

The “One Stick Standard” for vascular access

The role of ultrasound guidance in achieving a new safety goal

US visualization: one-stick standard and how the practice can significantly reduce- or even eliminate- dangerous complications.



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Obtaining vascular access is one of the most common procedures performed in U.S. hospitals, with more than 5 million central venous catheterisations (CVCs) performed annually (Feller-Klopman 2007). Nearly 80% of critical care patients undergo CVC (Gibbs; Murphy 2006) for administration of fluids, blood products, or vasoactive drugs; hemodynamic monitoring; hemodialysis or trans-venous pacing (Sisson; Nagdev 2007). However, this invasive procedure can have serious complications, including iatrogenic pneumothorax (the accidental puncture and collapse of the patient’s lung) and central line-associated bloodstream infections (CLABSIs), particularly if CVC is performed blindly, using traditional techniques based on anatomical landmarks.

“Reducing procedural complications is critical to improving patient safety,” reports Tejal K. Gandhi, MD, MPH, CPPS, president and chief executive officer, National Patient Safety Foundation. “Using ultrasound guidance is a highly recommended way to achieve that goal.” A 2016 policy statement from the American College of Emergency Physicians (ACEP) bears that out, stating that the benefits of procedural ultrasound, performed at the bedside, include “improved patient safety, decreased procedural attempts and decreased time to perform many procedures in patients whom the technique would otherwise be difficult” ([annemergmed.com/article/S0196-0644\(16\)30096-8/abstract](http://annemergmed.com/article/S0196-0644(16)30096-8/abstract))

Guidelines from numerous government and medical specialty groups recommend ultrasound-guided CVC, with ACEP presenting Class I evidence to support this

practice ([annemergmed.com/article/S0196-0644\(08\)02087-8/fulltext](http://annemergmed.com/article/S0196-0644(08)02087-8/fulltext)). The policy statement reported that procedural ultrasound not only allows clinicians to identify the relevant anatomy and pathology before proceeding with invasive procedures, but it also aids accurate execution through direct visualisation as the needle advances towards the target vessel. Quite simply, the effect is similar to turning on a car’s headlights at night to navigate safely to the desired destination.

“ USING ULTRASOUND VISUALISATION TO ACHIEVE A ONE-STICK STANDARD HAS BEEN SHOWN TO SIGNIFICANTLY REDUCE- OR EVEN ELIMINATE- DANGEROUS CVC COMPLICATIONS ”

Adding that procedural ultrasound is helpful for both central and peripheral line placement, ACEP advocates its use to enable a “one stick standard” for faster, safer vascular access to accelerate patient care. Here is a closer look at how to achieve that standard, drawing on recently published data and the author’s experiences as a critical care physician at Banner Health, which operates 29 hospitals and acute-care facilities across seven states.

Ultrasound guidance helps hospitals reduce a \$364 million risk

In fiscal year (FY) 2016, 758 U.S. hospitals incurred an estimated \$364 million in penalties under the Hospital Acquired Conditions (HAC)

Reduction Program ([cms.gov/Newsroom/MediaReleaseDatabase/Fact-sheets/2015-Fact-sheets-items/2015-12-10-2.html](https://www.cms.gov/Newsroom/MediaReleaseDatabase/Fact-sheets/2015-Fact-sheets-items/2015-12-10-2.html)). Under this program, the quartile of hospitals with the highest rates of pneumothorax, CLABSI and eight other preventable complications are docked 1% of their annual Medicare reimbursements across all diagnosis-related groups (DRGs), providing a powerful incentive to adopt proven best practices to reduce procedural errors and their associated costs.

About 250,000 CLABSIs occur annually each year in the U.S. with estimated attributable mortality of 12 to 25% and an estimated cost of up to \$56,000 per infection (O'Grady et al. 2011a; 2002b). Pneumothorax lengthens hospital stay by 4 to 7 days with an additional cost of up to \$45,000 per case (Zhan et al. 2004). The cost can escalate dramatically if the patient sues, with a recent study reporting malpractice payments of up to \$6.9 million for central line-related injuries, such as pneumothorax, pulmonary artery rupture, and air embolism (Domino et al. 2004).

Using ultrasound visualisation to achieve a one-stick standard has been shown to significantly reduce- or even eliminate- dangerous CVC complications. For example, in a randomised controlled trial with 900 critical care patients (Karakitsos et al. 2006), ultrasound-guided CVC reduced rates of pneumothorax to 0%, compared to 2.4% for landmark methods. A 35% reduction in CLABSI among those who received ultrasound guidance could be attributed to fewer needle passes and reduced rates of venous thrombosis and hematoma, suggested the investigators, who also reported the following outcomes:

- Superior success with ultrasound-guided CVC placement, compared to the landmark group (100% vs 94%)
- A reduced rate of carotid punctures (1% vs 10.6%)
- Fewer hematomas (0.4% vs 8.4%)
- Significantly reduced blood-vessel access time, higher first-pass success, and a decrease in hemothorax (0% vs 1.7%)

A six-point bundle to reduce central line infections

A recent guideline to reduce CLABSI issued jointly by the Centers for Disease Control (CDC),

the Society of Critical Care Medicine and other leading specialty groups recommends “ultrasound guidance to place central venous catheters (if this technology is available) to reduce the number of cannulation attempts and mechanical complications” (O'Grady et al. 2011) ([cid.oxfordjournals.org/content/52/9/1087.full](https://doi.org/10.1093/cid/cir1087)). The guideline also advises using the subclavian vein as the preferred CVC site, a recommendation also supported by a 2015 systematic review that reported, “subclavian catheterization is particularly favored for reported reduction in infectious and thrombotic complications compared with the other sites” (Kim; Koymfman 2015). Newer techniques now allow subclavian catheters to be placed under ultrasound guidance, though Internal Jugular vein access is the most commonly performed due to its ease.

The hospital where I practice- and many others across the U.S.- have seen striking reductions in CLABSI after adopting the following six-point safety bundle, which builds on the Institute for Healthcare Improvement's (IHI) widely used five-point central line insertion checklist by adding ultrasound guidance as a sixth component, as advised by the CDC guidelines. In a recent study, the IHI checklist was associated with a reduction of up to 66% over an 18-month period at 103 participating facilities (Pronovast et al. 2006).

1. Hand hygiene*
2. Maximal barrier precautions*
3. Chlorhexidine skin antisepsis*
4. Optimal catheter site selection*
5. Daily review of CVC line necessity, with prompt removal of unneeded lines*
6. Ultrasound-guided line placement**

*Component of the IHI checklist.

**Recommended by the CDC guideline.

Ultrasound-guided peripheral IV as an alternative to high-risk CVC

Achieving rapid vascular access is particularly critical for providing optimal care for critically and unstable patients. However, failure rates of emergent peripheral intravenous (PIV) access of 10 to 40% have been reported in the literature, with the average time needed for PIV reported at 2.5 to 13 minutes, and difficult PIV access taking up to 30 minutes (Leidel et al. 2009;

Crowley et al. 2012). Very often, patients with problematic PIV access due to such factors as obesity, chronic illness, chemotherapy, vascular pathology, or a history of IV drug use end up receiving CVCs.

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However, ultrasound-guided PIV, which is a standard practice at the hospital where I work, can help such patients avoid unnecessary CVCs and their associated risks. A randomised trial of emergency department patients with difficult vascular access found that ultrasound-guided PIV had a 97% success rate, compared to just 33% for landmark methods. The investigators

also reported the following results:

- Faster vascular access in the ultrasound group, compared to the landmark group (13 minutes vs 30 minutes)
- Fewer percutaneous punctures (1.7 vs 3.7)
- High patient satisfaction when ultrasound was used

Since CVCs can have a complication rate of up to 15% (Feller-Kopman 2007), with additional costs estimated at up to \$56,000 per case, the outcome of this trial, and others with similar findings (Au et al. 2012), offer a powerful argument for widespread adoption of ultrasound-guided PIV as an evidence-based safety practice to reduce costs and accelerate care for patients who need it the most. And if you or a loved one ever needed a central or peripheral line for emergency treatment, wouldn’t you want ultrasound at the bedside- and a medical provider who was firmly committed to achieving the one-stick standard? ■



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