

Quality Improvement Guidelines for Central Venous Access

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CENTRAL venous access is an integral component in the care of patients with malignant, infectious, and chronic diseases. Image-guided placement of central venous access catheters has been proven to be very safe and effective in providing access to the central venous circulation (1-21). Image-guided percutaneous placement of venous catheters and ports has become the method of choice in many institutions because it has reduced morbidity and mortality and has helped to reduce costs and length of stay in the hospital (5,7,8,10-13,16-25).

Participation by the radiologist in patient follow-up is an integral part of central venous access and will increase the success rate of the procedure. Close follow-up, with monitoring and management of the central venous access device, is appropriate for the radiologist.

These guidelines are written to be used in quality improvement programs to assess percutaneously placed central venous access devices. The most important processes of care are (a) patient selection, (b) procedure performance, and (c) patient monitoring. The outcome measures or indicators for these processes are indications, success rates, and

complication rates. Outcome measures are assigned threshold levels.

DEFINITIONS

Image-guided percutaneous central venous access is defined as the placement of a catheter with its tip in the caval atrial region utilizing the assistance of real-time imaging. The most commonly used imaging techniques during placement include fluoroscopy and ultrasonography.

Tunneled catheters are defined as catheters that travel through a subcutaneous tract prior to exiting the body through a small incision in the skin. Implanted ports are similar to tunneled catheters. However, they do not exit the skin, but terminate with a device buried in the subcutaneous tissues. The catheter exit or implanted port site can be located in several different locations but is usually placed over the torso/neck or peripherally. However, other alternative access routes have been described (3,9,10,15,22,26).

Successful placement is defined as follows: introduction of a catheter into the venous system with the tip in the desired location and the catheter functions for its intended use (eg, can be used to deliver medications or for dialysis). Functional success is the most important component of this definition.

While practicing physicians should strive to achieve perfect outcomes (eg, 100% success; 0% complications), in practice all physicians will fall short of

this ideal to a variable extent. Therefore, indicator thresholds may be used to assess the efficacy of ongoing quality improvement programs. For the purpose of these guidelines, a threshold is a specific level of an indicator that should prompt a review. "Procedure thresholds" or "overall thresholds" reference a group of indicators for a procedure (eg, major complications for the placement of central venous access devices). Individual complications may also be associated with complication-specific thresholds. When measures such as indications or success rates fall below a (minimum) threshold, or when complication rates exceed a (maximum) threshold, a review should be performed to determine causes and to implement changes, if necessary. Thresholds may vary from those listed here; for example, patient referral patterns and selection factors may dictate a different threshold value for a particular indicator at a particular institution. Therefore, setting universal thresholds is very difficult and each department is urged to alter the thresholds as needed to higher or lower values, to meet its own quality improvement program needs.

Complications can be stratified on the basis of outcome. Major complications result in admission to a hospital for therapy (for outpatient procedures), an unplanned increase in the level of care, prolonged hospitalization, permanent adverse sequelae, or death.

Minor complications result in no se-

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Table 1
Indications for Central Venous Access**Therapeutic Indications**

Administration of chemotherapy
Administration of total parenteral nutrition
Administration of blood products
Administration of intravenous medications
Intravenous fluid administration
Performance of plasmapheresis
Performance of hemodialysis

Diagnostic Indications

To establish or confirm a diagnosis
To establish a prognosis
To monitor response to treatment
For repeated blood sampling

Table 2
Success Rates

	Reported Rates (%)	Threshold (%)
Internal jugular approach (4,22,27–35)	96	95
Subclavian vein approach		
Catheter (6,8,11,14,16,17,19,22,23,28,31–33,36–44)	95	90
Infusion port (16,18,22,23,45)	95	90
Peripherally inserted central catheters (PICC) (1,7,20,22,23,25,46–51)	96	90
Peripherally implanted ports (2,5,10,12,13,16,21,23,24,48,52–57)	96	90
Translumbar approach (9,15,26)	96	90

Note.—Success rates and thresholds listed are for the adult population and could be expected to be lower in a pediatric population.

quela; they may require nominal therapy or a short hospital stay for observation (generally overnight) (Appendix A). The complication rates and thresholds below refer to major complications.

INDICATIONS FOR CENTRAL VENOUS ACCESS

Indications for central venous access are listed in **Table 1**. The threshold for these indications is 95%. When fewer than 95% of procedures are for these indications, the department will review the process of patient selection.

The decision to place a central venous access device should be made after considering the risks and benefits to each patient. Coagulopathy and sepsis may be relative contraindications to immediate implantation of long-term central venous access devices. Appropriate effort should be made to correct or improve a patient's coagulopathy prior to placement of a central venous catheter. Other factors that may also increase complications include venous stenosis, acute thrombosis, and local skin infection at the insertion site. In patients in whom these findings or abnormalities cannot be corrected, the procedure may still be indicated if the risk/benefit ratio is lower than the alternative methods of diagnosis or treatment.

SUCCESS RATES OF CENTRAL VENOUS ACCESS

Success rates for central venous access are listed in **Table 2**, along with recommended threshold values.

Table 3
Complication Rates and Suggested Thresholds for Central Venous Access

Specific Major Complications for Image-guided Central Venous Access	Rate (%)	Suggested Threshold (%)
Subclavian and jugular approaches		
Pneumothorax	1–2	3
Hemothorax	1	2
Hematoma	1	2
Perforation	0.5–1	2
Air embolism	1	2
Wound dehiscence	1	2
Procedure-induced sepsis	1	2
Thrombosis*	4	8
Peripheral placement PICC and peripheral ports		
Pneumothorax/hemothorax	0	0
Hematoma	1	2
Wound dehiscence	1	2
Phlebitis*	4	8
Arterial injury	0.5	1
Thrombosis*	3	6
Procedure-induced sepsis	1	2

* The literature is difficult to define, and most complications are thought not to be major complications.

COMPLICATIONS OF CENTRAL VENOUS ACCESS

Complications are defined as early (occurring within 30 days of placement) or late (occurring after 30 days). Early complications can be subdivided into procedurally related, defined as those that occur at the time or within 24 hours of the intervention, and those occurring beyond that period. Complications that occur at the time of the procedure usually consist of injury to the surrounding vital structures or malpositioning of the catheter tip. The

incidence of early complications is lower with image-guided techniques when compared to blind or external landmark techniques (7,27,31,34,38,43).

Complications (major and minor) occur in approximately 7% of patients when image guidance is used (7,11,14,18,20,31,37,39). Published complication rates and suggested thresholds are listed in **Table 3**.

Published rates for individual types of complications are highly dependent on patient selection and are based on series comprising several hundred pa-

tients, which is a volume larger than most individual practitioners are likely to treat. It is also recognized that a single complication can cause a rate to cross above a complication-specific threshold when the complication occurs in a small volume of patients (eg, early in a quality improvement program). In this situation, the overall procedure threshold is more appropriate for use in a quality improvement program.

The overall procedure threshold for major complications resulting from image-guided central venous access including the subclavian, jugular and peripheral approaches is 3%.

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APPENDIX A

Classification of Complications by Outcome

Minor Complications

- A. No therapy, no consequence.
- B. Nominal therapy, no consequence; includes overnight admission for observation only.

Major Complications

- C. Require therapy, minor hospitalization (<48 hours).
- D. Require major therapy, unplanned increase in level of care, prolonged hospitalization (>48 hours).
- E. Permanent adverse sequelae.
- F. Death.

APPENDIX B

Methodology

Technical documents specifying the exact consensus and literature review

methodologies are available upon request from the Society of Interventional Radiology, 10201 Lee Highway Suite 500, Fairfax, VA 22030.

Reported complication-specific rates in some cases reflect the aggregate of major and minor complications. Thresholds are derived from critical evaluation of the literature, evaluation of empirical data from standards of practice committee member practices, and, when available, the HI-IQ[®] system national database.

Consensus on statements in this document was obtained utilizing a modified Delphi technique (60,61).

ADDENDUM

Dr. Curtis A. Lewis, Chairman of the Standards of Practice Committee, authored the first draft of this document and served as topic leader during the subsequent revisions of the first draft. Dr. Curtis W. Bakal is Councilor of the Standards of Practice Committee. All other authors are listed alphabetically. Other members of the Standards of Practice Committee and SIR who participated in the development of this clinical practice guideline are: Timothy Allen, MD, John Aruny, MD, Raymond Bertino, MD, Dana Burke, MD, John Cardella, MD, Paramjit Chopra, MD, Steven Citron, MD, Patricia Cole, MD, PhD, Philip Cook, MD, Martin Crain, MD, Donald Denny, MD, Alain Drooz, MD, Elizabeth Drucker, MD, JD, Neil Freeman, MD, Gregg Gaylord, MD, Patricia Thorpe, MD, Murray Gordon, MD, Ziv Haskal, MD, James Husted, MD, Patrick Malloy, MD, Louis Martin, MD, M. Victoria Marx, MD, Terence Matalon, MD, Timothy McCowan, MD, Steven Meranze, MD, Van Moore, MD, Calvin Neithamer, MD, Albert Nemcek, Jr, MD, Steven Oglevie, MD, Kenneth Rholl, MD, Anne Roberts, MD, David Sacks, MD, Orestes Sanchez, MD, James Spies, MD, Richard Towbin, MD, Daniel Wunder, MD, Anthony Venbrux, MD, and Robert Vogelzang, MD.

The clinical practice guidelines of the Society of Interventional Radiology attempt to define practice principles that generally should assist in producing high-quality medical care. These guidelines are voluntary and are not rules. A physician may deviate from these guidelines, as necessitated by the individual patient and available resources. These practice guidelines should not be deemed inclusive of all proper methods of care or exclusive of other methods of care that are reasonably directed toward the same result. Other sources of information may be used in conjunction with these principles to produce a process leading to high-quality medical care. The ultimate judgment regarding the conduct of any specific procedure or course of management must be made by the physician, who should consider all circumstances relevant to the individual clinical situation. Adherence to the SIR Quality Improvement Program will not assure a successful outcome in every situation. It is prudent to document the rationale for any deviation from the suggested practice guidelines in the department policies and procedure manual or in the patient's medical record.