Central Vascular Access Device: An Adapted Evidence-Based Clinical Practice Guideline

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Central Vascular Access Device: An Adapted Evidence-Based Clinical Practice Guideline

Maria Ana Flor Rasonabe Ciocson, MN, RN
Maranda G. Hernandez, MN, RN, RM
Mohammad Atallah, PhD, MSN
Yasser S. Amer, MBBCCh, MSc Ped, MSc HC Inf
King Saud University Medical City, Riyadh, Saudi Arabia

Abstract

Background: Our aim was to adapt recommendations from high-quality, evidence-based clinical practice guidelines (CPGs) for central vascular access device (CVAD) insertion, management, and removal in King Saud University Medical City. Currently, the hospital has a policy and procedure for CVAD insertion; however, the methodology of creating the policy document was not evidence-based, and the clinical content was not up to date. A new CPG will guide the revision of CVAD policies and procedures and eliminate variation in clinician practices.

Methods: The King Saud University Medical City CPG Committee introduced the modified ADAPTE process methodology for adaptation and implementation of CPGs originally developed by the ADAPTE Collaboration.

Results: The final decision of the panel after full assessment of 2 selected source CPGs was to adopt all Centers for Disease Control and Prevention CPG recommendations and some essential sections from the Infusion Nurses Society CPG recommendations. In addition, the team developed new implementation tools.

Conclusions: The ADAPTE process is an excellent scientific and rigorous process for CPG adaptation and clinical performance improvement. It can be further adapted according to the local context and resources to promote a sense of ownership of the adapted CPG. Furthermore, new CPGs will have a positive effect on hospital-wide accreditation processes and local benchmarking of health care quality outcomes.

Keywords: ADAPTE process, Appraisal of Guidelines for Research and Evaluation, central vascular access device, evidence-based practice clinical practice guidelines, King Saud University

Introduction

The clinical practice guidelines (CPGs) on central vascular access device (CVAD) insertion will be a tool of reference in improving the care and delivery of the best quality services to our Saudi clientele, through a continuing collaborative effort of the central line-associated bloodstream infection (CLABSI) task force, the intravenous (IV) access team, and hospital and nursing administration.

Background and Objectives

The King Saud University Medical City, Riyadh, Saudi Arabia, has 3 bodies facilitating its CPG program: the research chair for Evidence-Based Health Care and Knowledge Translation, the Hospital CPG Committee and departmental sub-committees, and the Quality Management Department in collaboration with all the clinical departments. The CPG program has produced 19 adapted and implemented evidence-based CPGs and currently, the King Saud University Medical City research chair for Evidence-Based Health Care and Knowledge Translation is an active member of the Guidelines International Network.

Guideline adaptation is a valid and systematic approach to adapting guidelines produced in a cultural and organizational setting and using it as an alternative to developing a new guideline. In fact, various guideline groups recognize the...
importance of adapting guidelines rather than developing a new guideline because it reduces unnecessary duplication of efforts. In addition, developing a new guideline is not feasible to some organizations because it is time-consuming and needs expertise and more resources.

In September 2013, 2 nurse educators, 1 associate director of nursing in education, and 1 methodologist from the Quality Department formulated a team for a CPG adaptation and implementation project for CVADs. The hospital had a policy and procedure for CVADs; however, the methodology of creating the policy was not evidence-based, and it contained outdated clinical content. Therefore, the team aimed to adapt recommendations from high-quality evidence-based CPGs for CVAD insertion, management, and removal.

It is estimated that >400 CVADs are placed in our hospital each year based on the daily log sheets of Vascular and Interventional Radiology Unit, Peritoneal Dialysis Day Care, and IV access teams. The CVADs are commonly placed in the Vascular and Interventional Radiology Unit, intensive care units, operating rooms, Department of Emergency Medicine, and Peritoneal Dialysis Day Care.

CLABSIIs accounted for 1 of the top 2 hospital-acquired infections. Hence, the health topic of CVAD was selected primarily to decrease CLABSI rates in the hospital and secondarily to eliminate variation of practices, to improve patient outcomes, and increase patient safety.

**Methods**

The CPG team used the modified ADAPTE adaptation process methodology, which consists of 3 phases (shown in Figure 1). Phase 1 (Set-Up Phase) includes selection of the CPG topic and team formation. Phase 2 (Adaptation Phase) includes defining the health/clinical questions, identifying inclusion/exclusion CPG selection criteria, searching and screening the health topic through CPG databases and websites, using the Appraisal of Guidelines for Research and Evaluation II instrument to assess the quality of the source CPG, deciding and selecting from the appraised source CPG, and drafting the adapted CPG. Additionally, there are 6 domains in the Appraisal of Guidelines for Research and Evaluation instrument to appraise a CPG: scope and purpose, stakeholder involvement, rigor of development, clarity and presentation, applicability, and editorial independence. Phase 3 (Finalization Phase) includes the external review of the draft CPG, planning for the future review/update, and producing the final adapted CPG with implementation tools.

**Results**

There were 26 source CPGs retrieved from online CPG databases based on the defined health questions (eg, Guidelines International Network, National Institute for Health and

**Table 1. Appraisal of Guidelines for Research and Evaluation (AGREE) II Instrument Domain Scores for the 2 Selected Source Clinical Practice Guidelines (CPGs)**

<table>
<thead>
<tr>
<th>AGREE II Domain</th>
<th>Centers for Disease Control and Prevention 2011 CPG (%)</th>
<th>Infusion Nurses Society 2011 CPG (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scope and purpose</td>
<td>98</td>
<td>92</td>
</tr>
<tr>
<td>Stakeholder involvement</td>
<td>81</td>
<td>89</td>
</tr>
<tr>
<td>Rigor of development</td>
<td>88</td>
<td>57</td>
</tr>
<tr>
<td>Clarity and presentation</td>
<td>94</td>
<td>83</td>
</tr>
<tr>
<td>Applicability</td>
<td>40</td>
<td>17</td>
</tr>
<tr>
<td>Editorial independence</td>
<td>56</td>
<td>38</td>
</tr>
<tr>
<td>Overall assessment</td>
<td>67</td>
<td>75</td>
</tr>
<tr>
<td>Recommended for use in practice</td>
<td>Yes, with modifications</td>
<td>Yes, with modifications</td>
</tr>
</tbody>
</table>
Care Excellence, National Guideline Clearinghouse, and MEDLINE/PubMed). Then, 24 CPGs were excluded according to the inclusion/exclusion selection criteria. The criteria include CPGs that are evidence-based with a documented development process methodology, written in the English language, original source CPGs rather than adapted CPGs, have group authorship, and were published internationally between 2011 and 2013. The remaining 2 source CPGs were further appraised using the Appraisal of Guidelines for Research and Evaluation II instrument (Table 1). The 2 source CPGs that selected were the Centers for Disease Control and Prevention (CDC) 2011 guidelines on prevention of intravascular catheter-related infections (Table 2) and the Infusion Nurses Society (INS) 2011 standards of practice (Table 3).

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Strength of Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies</td>
<td>Category IA</td>
</tr>
<tr>
<td>Strongly recommended for implementation and supported by some experimental, clinical, or epidemiologic studies and a strong theoretical rationale; or an accepted practice (e.g., aseptic technique) supported by limited evidence.</td>
<td>Category IB</td>
</tr>
<tr>
<td>Required by state or federal regulations, rules, or standards</td>
<td>Category IC</td>
</tr>
<tr>
<td>Suggested for implementation and supported by suggestive clinical or epidemiologic studies or a theoretical rationale Unresolved Issue. Represents an unresolved issue for which evidence is insufficient or no consensus regarding efficacy exists.</td>
<td>Category II</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard</th>
<th>Strength of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meta-analysis, systematic literature review, guideline based on randomized controlled trials, or at least 3 well-designed randomized controlled trials</td>
<td>I</td>
</tr>
<tr>
<td>Includes evidence from anatomy, physiology, and pathophysiology as understood at the time of writing.</td>
<td>I A/P</td>
</tr>
<tr>
<td>Two well-designed randomized controlled trials, 2 or more multicenter, well-designed clinical trials without randomization, or systematic literature review of varied prospective study designs.</td>
<td>II</td>
</tr>
<tr>
<td>One well-designed randomized controlled trial, several well-designed clinical trials without randomization, or several studies with quasiexperimental designs focused on the same question.</td>
<td>III</td>
</tr>
<tr>
<td>Well-designed quasiexperimental study, case control study, cohort study, correlational study, time series study, systematic literature review of descriptive and qualitative studies, or narrative literature review, psychometric study.</td>
<td>IV</td>
</tr>
<tr>
<td>Includes 1 well-designed laboratory study.</td>
<td></td>
</tr>
<tr>
<td>Clinical article, clinical/professional book, consensus report, case report, guideline based on consensus, descriptive study, well-designed quality improvement project, theoretical basis, recommendations by accrediting bodies and professional organizations, or manufacturer recommendations for products or services.</td>
<td>V</td>
</tr>
<tr>
<td>Includes standard of practice that is generally accepted but does not have a research basis (e.g., patient identification).</td>
<td>Regulatory</td>
</tr>
<tr>
<td>Regulations and other criteria set by agencies with the ability to impose consequences, such as the American Association of Blood Banks, Centers for Medicare &amp; Medicaid Services, Occupational Safety and Health Administration, and state Boards of Nursing.</td>
<td></td>
</tr>
</tbody>
</table>
The final decision of the CPG team after full assessment of the 2 selected source CPGs was to adapt CPGs primarily from CDC recommendations and some essential sections from the INS recommendations related to CVADs only. Interventions and practices considered in the adapted CPGs on CVADs are shown in Appendix 1 and 2.

Discussion

The adapted CVAD CPGs team discussed the 2011 updates from CDC and INS. The team developed implementation tools, including a vascular access device algorithm, a central line insertion bundle checklist, a central line maintenance bundle checklist, a slide presentation, and CVAD patient education brochures in English and Arabic. There were external reviewers for the clinical content from the Vascular and Interventional Radiology Unit, Renal Dialysis Unit, Oncology Unit, IV access team, and Infection Control and Anesthesiology Departments. Another group of external reviewers for the adaptation process methodology from the hospital CPGs committee, Evidence-Based Practice Unit of the Quality Management Department, and the research chair for Evidence-Based Health Care and Knowledge Translation.

The final, adopted CPG recommendations on CVAD were piloted in our Renal Dialysis Unit before starting the dissemination and implementation program. The purpose of the pilot study was to assess current practices and make modifications using educational interventions and the adapted CPG on CVAD recommendations. The method of collection was the compliance monitoring rate on staff performance during dressing of the patient with hemodialysis catheters.

There were 3 phases during the pilot study. The first phase comprised a preintervention compliance audit tool that measured preparation of a sterile field, exit site inspection, exit site dressing, catheter disinfection, disinfection of the port, and disinfection of the access site. The second phase was educational interventions programs like a manufacturer’s in-service training (ie, chlorhexidine gel dressing, using disinfection caps, using needleless connectors, and using a customized central line kit), a staff training on CVAD care and maintenance bundle, staff education on compliance auditing, and catheter infection prevention from our Infection Control Department. The third phase was postintervention compliance audit measured in 3 consecutive months. The modified compliance checklist included patient education, environment, aseptic technique, catheter exit site, and catheter connection and disconnection. One of the major recommendations from the pilot study was an adaptation and implementation of the CPG on CVAD within the hospital to eliminate variation of practices.

The final document of the guideline has been approved by the King Saud University Medical City CPGs Committee and is set for hospital-wide implementation. The dissemination and implementation phase will be overseen and guided by the Quality Management Department over 3 years through periodic auditing at the concerned points of care. Moreover, the CPG will be used as a support for clinical decision making for health care providers from Nursing, Interventional Radiology, Anesthesia, and Infection Control Departments.

Conclusions

The ADAPTE process (version 1.0 and 2.0) for CPG adaptation was an excellent scientific and rigorous process for clinical performance improvement. It can be further adapted according to the local context and resources to promote the sense of ownership of the adapted CPG. Furthermore, the CPGs adaptation and implementation would have a positive effect on patient outcomes, hospital accreditation processes, and local benchmarking of health care quality outcomes.

The clinical practice guideline for CVAD will be a tool of reference in improving the care and delivery of the best quality services to our Saudi clientele, through a continuing collaborative effort of CLABSI taskforce, IV access team, and hospital and nursing administration.

The CPG subcommittee team developed implementation tools such as a wall poster (vascular access device selection algorithm), a slide presentation, a central line insertion bundle checklist, a central line maintenance bundle checklist, a revised policy and procedure, and patient education brochures for CVAD in English and Arabic.

Disclosure

The authors have no conflicts of interest to disclose.

Acknowledgments

The authors thank the following staff of King Saud University College of Medicine and Medical City and members of the external review panel. For the clinical content review: Tariq Alzahrani, Shagran BinKhamis, Grace Pimentel, Khawater Bahkali, Mhadiya Alfad, Victoria Tanjuakio, Saad Alobaily, and Madelyn Decena. For the adaptation methodology review (CPGs Committee): Lubna Al-Ansary, Hayfaa Wahbi, Manal Abou Elkheir, and Shaikh Mohammed Iqbal.

References

### Appendix 1. Centers for Disease Control and Prevention 2011 summary of recommendations.\(^6\)

#### A. Central Venous Access Device Insertion Practices

<table>
<thead>
<tr>
<th>1. Education, Training, and Staffing</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Educate health care personnel regarding the indications for intravascular catheter use, proper procedures for the insertion and maintenance of intravascular catheters, and appropriate infection control measures to prevent intravascular catheter-related infections. (Category IA)</td>
</tr>
<tr>
<td>b. Periodically assess knowledge of and adherence to guidelines for all personnel involved in the insertion and maintenance of intravascular catheters. (Category IA)</td>
</tr>
<tr>
<td>c. Designate only trained personnel who demonstrate competence for the insertion and maintenance of peripheral and central intravascular catheters. (Category IA)</td>
</tr>
<tr>
<td>d. Ensure appropriate nursing staff levels in intensive care units. Observational studies suggest that a higher proportion of “pool nurses” or an elevated patient-to-nurse ratio is associated with catheter-related bloodstream infections (CRBSIs) in intensive care units where nurses are managing patients with central venous catheters (CVCs). (Category IB)</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>2. Selection of Catheters and Sites</th>
</tr>
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<tbody>
<tr>
<td>a. Weigh the risks and benefits of placing a central venous device at a recommended site to reduce infectious complications against the risk for mechanical complications (eg, pneumothorax, subclavian artery puncture, subclavian vein laceration, subclavian vein stenosis, hemothorax, thrombosis, air embolism, and catheter misplacement). (Category IA)</td>
</tr>
<tr>
<td>b. Avoid using the femoral vein for central venous access in adult patients. (Category 1A)</td>
</tr>
<tr>
<td>c. Use a subclavian site, rather than a jugular or a femoral site, in adult patients to minimize infection risk for nontunneled CVC. (Category IB)</td>
</tr>
<tr>
<td>d. No recommendation can be made for a preferred site of insertion to minimize infection risk for a tunneled CVC. Unresolved issue. (Category II)</td>
</tr>
<tr>
<td>e. Avoid the subclavian site in hemodialysis patients and patients with advanced kidney disease, to avoid subclavian vein stenosis. (Category IA)</td>
</tr>
<tr>
<td>f. Use a fistula or graft in patients with chronic renal failure instead of a CVC for permanent access for dialysis. (Category 1A)</td>
</tr>
<tr>
<td>g. Use ultrasound guidance to place CVCs (if this technology is available) to reduce the number of cannulation attempts and mechanical complications. Ultrasound guidance should only be used by those fully trained in its technique. (Category IB)</td>
</tr>
<tr>
<td>h. Use a CVC with the minimum number of ports or lumens essential for the management of the patient. (Category IB)</td>
</tr>
<tr>
<td>i. No recommendation can be made regarding the use of a designated lumen for parenteral nutrition. Unresolved issue. (Category II)</td>
</tr>
<tr>
<td>j. Promptly remove any intravascular catheter that is no longer essential. (Category IA)</td>
</tr>
<tr>
<td>k. When adherence to aseptic technique cannot be ensured (ie, catheters inserted during a medical emergency), replace the catheter as soon as possible (within 48 hours). (Category IB)</td>
</tr>
</tbody>
</table>

(Continued on next page)
3. Hand Hygiene and Aseptic Technique
   a. Perform hand hygiene procedures, either by washing hands with conventional soap and water or with alcohol-based hand rubs. Hand hygiene should be performed before and after palpating catheter insertion sites, as well as before and after inserting, replacing, accessing, repairing, or dressing an intravascular catheter. Palpation of the insertion site should not be performed after the application of antiseptic, unless aseptic technique is maintained. (Category IB)
   
   b. Maintain aseptic technique for the insertion and care of intravascular catheters. (Category IB)
   
   c. Wear clean, rather than sterile gloves, for the insertion of peripheral intravascular catheters, if the access site is not touched after the application of skin antiseptics. (Category IC)
   
   d. Sterile gloves should be worn for the insertion of arterial, central, and midline catheters. (Category IA)
   
   e. Use new sterile gloves before handling the new catheter when guide wire exchanges are performed. (Category II)
   
   f. Wear either clean or sterile gloves when changing the dressing on intravascular catheters. (Category IC)

4. Maximal Sterile Barrier Precautions
   a. Use maximal sterile barrier precautions, including the use of a cap, mask, sterile gown, sterile gloves, and a sterile full body drape, for the insertion of CVCs, peripherally inserted central catheters, or guide wire exchange. (Category IB)

5. Skin Preparation
   a. Prepare clean skin with a >0.5% chlorhexidine preparation with alcohol before CVC and peripheral arterial catheter insertion and during dressing changes. If there is a contraindication to chlorhexidine, tincture of iodine, an iodophor, or 70% alcohol can be used as alternatives. (Category IA)
   
   b. No comparison has been made between using chlorhexidine preparations with alcohol and povidone-iodine in alcohol to prepare clean skin. Unresolved issue. (Category II)
   
   c. No recommendation can be made for the safety or efficacy of chlorhexidine in infants aged <2 months. Unresolved issue. (Category II)
   
   d. Antiseptics should be allowed to dry according to the manufacturer’s recommendation prior to placing the catheter. (Category IB)

6. Catheter Securement Devices
   a. Use a sutureless securement device to reduce the risk of infection for intravascular catheters. (Category II)

7. Antimicrobial/Antiseptic Impregnated Catheters and Cuffs
   a. Use a chlorhexidine/silver sulfadiazine or minocycline/rifampin-impregnated CVC in patients whose catheter is expected to remain in place >5 days if, after successful implementation of a comprehensive strategy to reduce rates of central line-associated bloodstream infection, the infection rate is not decreasing. The comprehensive strategy should include at least the following 3 components: educating persons who insert and maintain catheters, use of maximal sterile barrier precautions, and a >0.5% chlorhexidine preparation with alcohol for skin antisepsis during CVC insertion. (Category IA)

(Continued on next page)
Appendix 1. (Continued)

8. Systemic Antibiotic Prophylaxis
   a. Do not administer systemic antimicrobial prophylaxis routinely before insertion or during use of an intravascular catheter to prevent catheter colonization or catheter-related bloodstream infection. (Category IB)

9. Antibiotic/Antiseptic Ointments
   a. Use povidone iodine antiseptic ointment or bacitracin/gramicidin/polymyxin B ointment at the hemodialysis catheter exit site after catheter insertion and at the end of each dialysis session only if this ointment does not interact with the material of the hemodialysis catheter per manufacturer’s recommendation. (Category IB)

10. Replacement of CVCs, Including PICCs and Hemodialysis Catheters
    a. Do not routinely replace CVCs, peripherally inserted central catheters, hemodialysis catheters, or pulmonary artery catheters to prevent catheter-related infections. (Category IB)
    b. Do not remove CVCs or peripherally inserted central catheters on the basis of fever alone. Use clinical judgment regarding the appropriateness of removing the catheter if infection is evidenced elsewhere or if a noninfectious cause of fever is suspected. (Category II)
    c. Do not use guide wire exchanges routinely for nontunneled catheters to prevent infection. (Category IB)
    d. Do not use guide wire exchanges to replace a nontunneled catheter suspected of infection. (Category IB)
    e. Use a guide wire exchange to replace a malfunctioning nontunneled catheter if no evidence of infection is present. (Category IB)
    f. Use new sterile gloves before handling the new catheter when guide wire exchanges are performed. (Category II)

11. Performance Improvement
    a. Use hospital-specific or collaborative-based performance improvement initiatives in which multifaceted strategies are bundled together to improve compliance with evidence-based recommended practices. (Category IB)

B. Central Venous Access Devices Care and Maintenance Practices

1. Patient Cleansing
   a. Use a 2% chlorhexidine wash for daily skin cleansing to reduce catheter-related bloodstream infection. (Category II)

2. Needleless Intravascular Catheter Systems
   a. Change the needleless components at least as frequently as the administration set. There is no benefit to changing these more frequently than every 72 hours. (Category II)
   b. Change needleless connectors no more frequently than every 72 hours or according to manufacturers’ recommendations for the purpose of reducing infection rates. (Category II)
   c. Ensure that all components of the system are compatible to minimize leaks and breaks in the system. (Category II)
Appendix 1. (Continued)

d. Minimize contamination risk by scrubbing the access port with an appropriate antiseptic (chlorhexidine, povidone-iodine, iodophor, or 70% alcohol) and accessing the port only with sterile devices. (Category IA)

e. Use a needleless system to access intravenous tubing. (Category IC)

f. When needleless systems are used, a split septum valve may be preferred over some mechanical valves due to increased risk of infection with the mechanical valves. (Category II)

3. Vascular Access Device Site and Dressing Change

a. Use either sterile gauze or sterile, transparent, semipermeable dressing to cover the catheter site. (Category IA)

b. If the patient is diaphoretic or if the site is bleeding or oozing, use a gauze dressing until this is resolved. (Category II)

c. Replace catheter site dressing if the dressing becomes damp, loosened, or visibly soiled. (Category IB)

d. Do not use topical antibiotic ointment or creams on insertion sites, except for dialysis catheters, because of their potential to promote fungal infections and antimicrobial resistance. (Category IB)

e. Do not submerge the catheter or catheter site in water. Showering should be permitted if precautions can be taken to reduce the likelihood of introducing organisms into the catheter. (Category IB)

f. Replace dressings used on short-term CVC sites every 2 days for gauze dressings. (Category II)

g. Replace dressings used on short-term CVC sites at least every 7 days for transparent dressings, except in those pediatric patients in which the risk for dislodging the catheter may outweigh the benefit of changing the dressing. (Category IB)

h. Replace transparent dressings used on tunneled or implanted CVC sites no more than once per week (unless the dressing is soiled or loose), until the insertion site has healed. (Category II)

i. No recommendation can be made regarding the necessity for any dressing on well-healed exit sites of long-term cuffed and tunneled CVCs. Unresolved issue. (Category II)

j. Ensure that catheter site care is compatible with the catheter material. (Category IB)

k. Use a chlorhexidine-impregnated sponge dressing for temporary short-term catheters in patients older than age 2 months if the central line-associated bloodstream infection rate is not decreasing despite adherence to basic prevention measures, including education and training, appropriate use of chlorhexidine for skin antisepsis, and maximum sterile barrier. (Category IB)

m. No recommendation is made for other types of chlorhexidine dressings. Unresolved issue. (Category II)

n. Monitor the catheter sites visually when changing the dressing or by palpation through an intact dressing on a regular basis, depending on the clinical situation of the individual patient. If patients have tenderness at the insertion site, fever without obvious source, or other manifestations suggesting local or bloodstream infection, the dressing should be removed to allow thorough examination of the site. (Category IB)

o. Encourage patients to report any changes in their catheter site or any new discomfort to their provider. (Category II)
### Appendix 2. Infusion Nurses Society Infusion Nursing Standards of Practice 2011 summary of recommendations.7

#### 1. Hand Hygiene

**Standard**

a. Hand hygiene shall be a routine practice established in organizational policies, procedures, and/or practice guidelines.

b. Hand hygiene shall be performed before and after touching a patient, before handling an invasive device, before moving from a contaminated body site to another site, before donning and after removing gloves, and after contact with inanimate objects in the immediate vicinity of the patient.

c. The nurse shall not wear artificial nails when performing infusion therapy procedures.

d. In cases in which the nurse’s hands are visibly contaminated with blood or body fluids or hands have been exposed to spore-producing pathogens, hand hygiene with either nonantiseptic or antiseptic (preferably antiseptic containing) liquid soap and water shall be performed.

**Practice Criteria**

a. Alcohol-based hand rubs are preferred for routine hand hygiene unless hands are visibly soiled. (II)

b. Chosen hand hygiene products should provide high efficiency with low potential for skin irritation. Towelettes and nonalcohol-based hand rubs should not be used for hand hygiene. Hand hygiene products should be used according to manufacturers’ directions for use. (V)

c. Proper hand hygiene should be taught to the patient and caregivers involved in care of the patient. (V)

d. Dispensers of liquid soap or antiseptic solutions are recommended. Containers should be filled, discarded, and replaced according to organizational policies, procedures, and/or practice guidelines and should be accessible at the point of care. (V)

e. Single-use soap scrub packets or waterless antiseptic products should be used when clean running water is not ensured or is unavailable. (V)

f. The nurse should be involved with hand hygiene product evaluation to assess for product feel, fragrance, and skin irritation. Nurses who have sensitivity to a particular product should be provided with an alternative. Other products for skin care such as gloves, lotions, and moisturizers should be assessed for compatibility with hand antisepsis products. (V)

g. Hand hygiene is a key component of a group of evidence-based interventions to promote better outcomes for patients with intravascular catheters. (V)

h. Artificial nails have been associated with transmission and outbreaks of infection. (IV)

#### 2. Administration Set Change

a. The frequency of performing administration set changes and the system used to promote adherence to administration set change (eg, labeling/electronic) shall be established in organizational policies, procedures, and/or practice guidelines.

b. A vented administration set shall be used for solutions supplied in glass or semirigid containers, and a nonvented administration set shall be used for plastic fluid containers.

c. All administration sets shall be of Luer-lock design to ensure a secure junction.

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## Practice Criteria

### i. Primary and Secondary Continuous Infusions

a. Primary and secondary continuous administration sets used to administer fluids other than lipid, blood, or blood products should be changed no more frequently than every 96 hours. There is strong evidence that changing the administration sets more frequently does not decrease the risk of infection. (I)

b. Extending the administration set change to every 7 days may be considered when an anti-infective central vascular access device is being used or if fluids that enhance microbial growth are not administered through the set. (II)

c. If a secondary administration set is detached from the primary administration set, the secondary administration set is considered a primary intermittent administration set and should be changed every 24 hours. (V)

d. When compatibility of infusates is verified, use of secondary administration sets that use back-priming infusion methods are preferred due to reduced need for disconnecting secondary intermittent administration sets. (V)

### ii. Primary Intermittent Infusions

a. Primary intermittent administration sets should be changed every 24 hours. When an intermittent infusion is repeatedly disconnected and reconnected for the infusion, there is increased risk of contamination at the catheter hub, needleless connector, and the male Luer end of the administration set, potentially increasing risk for catheter related bloodstream infection. There is an absence of studies addressing administration set changes for intermittent infusions. In a meta-analysis of 12 randomized, controlled trials that supported increasing the time interval for administration set changes to 96 hours, at least 2 of the studies excluded administration sets used for heparin locked catheters and in sets disconnected for > 4 hours. In several others, exclusions were not stated. (V)

b. A new, sterile, compatible covering device should be aseptically attached to the end of the administration set after each intermittent use. The practice of attaching the exposed end of the administration set to a port on the same set ("looping") should be avoided. (V)

### iii. Parenteral Nutrition

a. Administration sets used for nonlipid-containing parenteral nutrition solutions should be routinely changed no more often than every 96 hours. (I)

b. Administration sets used for total nutrient admixtures containing intravenous fat emulsions with the amino acid and dextrose solution should be routinely changed every 24 hours. (III)

c. When primary administration sets used for parenteral nutrition are exposed to intravenous fat emulsions, consideration should be made to changing the administration set every 24 hours. Limited evidence suggests an increased risk for infection when duration of administration sets is extended beyond 24 hours. (III)

### iv. Intravenous Fat Emulsions and Other Lipid Product Infusions

a. When units of intravenous fat emulsions are administered intermittently, the administration set should be changed with each new container; the characteristics of intravenous fat emulsions (iso-osmotic, near neutral alkaline pH, and containing glycerol) are conducive to the growth of microorganisms. (III)

b. When units of intravenous fat emulsions are administered consecutively, the administration set should be routinely changed every 24 hours. (III)

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### Appendix 2. (Continued)

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<tbody>
<tr>
<td>c.</td>
<td>A dedicated administration set should be used to administer propofol infusions and should be replaced every 12 hours, when the vial is changed, and according to the manufacturer’s directions for use. (Regulatory)</td>
</tr>
<tr>
<td>d.</td>
<td>Administration sets used to administer lipid-based infusates, such as intravenous fat emulsions or total nutrient admixtures, should be free of diethylhexyl-phthalate. Diethylhexyl-phthalate is lipophilic and is extracted into the lipid solution with commonly used polyvinyl chloride administration sets and containers. Diethylhexyl-phthalate is considered a toxin, and studies have demonstrated increased diethylhexyl-phthalate levels in lipid solutions, which is especially a risk with neonatal, pediatric, and long-term home care patients. (IV)</td>
</tr>
<tr>
<td>v. <strong>Blood and Blood Components</strong></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Administration sets used for blood and blood components should be specific to blood transfusion and include a filter; the administration sets should be replaced every 4 hours. (IV)</td>
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### 3. Flushing and Locking

#### Standard

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<thead>
<tr>
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<tbody>
<tr>
<td>a.</td>
<td>Vascular access devices shall be flushed prior to each infusion as part of the steps to assess catheter function.</td>
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<tr>
<td>b.</td>
<td>Vascular access devices shall be flushed after each infusion to clear the infused medication from the catheter lumen, preventing contact between incompatible medications.</td>
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<tr>
<td>c.</td>
<td>Vascular access devices shall be locked after completion of the final flush solution to decrease the risk of occlusion.</td>
</tr>
<tr>
<td>d.</td>
<td>Flushing and locking of all vascular access devices shall be established in organizational policies, procedures, and/or practice guidelines and in accordance with manufacturers’ directions for use.</td>
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#### Practice Criteria

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>a.</td>
<td>Single-use systems include single-dose vials and prefilled syringes and are the preferred choices for flushing and locking. If multiple-dose containers must be used, each container should be dedicated to a single patient. (IV)</td>
</tr>
<tr>
<td>b.</td>
<td>Flushing is accomplished with preservative-free 0.9% sodium chloride. When the medication is incompatible with preservative-free 0.9% sodium chloride, 5% dextrose in water should be used and followed by flushing with preservative-free 0.9% sodium chloride and/or heparin lock solution. Dextrose should be flushed from the catheter lumen because it can provide nutrients for biofilm growth. (IV)</td>
</tr>
<tr>
<td>c.</td>
<td>Bacteriostatic 0.9% sodium chloride contains benzyl alcohol as the preservative. The maximum volume that can be tolerated by adult and pediatric patients is undetermined; however, 1 study suggests that this should not exceed 30 mL in a 24-hour period for adults. (IV)</td>
</tr>
<tr>
<td>d.</td>
<td>The minimum volume of preservative-free 0.9% sodium chloride for catheter flushing depends upon the type and size of catheter, age of the patient, and type of infusion therapy being given. A minimum volume of twice the internal volume of the catheter system is recommended; however, a larger volume may be needed for blood sampling or blood transfusion procedures. (V)</td>
</tr>
<tr>
<td>e.</td>
<td>The nurse should aspirate the catheter for blood return as a component of assessing catheter function before administration of medications and solutions. (V)</td>
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(Continued on next page)
Appendix 2. (Continued)

f. Due to varying degrees of physiologic maturity for drug metabolism and excretion in the neonate, solutions used for flushing and/or locking catheters should not contain the preservative benzyl alcohol. (IV)

g. If resistance is met and/or no blood return noted, the nurse should take further steps to assess patency of the catheter before administration of medications and solutions. The catheter should not be forcibly flushed. (V)

h. To prevent catheter damage, the size of the syringe used for flushing and locking should be in accordance with the catheter manufacturer’s directions for use. Patency is assessed with a minimum 10-mL syringe filled with preservative-free 0.9% sodium chloride. Flush syringes holding a smaller volume and/or designed to generate lower amounts of pressure may also be used to assess patency. Administration of small quantities of medication should be given in a syringe appropriately sized for the dose required following confirmation of catheter lumen patency. (V)

i. Prefilled syringes filled with preservative-free 0.9% sodium chloride should not be used for dilution of medications. Due to risk of serious medication errors, syringe-to-syringe drug transfer is not recommended. (V)

j. Short peripheral catheters should be locked with preservative-free 0.9% sodium chloride following each catheter use in adults and children. (I)

k. No specific recommendation can be made about the use of heparin lock solution or preservative-free 0.9% sodium chloride for locking short peripheral catheters in neonatal patients. Data are inconsistent and inadequate to make specific recommendations. (V)

l. The nurse should assess for contraindications for the use of heparin lock solution, including, but not limited to, presence or risk for heparin-induced thrombocytopenia, heparin’s influence on laboratory studies drawn from the catheter, and systemic anticoagulation. Heparin-induced thrombocytopenia has been reported with the use of heparin flush solutions, although the exact rates are unknown. All patients should be monitored closely for signs and symptoms of heparin-induced thrombocytopenia. If present or suspected, heparin and all sources of heparin (ie heparin-coated catheters) should be discontinued. (IV)

m. For postoperative patients receiving heparin lock solutions of any concentration, monitoring platelet counts for heparin-induced thrombocytopenia is recommended every 2 to 3 days from Day 4 through Day 14 or until the heparin is stopped. For medical patients receiving heparin lock solutions, routine platelet count monitoring is not recommended. (II)

n. The use of preservative-free 0.9% sodium chloride for locking catheters with an integral pressure-sensitive valve system is recommended by manufacturers’ directions for use, although the continued use of heparin lock solution has also been suggested. There are multiple designs of these valves located on the internal catheter tip and the external catheter hub. Available data are inconclusive and conflicting. (II)

o. Whereas many studies report equivalent outcomes in central vascular access catheters when locked with heparin lock solution or preservative-free 0.9% sodium chloride, others have reported greater complications with saline locking. Due to the risk and costs associated with central vascular access device insertion, heparin lock solution 10 units/mL is the preferred lock solution after each intermittent use. (III)

4. Blood sampling from central vascular access device

Practice Criteria

a. Blood sampling for laboratory testing from a central vascular access device should be considered based on an evaluation of benefits vs risks. Benefits include avoidance of anxiety, discomfort, and dissatisfaction associated with venipuncture in patients who require frequent blood tests and/or those with difficult vascular access. (Continued on next page)
Appendix 2. (Continued)

Risks include increased risk for occlusion and catheter-related bloodstream infection due to increased hub manipulation and potential for inaccurate laboratory results, although there was no significant increase in occlusion, infection, or other complications in peripherally inserted central catheters used for blood sampling in 1 study. (V)

b. Sampling of blood through short peripheral catheters has been found to be reliable for many routine blood tests, including coagulation studies, and may be considered for pediatric patients, those who require multiple laboratory tests, including patients with risk for bleeding, and/or those who have difficult vascular access. (IV)

c. Caution should be exercised when interpreting drug levels with a central vascular access device-obtained blood sample. When questionable results are obtained (eg, unexpected high levels that would necessitate a medication dose change), the nurse should collaborate with the licensed independent practitioner in retesting via direct venipuncture. Some studies have shown elevated drug levels with blood sampling from central vascular access devices; factors negatively influencing accuracy include sampling from implanted ports, silicone catheters, and from the same catheter lumen used for drug infusion. (IV)

d. Caution should be exercised when interpreting coagulation values with a blood sample obtained from a heparinized central vascular access device. Current literature does not support blood sampling for coagulation levels via heparinized central vascular access devices; literature is inconsistent in relation to sampling from heparinized arterial catheters. With hemodialysis catheters, accurate coagulation levels were obtained using the arterial port of the catheter. When questionable results are obtained (eg, unexpected high levels that would necessitate a medication dosage change), the nurse should collaborate with the licensed independent practitioner in retesting via direct venipuncture. (IV)

e. The nurse should be knowledgeable about technical factors involved in blood specimen collection, such as changing the needleless connector, need for patient fasting prior to collection, use of appropriate blood collection tubes in the correct sequence, and timeliness of dispatch to the laboratory. (V)

f. The reinfusion method for blood withdrawal should not be used due to risk of contamination and blood clot formation, because this method includes reinfusion of the discard specimen following blood withdrawal. (IV)

g. Before blood sampling from a VAD, infusions should be stopped and the VAD flushed with preservative-free 0.9% sodium chloride. The largest lumen should be used for blood sampling with multilumen central vascular access devices. For central vascular access devices with staggered lumen exit sites, the sample should be drawn from the 1 highest in the superior vena cava; for drug levels, the sample should be preferentially drawn from the catheter lumen not being used for the drug infusion. (IV)

h. Only the volume of blood needed for accurate testing should be obtained; phlebotomy contributes to iron deficiency and blood loss in critically ill patients and neonates, so efforts to conserve blood should be considered. These may include use of low-volume blood collection tubes, recording the volume of blood obtained for laboratory testing, and avoidance of routine testing, use of point of-care testing methods, consolidation of all daily tests with 1 draw, and consideration of the use of the mixing method for blood sampling from central vascular access devices. (V)


Standard

a. Medications and/or solutions used to dissolve thrombotic deposits or precipitate in central vascular access devices shall be administered upon the order of a licensed independent practitioner in accordance with organizational policies, procedures, and/or practice guidelines.

b. The nurse shall be competent in performing procedures used in catheter clearance.
Appendix 2. (Continued)

c. The nurse shall assess the patient and the patient’s central vascular access device for appropriateness of the use of catheter clearance medications and/or solutions in relation to the suspected cause of catheter occlusion.

Practice Criteria

a. The nurse should assess for and identify signs of central vascular access devices occlusion, including the inability to withdraw blood, sluggish flow, and/or inability to flush or infuse through the device. (III)

b. The nurse should assess for potential causes of catheter occlusion and consider the use of an appropriate catheter clearance procedure to preserve the patient’s central vascular access devices. (III)

c. The responsibility of the nurse performing catheter clearance should include, but not be limited to, knowledge of medication and/or solution dosage, contraindications, side effects, techniques for instillation, potential complications, and patient and caregiver education. (V)

d. The instillation of low-dose alteplase is effective in restoring blood flow and has been found to be safe for use in both adult and pediatric patients. (II)

e. Infusions of low doses of alteplase over 1-2 hours have been found successful in restoring patency to hemodialysis catheters. (IV)

f. Instillation of 0.1 N hydrochloric acid into the occluded catheter lumen has been used to dissolve low pH drug precipitates, and instillation of sodium bicarbonate has been used to dissolve high pH drug precipitates. (V)

g. Instillation of ethanol, ethyl alcohol, and sodium hydroxide into the occluded catheter lumen has been used to restore patency to catheters with suspected buildup of intravenous fat emulsions particularly associated with administration of total nutrient admixtures. (V)

h. Instillation of alcohol solutions such as ethanol or ethyl alcohol may damage catheters made of some types of polyurethane; manufacturers’ directions for use should be reviewed and followed. (V)

i. Consideration should be given to the potential pressure exerted on an occluded central vascular access device when medications and/or solutions used for catheter clearance are instilled. The syringe size used for catheter clearance procedures should be no smaller than 10 mL and should be in accordance with the catheter manufacturer’s directions for use. Instillation methods that use a negative-pressure approach should be considered. (V)

j. If the catheter clearance procedure does not result in patency of the central vascular access devices, the licensed independent practitioner should be notified; alternative actions such as a referral to interventional radiology should be considered; and catheter removal should be considered if catheter patency is not restored. (V)

C. Vascular Access Device Removal

Standard

a. Removal of a vascular access device shall be performed upon the order of the licensed independent practitioner, in accordance with the rules and regulations as promulgated by the state’s Board of Nursing, organizational policies, procedures, and/or practice guidelines, or immediately upon suspected contamination or complication.

b. The nurse shall be competent in the process of vascular access device removal, including identification of potential complications, and appropriate nursing interventions and/or emergency measures as needed, and patient and caregiver education.

(Continued on next page)
**Appendix 2. (Continued)**

- **c.** Vascular access devices shall be removed upon unresolved complication, therapy discontinuation, or if deemed unnecessary.
- **d.** Vascular access devices placed in an emergency situation shall be replaced as soon as possible and not later than 48 hours.
- **e.** The frequency of short peripheral catheter removal for the purpose of site rotation shall be established in organizational policies, procedures, and/or practice guidelines.
- **f.** Removal of an implanted port shall be considered a surgical procedure and shall be performed by a licensed independent practitioner with validated competency operating within the state’s rules and regulations for professional practice, and according to organizational policies, procedures, and/or practice guidelines.

1. **Nontunneled Central Vascular Access Devices**
   - **a.** Daily assessment of central vascular access devices need and removal when no longer needed are components of the central line bundle known to decrease risk of infection. The maximum dwell time of a nontunneled central vascular access device is unknown; ongoing and daily monitoring of the device necessity should be performed. (II)
   - **b.** Removal of a nontunneled central vascular access device should be determined by patient condition, completion of therapy, presence of infectious or inflammatory process, catheter malposition, or catheter dysfunction. (V)
   - **c.** The decision to remove or salvage a catheter due to suspected or confirmed catheter related bloodstream infection should be based on blood culture results, specific type of cultured organism, patient’s current condition, available vascular access sites, effectiveness of antimicrobial therapy, and licensed independent practitioner direction. (V)
   - **d.** The central vascular access device should be removed after patient assessment and in collaboration with the health care team if a catheter-related complication is suspected and interventions are unsuccessful. (V)
   - **e.** A central vascular access device with a malposition catheter tip location that cannot be repositioned to a central vein should be removed. (V)
   - **f.** Caution should be used in the removal of a nontunneled central vascular access device, including precautions to prevent air embolism. Digital pressure should be applied until hemostasis is achieved by using manual compression and/or other adjunct approaches such as hemostatic pads, patches, or powders that are designed to potentiate clot formation. The nurse should apply petroleum-based ointment and a sterile dressing to the access site to seal the skin-to-vein tract and decrease the risk of air embolus. When removing the central vascular access device, the nurse should position the patient so that the central vascular access device insertion site is at or below the level of the heart to reduce the risk of air embolus. (IV)
   - **g.** If resistance is encountered when the catheter is being removed, the catheter should not be forcibly removed, and the licensed independent practitioner should be notified and discussion should occur related to initiating appropriate interventions for successful removal. (V)
   - **h.** With any patient reports of discomfort or pain related to the central vascular access device, the patient and central vascular access device should be assessed, appropriate interventions performed, and the LiP notified. When interventions are unsuccessful, the central vascular access device should be removed. (V)
   - **i.** Coagulation studies, such as the international normalized ratio, are not routinely necessary for the removal of a central vascular access device. (IV)

2. **Surgically Placed Central Vascular Access Devices: Tunneled/Implanted Ports**

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Appendix 2. (Continued)

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<tr>
<td>a.</td>
<td>The maximum dwell time of a surgically placed central vascular access device is unknown; ongoing and frequent monitoring of the access site should be done as well as ongoing assessment of need. When no longer necessary, the surgically placed central vascular access device should be removed. (V)</td>
</tr>
<tr>
<td>b.</td>
<td>The decision to remove or salvage a central vascular access device due to suspected or confirmed catheter-related bloodstream infections should be based on blood culture results, specific type of cultured organism, patient's current condition, available vascular access sites, effectiveness of antimicrobial therapy, and licensed independent practitioner's direction. (V)</td>
</tr>
<tr>
<td>c.</td>
<td>If a catheter-related complication occurs (eg, cuff exposure, dislodgment, and infection) and interventions are unsuccessful, the catheter should be removed after patient assessment and in collaboration with the health care team. (V)</td>
</tr>
<tr>
<td>d.</td>
<td>If resistance is encountered when the tunneled central vascular access device is being removed, the device should not be forcibly removed, and further collaboration with the health care team should occur. (IV)</td>
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