPC-I-109 Peripheral Intravenous Catheter Care (PIV)
- CCHMC VAT Orientation Flow Sheet for Ultrasound PIV Placement

### Outcome or Process Measures:

- Number of times ultrasound is used for PIV access
- Successful cannulations with use of ultrasound
- Patient pain scale results
- Parent satisfaction results
- Number of attempts before ultrasound is used

## SUPPORTING INFORMATION

### Background/Purpose of BEST Development:

The use of ultrasound guidance to obtain PIV access was presented at the 2011 Association for Vascular Access (AVA) conference. Patients at Cincinnati Children's Hospital Medical Center with a known history or current experience of difficult PIV access may require multiple attempts before successful IV cannulation is achieved. Therefore, it was determined that the VAT staff will be trained in the use of ultrasound to obtain PIV access. The goal is to decrease the number of attempts required to successful IV cannulation, decrease patient pain, and increase parent satisfaction.

**Definitions:**

Difficult PIV access is also known as peripheral difficult venous access (DVA). A consensus panel of experts in pediatric emergency medicine, nursing, hospital medicine, anesthesia, and critical care created the definition of DVA to describe a clinical condition in which multiple attempts and/or special interventions are anticipated or required to achieve and maintain peripheral venous access (Kuensting et al., 2009 [5a]).

Successful PIV catheter insertion is defined as the observation of blood return in the catheter and the absence of signs of extravasation when flushing.

**Search Strategy:**

*Databases:* OVID, CINAHL, Medline, National Association of Children's Hospitals and Related Institutions (NACHRI) list serve

*Search Terms:* peripheral IV insertion, ultrasound guidance, sonography, ultrasonography, difficult access, bedside ultrasonography, IV access

*Limits and Filters:* English, Humans

*Search Date:* 11/20/2012; 2000-2012

**Relevant CCHMC Evidence-Based Documents:**

None were found.

**Group / Team Members:**

*Team Author:* Sharon Dwyer, RNII, Vascular-Access Board Certified (VA-BC), Vascular Access Team (VAT)

*Team Co-Author:* Neil Johnson, MB.BS, FRANZCR. M. Med, Interventional Radiology, Medical Director VAT

*Support/Consultant:* Barbara K. Giambra, MS, RN, CNP, Evidence-Based Practice Mentor, Center for Professional Excellence-Research and Evidence-Based Practice

*Ad Hoc/Content Reviewers:* Sylvia Rineair, MSHA, BSN, RN, VA-BC, Clinical Director VAT; Samantha Bass, RN, VAT; Laura Eades, RN, VA-BC, VAT; Julie Stalf, MSN, RN, VA-BC, Education Specialist II, VAT

**Conflicts of Interest were declared for each team member:**

- No financial or intellectual conflicts of interest were found.
- No external funding was received for development of this BESt.
- The following conflicts of interest were disclosed: None.

**Note:** Full tables of the [LEGEND evidence evaluation system](#) are available in separate documents:

- [Table of Evidence Levels of Individual Studies by Domain, Study Design, & Quality](#) (abbreviated table below)
- [Grading a Body of Evidence to Answer a Clinical Question](#)
- [Judging the Strength of a Recommendation](#) (dimensions table below)

**Table of Evidence Levels** (see note above):

Quality level	Definition
1a† or 1b†	Systematic review, meta-analysis, or meta-synthesis of multiple studies
2a or 2b	Best study design for domain
3a or 3b	Fair study design for domain
4a or 4b	Weak study design for domain
5a or 5b	General review, expert opinion, case report, consensus report, or guideline
5	Local Consensus

†a = good quality study; b = lesser quality study

**Table of Language and Definitions for Recommendation Strength** (see note above):

Language for Strength	Definition
It is strongly recommended that... It is strongly recommended that... not...	When the dimensions for judging the strength of the evidence are applied, there is high support that benefits clearly outweigh risks and burdens. <i>(or visa-versa for negative recommendations)</i>
It is recommended that... It is recommended that... not...	When the dimensions for judging the strength of the evidence are applied, there is moderate support that benefits are closely balanced with risks and burdens.
There is insufficient evidence and a lack of consensus to make a recommendation...	
<i>Given the dimensions below and that more answers to the left of the scales indicate support for a stronger recommendation, the recommendation statement above reflects the strength of the recommendation as judged by the development group. (Note that for negative recommendations, the left/right logic may be reversed for one or more dimensions.)</i>	
<b>Rationale for judgment and selection of each dimension:</b>	
<b>1. Grade of the Body of Evidence</b>	<input type="checkbox"/> High <input checked="" type="checkbox"/> Moderate <input type="checkbox"/> Low
<i>Rationale:</i>	
<b>2. Safety/Harm (Side Effects and Risks)</b>	<input checked="" type="checkbox"/> Minimal <input type="checkbox"/> Moderate <input type="checkbox"/> Serious
<i>Rationale:</i> One study reported one arterial puncture in the ultrasound group (Doniger 2009 [2b]).	
<b>3. Health benefit to patient</b>	<input type="checkbox"/> Significant <input checked="" type="checkbox"/> Moderate <input type="checkbox"/> Minimal
<i>Rationale:</i>	
<b>4. Burden on patient to adhere to recommendation</b>	<input checked="" type="checkbox"/> Low <input type="checkbox"/> Unable to determine <input type="checkbox"/> High
<i>Rationale:</i>	
<b>5. Cost-effectiveness to healthcare system</b>	<input type="checkbox"/> Cost-effective <input checked="" type="checkbox"/> Inconclusive <input type="checkbox"/> Not cost-effective
<i>Rationale:</i>	
<b>6. Directness of the evidence for this target population</b>	<input checked="" type="checkbox"/> Directly relates <input type="checkbox"/> Some concern of directness <input type="checkbox"/> Indirectly relates
<i>Rationale:</i> Four of the studies cited included children as study participants (Benkhadra 2012 [2a]; Bair 2008 [2b]; Doniger 2009 [2b]; and Triffterer 2012 [3b])	
<b>7. Impact on morbidity/mortality or quality of life</b>	<input type="checkbox"/> High <input checked="" type="checkbox"/> Medium <input type="checkbox"/> Low
<i>Rationale:</i>	

Copies of this Best Evidence Statement (BESt) and related tools (if applicable, e.g., screening tools, algorithms, etc.) are available online and may be distributed by any organization for the global purpose of improving child health outcomes.

Website address: <http://www.cincinnatichildrens.org/service/i/anderson-center/evidence-based-care/bests/>

Examples of approved uses of the BESt include the following:

- Copies may be provided to anyone involved in the organization's process for developing and implementing evidence based care;
- Hyperlinks to the CCHMC website may be placed on the organization's website;
- The BESt may be adopted or adapted for use within the organization, provided that CCHMC receives appropriate attribution on all written or electronic documents; and
- Copies may be provided to patients and the clinicians who manage their care.

Notification of CCHMC at [EBDMinfo@cchmc.org](mailto:EBDMinfo@cchmc.org) for any BESt adopted, adapted, implemented, or hyperlinked by the organization is appreciated.

Please cite as: Dwyer, S., Cincinnati Children's Hospital Medical Center: Best Evidence Statement Use of Ultrasound Guidance for Peripheral Intravenous Access in the Pediatric Population, <http://www.cincinnatichildrens.org/svc/alpha/h/health-policy/best.htm>, BESt 154, pages 1-5, 5/8/13.

This Best Evidence Statement has been reviewed against quality criteria by two independent reviewers from the CCHMC Evidence Collaboration. Conflict of interest declaration forms are filed with the CCHMC EBDM group.

Once the BESt has been in place for five years, the development team reconvenes to explore the continued validity of the guideline. This phase can be initiated at any point that evidence indicates a critical change is needed. CCHMC EBDM staff performs a quarterly search for new evidence in an horizon scanning process. If new evidence arises related to this BESt, authors are contacted to evaluate and revise, if necessary.

*For more information about CCHMC Best Evidence Statements and the development process, contact the Evidence Collaboration at [EBDMinfo@cchmc.org](mailto:EBDMinfo@cchmc.org).*

#### **Note**

**This Best Evidence Statement addresses only key points of care for the target population; it is not intended to be a comprehensive practice guideline. These recommendations result from review of literature and practices current at the time of their formulation. This Best Evidence Statement does not preclude using care modalities proven efficacious in studies published subsequent to the current revision of this document. This document is not intended to impose standards of care preventing selective variances from the recommendations to meet the specific and unique requirements of individual patients. Adherence to this Statement is voluntary. The clinician in light of the individual circumstances presented by the patient must make the ultimate judgment regarding the priority of any specific procedure.**