

**Brief report - TAU**  
**Review of Ultrasound-guided insertion of PICC Line**  
**Tory Atwood MSc; James Brophy MD, Ph.D.**  
**August 24, 2007**

**Request**

Diane Borisov requested on July 26 2007 that TAU perform a “technology assessment of ultrasound guided insertion of peripherally inserted central catheters (PICC) lines vs. palpation guided insertion”. This brief report responds to that request.

**Methods**

A systematic search of the medical literature and health technology databases was performed for evidence regarding ultrasound guided insertion of PICC lines. No previous health technology assessments of this technology were found. Also no randomized trials were identified. The identified literature was largely restricted to observational reports from single center sites. The paucity of literature has lead us to performing only a brief report.

**Results**

The ‘gold standard’ for insertion of peripherally inserted central catheter (PICC) lines involves inserting the line under fluoroscopy in an interventional radiology (IR) suite. Given the lengthy wait times that can be involved in scheduling time in a busy IR suite, there has been a strong interest in the last few years of developing alternate methods of central catheter placement, particularly as peripherally inserted lines have become more and more common.

The initial step in this process has involved the development of nurse-led intravenous teams in a number of hospital centres. These specially trained nurses attempt to insert the PICC at the patient’s bedside, with failures referred to IR. This strategy may be resource and time efficient, provided success rates are sufficiently high and complication rates low. In addition to freeing up radiology resources for other conditions, bedside installation for critically-ill patients reduces patient transport costs

Traditional methods of inserting PICC lines at the bedside have generally seen success rates in the range of 65-75%, with reports of success rates as low as 60%<sup>2-5</sup>. The traditional placement (within 1.5 inches of the antecubital fossa) is also prone to complications ranging from occlusion alarms to mechanical phlebitis and infections. Ultrasound-guided bedside placement of PICC lines was pioneered at University of Washington Medical Center in 1997, to locate non-palpable vessels in the upper arm<sup>3</sup>. Since that time, the use of portable ultrasound machines and microinducers are becoming more and more common, resulting in improved success rates and fewer referrals to IR. Present bedside success rates using ultrasound appear to be >90%<sup>2-5</sup>.

This can result in significant cost savings, and better use of limited hospital resources. Part of the reason for this improved success is the identification of the optimum vein for insertion. Patients, when given the choice, tend to prefer insertion site away from the antecubital fossa, as alternate locations are less likely to impede daily activities. In addition, the possibility of inserting the PICC in a location away from the antecubital fossa can limit or eliminate complications such as mechanical phlebitis. At the VA Puget Sound, of 30 patients who had PICC lines inserted at or below the antecubital fossa in the initial stages of the introduction of microinducer and ultrasound technology, 4 developed mechanical phlebitis. Of those patients with PICC insertion above the antecubital fossa (over 400) none developed this complication.

It is to be noted that there is a learning curve to develop the skills necessary to watch the ultrasound screen in addition to the patient's arm, of approximately 20-50 insertions<sup>3</sup>. Manipulation of the probe may also be a complication, although 'hands-free' ultrasound technology is apparently now available<sup>2</sup>. However these issues are not strong reasons to recommend against introducing this technology.

Therefore, there is reasonable evidence that the use of bedside portable ultrasound can substantially increase the success rates of PICC line insertions by trained nursing personnel. This may lead to decrease costs per PICC line insertion and allow the radiology suites to be used for other required procedures. Moreover, ultrasound guided bedside insertion may expedite patient access to this technology thereby further decreasing hospital costs by reducing wait times and shortening hospital stays.

It may also be useful to take advantage of some of the other PICC line insertion process of care improvements discovered during the course of this literature search. Falkowski<sup>1</sup> discusses a triage system developed to capture patients who might need a PICC, either at admission, or at the beginning of treatment. The goal was to reduce overall risks associated with venipuncture, but there was also an interest in decreasing overall length of stay by facilitating discharge, which may be delayed if PICC insertion is delayed<sup>4</sup>. A combined consent form for both the bedside PICC insertion and – in case of failure – IR insertion was also developed. Robinson *et al.*<sup>4</sup> describe an alternate triage protocol. They mention that, with the increase in PICC insertions, PICC may end up being placed for inappropriate indications. To address this issue, and the issue of treatment and discharge delay due to delay in PICC insertion, Brigham and Women's Hospital developed a dedicated PICC team, to evaluate, approve, and place PICC lines as appropriate.

Ultrasound guidance for the installation of central venous catheters (CVC) (eg., jugular and subclavian insertion sites) is now endorsed by the US Agency for Healthcare Research and Quality and the Centers for Disease Control and Prevention, based on a meta-analysis of eight studies by Randolph et al. and 4 additional studies. However, there is no formal study or endorsement of the use of ultrasound for PICC line insertion. While some health benefits may accrue with ultrasound guidance of PICC line insertions, the avoidance of serious complications is likely less than for CVC insertion.

In the event that a purchase of new equipment would be necessary, an appropriate device is available from Sonosite Canada Inc. at a cost of approximately \$20,000. This cost is for the device itself: additional expenses may be incurred for capital expenses such as a transport cart or hands-free adapters. Costs may also be slightly higher on a per-insertion basis due to the need to use a probe cover to ensure aseptic technique. Any capital costs would be rapidly offset by more rapid hospital discharges resulting from quicker PICC line insertions

### **Recommendation**

Although there is less than ideal evidence, this brief report suggests that the introduction of bedside ultrasound PICC insertion is associated with higher success rates, low complication rates, and an acceptable economic perspective. If such an approach is adopted at the MUHC, a specialized team is required and a detailed registry of all cases would provide much needed information both for quality control purposes and for a future evaluation of this procedure.

### Reference List

1. Falkowski, A. Improving the PICC insertion process. *Nursing.*, 36: 26-27, 2006.
2. Hunter, M. Peripherally inserted central catheter placement @ the speed of sound. *Nutr. Clin. Pract.*, 22: 406-411, 2007.
3. McMahon, D. D. Evaluating new technology to improve patient outcomes: a quality improvement approach. *J. Infus. Nurs.*, 25: 250-255, 2002.
4. Robinson, M. K., Mogensen, K. M., Grudinskas, G. F., Kohler, S., and Jacobs, D. O. Improved care and reduced costs for patients requiring peripherally inserted central catheters: the role of bedside ultrasound and a dedicated team. *JPEN J. Parenter. Enteral Nutr.*, 29: 374-379, 2005.
5. Royer, T. Nurse-driven interventional technology. A cost and benefit perspective. *J. Infus. Nurs.*, 24: 326-331, 2001.