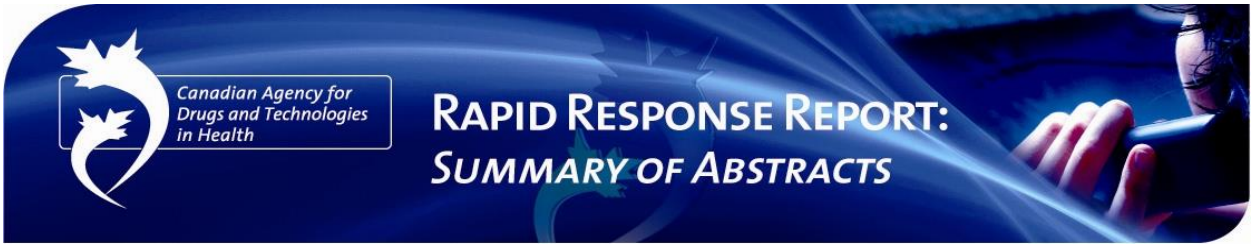


**TITLE: Vein Illumination Devices for Vascular Access: Clinical Effectiveness, Cost-Effectiveness and Guidelines**

**DATE:** 13 October 2016

## RESEARCH QUESTIONS

1. What is the clinical effectiveness of vein illumination devices for vascular access procedures for neonates in acute care settings?

2. What is the clinical effectiveness of vein illumination devices for vascular access procedures for patients in the emergency department?

3. What is the cost-effectiveness of vein illumination devices?

4. What are the evidence-based guidelines for use of vascular access imaging devices for neonates?

5. What are the evidence-based guidelines for use of vascular access imaging devices for patients in the emergency department?

## KEY FINDINGS

One systematic review with meta-analysis, eight randomized controlled trials, and three non-randomized studies were identified regarding vein illumination devices for vascular access procedures for neonates or adults in acute care settings or in the emergency department. In addition, one evidence-based guideline was identified regarding the use of vascular access imaging devices for patients.

## METHODS

A limited literature search was conducted on key resources including Embase, Medline, PubMed, The Cochrane Library, University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. No filters were applied to limit retrieval by study type for questions 1, 2 and 3. Methodological filters were applied to limit retrieval to health technology assessments,

systematic reviews, meta-analyses and guidelines for questions 4 and 5. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2011 and September 29, 2016. 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.

## SELECTION CRITERIA

One reviewer screened citations and selected studies based on the inclusion criteria presented in Table 1.

**Table 1: Selection Criteria**

| | |
|---|---|
| **Population** | Q1 & 4: Neonates (< 4 weeks) in acute care settings<br>Q2 & 5: Patients (any age) in the emergency department<br>Q3: Patients (any age) requiring vein illumination devices for vascular access procedures |
| **Intervention** | Vein illumination devices (e.g., vascular access imaging devices such as AccuVein® AV400, Vein Viewer®, Translite [VeinLite LED], TransLite LLC [VeinLite EMS Pro], Christie [also called Vein Viewer Vision]) |
| **Comparators** | Q1-3: Standard clinical practice, including other vascular access imaging devices (e.g., ultrasound, infrared)<br>Q4 & 5: No comparator |
| **Outcomes** | Q1 & 2: Clinical effectiveness (e.g., harms, benefits, safety)<br>Q3: Cost-effectiveness (e.g., cost per QALY, incremental cost-effectiveness ratio)<br>Q4: Guidelines and recommendations for the use of vein illumination devices (e.g., in which patients to use these devices, how best to implement this equipment, training and education needed to use this equipment) |
| **Study Designs** | Health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, non-randomized studies, economic evaluations, evidence-based guidelines |

## RESULTS

Rapid Response 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, economic evaluations, and evidence-based guidelines.

One systematic review with meta-analysis, eight randomized controlled trials, and three non-randomized studies were identified regarding vein illumination devices for vascular access procedures for neonates or adults in acute care settings or in the emergency department. In addition, one evidence-based guideline was identified regarding the use of vascular access imaging devices for patients. No health technology assessments or economic evaluations were identified.

Additional references of potential interest are provided in the appendix.

## OVERALL SUMMARY OF FINDINGS

One systematic review with meta-analysis,[1] eight randomized controlled trials,[2-9] and three non-randomized studies[10-12] were identified regarding vein illumination devices for vascular access procedures for neonates or adults in acute care settings or in the emergency department (ED). Most studies did not identify a benefit when using near-infrared vein illumination devices for intravenous (IV) cannulation[3-6, 8, 10-11] or arterial cannulation[11] whether in the ED[8-9] or for standard procedures.[3-6, 10-11] While one study recognized no benefit in its overall population, a subgroup analysis in children aged zero to two years suggested that the Vein Viewer may decrease the time to peripheral intravenous catheterization placement.[7] In addition, the Vein Viewer also improved successful line placement in infants of greater gestational age in one study[2] and near-infrared vascular imaging systems were observed as providing promising results in facilitating venipunctures in another study.[12] Detailed study characteristics and author conclusions are presented in Table 2.

One evidence-based guideline[13] was identified regarding the use of vascular access imaging devices for patients. The Emergency Nurses Association notes that there is inadequate evidence to support the use of infrared light, transillumination, and the Vein Entry Indicator Devices in patients with difficult intravenous access in the emergency department.[13]

**Table 2: Study Characteristics and Summary of Findings from the Included Studies**

| First Author, Year | Population | Intervention(s) | Comparator(s) | Author Findings and Conclusions |
|---|---|---|---|---|
| *Systematic Review* | | | | |
| Parker et al., 2016[1] | Adult patients in the ED and inpatients (N=3201) | PIVC using the following:<br>• AccuVein™<br>• AccuCath™ catheter system<br>• Ultrasound<br>• Safety catheters<br>• Topical anesthetics | | • Limited evidence to support ultrasound to increase success of first attempt<br>• Only three studies comparing AutoGuard and Insyte catheters were suitable for MA<br>• Nothing specific in the abstract regarding AccuVein™ or AccuCath™ |
| *Randomized Controlled Trials* | | | | |
| *Neonate-Specific Population* | | | | |
| Phipps et al., 2012[2] | Preterm and term neonates in level 3 NICU (N=115) | Vein Viewer (n=59) | Control (n=56) | • Vein Viewer improved successful line placement with most benefit seen in infants of greater GA |
| *Mixed Pediatric Population (Includes Neonates)* | | | | |
| Cuper et al., 2013[3] | Mixed pediatric population (0-18 years) receiving IV cannulation in OR (N=770) | VascuLuminator (NIR vascular imaging system) | Control | • VascuLuminator did not improve success rate or time to obtain IV cannulation |
| de Graaff et al., 2013[4] | Mixed pediatric population (0-18 years) receiving IV | IV cannulation with the following:<br>• Vein Viewer<br>• AccuVein | Control | • Although vein visibility is enhanced, NIR devices do not improve IV cannulation |

**Table 2: Study Characteristics and Summary of Findings from the Included Studies**

| First Author, Year | Population | Intervention(s) | Comparator(s) | Author Findings and Conclusions |
|---|---|---|---|---|
| | cannulation in OR (N=1913) | AV300<br>• VascuLuminator Vision | | |
| van der Woude et al., 2013[5] | Mixed pediatric population (0-15 years) with dark skin colour receiving IV cannulation in Curacao in OR (N=88) | VascuLuminator (n=43) | Control (n=45) | • VascuLuminator has limited value in improving success at first IV cannulation attempt in children with dark skin colour |
| Kaddoum et al., 2012[6] | Mixed pediatric population (0.18-17.1 years) receiving IV cannulation under anesthesia (N=146) | AccuVein AV300 | Standard Method | • AccuVein AV300 was easy to use and improved visualization of veins<br>• However, no evidence that is was superior to standard method of IV cannulation in patients under anesthesia |
| *Pediatric Population in ER* | | | | |
| Chapman et al., 2011[7] | Pediatric population (0-17 years) in the ER receiving nonemergent PIVC (N=323)<br>• Subgroup analysis of 0-2 year old population (n=107) | PIVC with Vein Viewer | Standard PIVC | • No results were significant for the overall study group<br>• Subgroup analysis of children aged 0-2 years suggest the Vein Viewer may decrease the time to PIVC placement |
| Perry et al., 2011[8] | Pediatric population (<20 years) receiving IV catheters in high-volume pediatric ER (N=123) | Vein Viewer (n=61) | Standard (n=62) | • First-attempt success rate for IC placement was non-significantly higher with standard than with Vein Viewer<br>• Nurses noted several benefits using the Vein Viewer with specific patient groups |
| *Adult Population in ER* | | | | |
| Aulagnier et al., 2014[9] | Adults presenting to ER receiving routine IV catheter insertion (N=266) | AccuVein (n=115) | Routine cannulation (n=157) | • Use of AccuVein did not improve IV cannulation in nonselected ER patients |

**Table 2: Study Characteristics and Summary of Findings from the Included Studies**

| First Author, Year | Population | Intervention(s) | Comparator(s) | Author Findings and Conclusions |
|---|---|---|---|---|
| *Non-Randomized Studies* | | | | |
| *Mixed Pediatric Population (Includes Neonates)* | | | | |
| Rothbart et al., 2015[10] | Mixed pediatric population (0-17 years) receiving venous cannulation prior to surgical interventions (N=238) | AccuVein AV300 (n=114) | Control (n=124) | • Neither time or number of attempts until successful cannulation were reduced using the AccuVein AV300 |
| Cuper et al., 2012[11] | Mixed pediatric population (0-3 years) undergoing arterial cannulation prior to cardiothoracic surgery (N=77) | NIRVIS (n=39) | Usual method (n=38) | • There was no significant clinical improvement when NIR was used during arterial cannulation in small children |
| Cuper et al., 2011[12] | Mixed pediatric population receiving venipuncture for blood withdrawal (N=125) | NIR (n=45) | Usual method (n=80) | • Promising results of an NIR vascular imaging system in facilitating venipunctures |

ED = emergency department; IV = intravenous; GA = gestational age; MA = meta-analysis; NICU = neonatal intensive care unit; NIR = near infrared; NIRVIS = near-infrared vascular imaging systems; OR = operating room; PIVC = peripheral intravenous catheterization.

## REFERENCES SUMMARIZED

### Health Technology Assessments

No literature identified.

### Systematic Reviews and Meta-analyses

*Adult Population in Emergency Department*

1. Parker SI, Benzies KM, Hayden KA, Lang ES. Effectiveness of interventions for adult peripheral intravenous catheterization: A systematic review and meta-analysis of randomized controlled trials. Int Emerg Nurs. 2016 Jul 11. [Epub ahead of print]
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### Randomized Controlled Trials

*Neonate Population*

2. Phipps K, Modic A, O'Riordan MA, Walsh M. A randomized trial of the Vein Viewer versus standard technique for placement of peripherally inserted central catheters (PICCs) in neonates. J Perinatol. 2012 Jul;32(7):498-501.
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*Mixed Pediatric Population (Neonates Included)*

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PubMed: PM23649104

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*Pediatric Population in the Emergency Department*

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*Adult Population in the Emergency Department*

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PubMed: PM25176152

**Non-Randomized Studies**

*Mixed Pediatric Population (Neonates Included)*

10. Rothbart A, Yu P, Muller-Lobeck L, Spies CD, Wernecke KD, Nachtigall I. Peripheral intravenous cannulation with support of infrared laser vein viewing system in a pre-operation setting in pediatric patients. BMC Res Notes [Internet]. 2015 [cited 2016 Oct 12];8:463. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4576370
PubMed: PM26391665

11. Cuper NJ, de Graaff JC, Hartman BJ, Verdaasdonk RM, Kalkman CJ. Difficult arterial cannulation in children: is a near-infrared vascular imaging system the answer? Br J Anaesth. 2012 Sep;109(3):420-6.
PubMed: PM22735300

12. Cuper NJ, Verdaasdonk RM, de Roode R, de Vooght KM, Viergever MA, Kalkman CJ, et al. Visualizing veins with near-infrared light to facilitate blood withdrawal in children. Clin Pediatr (Phila). 2011 Jun;50(6):508-12.
PubMed: PM21357203

**Economic Evaluations**

No literature identified.

**Guidelines and Recommendations**

13. Clinical practice guideline: difficult intravenous access [Internet]. Des Plaines (IL): Emergency Nurses Association; [2013]. [cited 2016 Oct 12]. Available from: https://www.ena.org/practice-research/research/CPG/Documents/DifficultIVAccessCPG.pdf
*See: Description of Decision Options/Interventions and the Level of Recommendation, 5. Alternative Methods, page 12*

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## APPENDIX – FURTHER INFORMATION:

### Systematic Reviews and Meta-analyses – Pediatric Population (Neonates Not Specified)

14. Heinrichs J, Fritze Z, Klassen T, Curtis S. A systematic review and meta-analysis of new interventions for peripheral intravenous cannulation of children. Pediatr Emerg Care. 2013 Jul;29(7):858-66.
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### Randomized Controlled Trials

*Pediatric Population (Neonates Not Specified or Non-Neonate Population)*

15. de Graaff JC, Cuper NJ, van Dijk AT, Timmers-Raaijmaakers BC, van der Werff DB, Kalkman CJ. Evaluating NIR vascular imaging to support intravenous cannulation in awake children difficult to cannulate; a randomized clinical trial. Paediatr Anaesth. 2014 Nov;24(11):1174-9.
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PubMed: PM23492965

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PubMed: PM22415409

*Adult Population – Alternate Setting*

20. Fumagalli S, Torricelli G, Massi M, Calvani S, Boni S, Roberts AT, et al. Effects of a new device to guide venous puncture in elderly critically ill patients: results of a pilot randomized study. Aging Clin Exp Res. 2016 Feb 23. [Epub ahead of print].
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**Non-Randomized Studies**

*Adult Population – Alternate Setting*

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PubMed: PM27235559

*Mixed Population with Hemophilia – Alternate Setting*

22. Guillon P, Makhloufi M, Baillie S, Roucoulet C, Dolimier E, Masquelier AM. Prospective evaluation of venous access difficulty and a near-infrared vein visualizer at four French haemophilia treatment centres. Haemophilia. 2015 Jan;21(1):21-6.
PubMed: PM25335191

*No Patient Outcomes*

23. Chiao FB, Resta-Flarer F, Lesser J, Ng J, Ganz A, Pino-Luey D, et al. Vein visualization: patient characteristic factors and efficacy of a new infrared vein finder technology. Br J Anaesth. 2013 Jun;110(6):966-71.
PubMed: PM23384732

**Clinical Practice Guidelines – Uncertain Methodology**

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**Review Articles**

25. Johr M, Berger TM. Venous access in children: state of the art. Curr Opin Anaesthesiol. 2015 Jun;28(3):314-20.
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*Technology Reviews*

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