

Special Report

Guidelines for the Prevention of Intravascular Catheter-Related Infections

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ABSTRACT

BACKGROUND: Although many catheter-related bloodstream infections (CRBSIs) are preventable, measures to reduce these infections are not uniformly implemented.

OBJECTIVE: To update an existing evidenced-based guideline that promotes strategies to prevent CRBSIs.

DATA SOURCES: The MEDLINE database, conference proceedings, and bibliographies of review articles and book chapters were searched for relevant articles.

STUDIES INCLUDED: Laboratory-based studies, controlled clinical trials, prospective interventional trials, and epidemiologic investigations.

OUTCOME MEASURES: Reduction in CRBSI, catheter colonization, or catheter-related infection.

SYNTHESIS: The recommended preventive strategies with the strongest supportive evidence are education and training of healthcare providers who insert and maintain catheters; maximal sterile barrier precautions during central venous catheter insertion; use of a 2% chlorhexidine preparation for skin antisepsis; no routine replacement of central venous catheters for prevention of infection; and use of antiseptic/antibiotic-impregnated short-term central venous catheters if the rate of infection is high despite adherence to other strategies (ie, education and training, maximal sterile barrier precautions, and 2% chlorhexidine for skin antisepsis).

CONCLUSION: Successful implementation of these evidence-based interventions can reduce the risk for serious catheter-related infection (*Infect Control Hosp Epidemiol* 2002;23:759-769).

EXECUTIVE SUMMARY

This guideline for the prevention of catheter-related infections has been developed for practitioners who insert catheters and for those who are responsible for surveil-

lance and control of infections in the hospital, the outpatient, and home healthcare settings. This document was prepared by a working group composed of members from professional organizations representing the disciplines of

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Issam Raad: Holds two patents associated with minocycline-rifampin catheters. Patents are the property of the University of Texas, MD Anderson Cancer Center, Baylor College of Medicine, and Wake Forest University. Both patents are licensed to Cook Critical Care with royalty rights to the institutions involved, with a percentage of royalties to the inventors. Co-inventor of patents associated with minocycline-EDTA flush solution. These patents are not yet licensed. Grant and research support from Kimberly Clark, Becton Dickinson, Abbott Labs, Immunomedics, and Cook Critical Care, Inc.

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critical care medicine, infectious diseases, healthcare infection control, surgery, anesthesiology, interventional radiology, pulmonary medicine, pediatric medicine, and nursing. The working group was led by the Society of Critical Care Medicine (SCCM), in collaboration with the Infectious Diseases Society of America (IDSA), Society for Healthcare Epidemiology of America (SHEA), Surgical Infection Society (SIS), American College of Chest Physicians (ACCP), American Thoracic Society (ATS), American Society of Critical Care Anesthesiologists (ASCCA), Association for Professionals in Infection Control and Epidemiology (APIC), Infusion Nurses Society (INS), Oncology Nursing Society (ONS), Society of Cardiovascular and Interventional Radiology (SCVIR), American Academy of Pediatrics (AAP), and Healthcare Infection Control Practices Advisory Committee (HICPAC) of the Centers for Disease Control and Prevention (CDC), and this document is intended to replace the "Guideline for Prevention of Intravascular Device-Related Infections" published in 1996. The goal of this guideline is to provide evidence-based recommendations for preventing catheter-related infections. Major areas of emphasis include (1) educating and training healthcare providers who insert and maintain catheters; (2) using maximal sterile barrier precautions during central venous catheter (CVC) insertion; (3) using a 2% chlorhexidine preparation for skin antiseptics; (4) avoiding routine replacement of CVCs as a strategy to prevent infection; and (5) using antiseptic/antibiotic-impregnated short-term CVCs if the rate of infection is high despite adherence to other strategies (ie, education and training, maximal sterile barrier precautions, and 2% chlorhexidine for skin antiseptics). These guidelines also identify performance indicators that can be used locally by healthcare institutions or organizations to monitor their success in implementing these evidence-based recommendations.

RECOMMENDATIONS FOR PLACEMENT OF INTRAVENOUS CATHETERS IN ADULTS AND CHILDREN

These recommendations are designed to reduce the infectious complications associated with intravascular catheter use. Recommendations should be considered in the context of the institution's experience with catheter-related infections, experience with other adverse catheter-related complications (eg, thrombosis, hemorrhage, and pneumothorax), and availability of personnel skilled in the placement of intravascular devices. Recommendations are provided for (a) intravascular catheter use in general; (b) specific devices; and (c) special circumstances (ie, intravascular device use in pediatric patients and CVC use for parenteral nutrition and hemodialysis access). Recommendations regarding the frequency of replacing catheters, dressings, administration sets, and fluids are also provided (Table).

As in previous guidelines issued by CDC and HICPAC, each recommendation is categorized on the basis of existing scientific data, theoretical rationale, applicability,

and economic impact. The CDC/HICPAC system for categorizing recommendations is as follows:

Category IA

Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies.

Category IB

Strongly recommended for implementation and supported by some experimental, clinical, or epidemiologic studies and a strong theoretical rationale.

Category IC

Required by state or federal regulations, rules, or standards.

Category II

Suggested for implementation and supported by suggestive clinical or epidemiologic studies or a theoretical rationale.

No Recommendation; Unresolved Issue

Represents an unresolved issue for which evidence is insufficient or no consensus regarding efficacy exists.

I. Healthcare worker education and training

A. Educate healthcare workers 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.¹⁻¹¹ Category IA

B. Assess knowledge of and adherence to guidelines periodically for all persons who insert and manage intravascular catheters.^{1,2,4,6,12} Category IA

C. Ensure appropriate nursing staff levels in intensive care units (ICUs) to minimize the incidence of catheter-related bloodstream infections (CRBSIs).¹³⁻¹⁵ Category IB

II. Surveillance for catheter-related infection

A. Monitor the catheter sites visually or by palpation through the intact dressing on a regular basis, depending on the clinical situation of individual patients. 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.¹⁶⁻¹⁹ Category IB

B. Encourage patients to report to their healthcare provider any changes in their catheter site or any new discomfort. Category II

C. Record the operator, date, and time of catheter insertion and removal and dressing changes on a standardized form. Category II

D. Do not routinely culture catheter tips.²⁰⁻²² Category IA

III. Hand hygiene

A. Observe proper hand hygiene procedures by washing hands with either conventional antiseptic-contain-

TABLE

SUMMARY OF RECOMMENDED FREQUENCY OF REPLACEMENTS FOR CATHETERS, DRESSINGS, ADMINISTRATION SETS, AND FLUIDS

Catheter	Replacement and Relocation of Device	Replacement of Catheter-Site Dressing	Replacement of Administration Sets	Hang Time for Parenteral Fluids
Peripheral venous catheters	In adults, replace catheter and rotate site no more frequently than every 72 to 96 hours. Replace catheters inserted under emergency basis and insert a new catheter at a different site within 48 hours. In pediatric patients, do not replace peripheral catheters unless clinically indicated.	Replace dressing when the catheter is removed or replaced, or when the dressing becomes damp, loosened, or soiled. Replace dressings more frequently in diaphoretic patients. In patients who have large bulky dressings that prevent palpation or direct visualization of the catheter insertion site, remove the dressing and visually inspect the catheter at least daily and apply a new dressing.	Replace intravenous tubing, including add-on devices, no more frequently than at 72-hour intervals unless clinically indicated. Replace tubing used to administer blood, blood products, or lipid emulsions within 24 hours of initiating the infusion. No recommendation for replacement of tubing used for intermittent infusions. Consider short extension tubing connected to the catheter to be a portion of the device. Replace such extension tubing when the catheter is changed.	No recommendation for the hang time of intravenous fluids, including nonlipid-containing parenteral nutrition fluids. Complete infusion of lipid-containing parenteral nutrition fluids (eg, 3-in-1 solutions) within 24 hours of hanging the fluid. Complete infusion of lipid emulsions alone within 12 hours of hanging the fluid. Complete infusions of blood products within 4 hours of hanging the product.
Midline catheters	No recommendation for the frequency of the catheter replacement.	As above.	As above.	As above.
Peripheral arterial catheters	In adults, do not replace catheters routinely to prevent catheter-related infection. In pediatric patients, no recommendation for the frequency of catheter replacement. Replace disposable or reusable transducers at 96-hour intervals. Replace continuous flush device at the time the transducer is replaced.	Replace dressing when the catheter is replaced, or when the dressing becomes damp, loosened, or soiled, or when inspection of the site is necessary.	Replace the intravenous tubing at the time the transducer is replaced (ie, 96-hour intervals).	Replace the flush solution at the time the transducer is replaced (ie, 96-hour intervals).
Central venous catheters,* including peripherally inserted central catheters and hemodialysis catheters	Do not routinely replace catheters.	Replace gauze dressings every 2 days and transparent dressings every 7 days on short-term catheters. Replace the dressing when the catheter is replaced, or when the dressing becomes damp, loosened, or soiled, or when inspection of the site is necessary.	Replace intravenous tubing and add-on devices no more frequently than at 72-hour intervals. Replace tubing used to administer blood products or lipid emulsions within 24 hours of initiating the infusion.	No recommendation for the hang time of intravenous fluids, including nonlipid-containing parenteral nutrition fluids. Complete infusions of lipid-containing fluids within 24 hours of hanging the fluid.
Pulmonary artery catheters	Do not replace catheter to prevent catheter-related infection.	As above.	As above.	As above.
Umbilical catheters	Do not routinely replace catheters.	Not applicable.	Replace intravenous tubing and add-on devices no more frequently than at 72-hour intervals. Replace tubing used to administer blood products or lipid emulsions within 24 hours of initiating the infusion.	No recommendation for the hang time of intravenous fluids, including nonlipid-containing parenteral nutrition fluids. Complete infusion of lipid-containing fluids within 24 hours of hanging the fluid.

*Includes nontunneled catheters, tunneled catheters, and totally implanted devices.

ing soap and water or waterless alcohol-based gels or foams. Observe hand hygiene 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 done after the application of antiseptic, unless aseptic technique is maintained.^{2,23-28} Category IA

B. Use of gloves does not obviate the need for hand hygiene.^{2,26,27} Category IA

IV. Aseptic technique during catheter insertion and care
A. Maintain aseptic technique for the insertion and care of intravascular catheters.²⁹⁻³² Category IA

B. Wear clean or sterile gloves when inserting an intravascular catheter as required by the Occupational Safety and Health Administration (OSHA) Bloodborne Pathogens Standard. Category IC. Wearing clean gloves rather than sterile gloves is acceptable for the insertion of peripheral intravascular catheters if the access site is not touched after the application of skin antiseptics. Sterile gloves must be worn for the insertion of arterial and central catheters.^{31,33} Category IA

C. Wear clean or sterile gloves when changing the dressing on intravascular catheters. Category IC

V. Catheter insertion

Do not routinely use arterial or venous cut-down procedures as a method to insert catheters.³⁴⁻³⁶ Category IA

VI. Catheter-site care

A. Cutaneous antiseptics

1. Disinfect clean skin with an appropriate antiseptic before catheter insertion and during dressing changes. Although a 2% chlorhexidine-based preparation is preferred, tincture of iodine, an iodophor, or 70% alcohol can be used.³⁷⁻⁴⁰ Category IA

2. No recommendation can be made for the use of chlorhexidine in infants younger than 2 months. Unresolved issue.

3. Allow the antiseptic to remain on the insertion site and to air dry before catheter insertion. Allow povidone-iodine to remain on the skin for at least 2 minutes, or longer if it is not yet dry before insertion.³⁷⁻⁴⁰ Category IB

4. Do not apply organic solvents (eg, acetone and ether) to the skin before insertion of catheters or during dressing changes.⁴¹ Category IA

VII. Catheter-site dressing regimens

A. Use either sterile gauze or sterile, transparent, semipermeable dressing to cover the catheter site.⁴²⁻⁴⁵ Category IA

B. Tunneled CVC sites that are well healed may not require dressings. Category II

C. If the patient is diaphoretic, or if the site is bleeding or oozing, a gauze dressing is preferable to a transparent, semipermeable dressing.⁴²⁻⁴⁵ Category II

D. Replace catheter-site dressing if the dressing becomes damp, loosened, or visibly soiled.^{42,43} Category IB

E. Change dressings regularly for adult and adolescent patients depending on the circumstances of the individual patient, but should be done at least weekly.⁴⁴ Category II

F. Do not use topical antibiotic ointment or creams on insertion sites (except when using dialysis catheters) because of their potential to promote fungal infections and antimicrobial resistance.^{46,47} Category IA

G. Do not submerge the catheter under water. Showering should be permitted if precautions can be taken to reduce the likelihood of introducing organisms into the catheter (eg, if the catheter and connecting device are protected with an impermeable cover during the shower).^{48,49} Category II

VIII. Selection and replacement of intravascular catheters

A. Select the catheter, insertion technique, and insertion site with the lowest risk of complications (infectious and non-infectious) for the anticipated type and duration of intravenous therapy.^{29,50-54} Category IA

B. Promptly remove any intravascular catheter that is no longer essential.^{55,56} Category IA

C. Do not routinely replace central venous or arterial catheters solely for the purposes of reducing the incidence of infection.⁵⁷⁻⁵⁹ Category IB

D. Replace peripheral venous catheters at least every 72 to 96 hours in adults to prevent phlebitis.⁶⁰ Leave peripheral venous catheters in place in children until intravenous therapy is completed, unless complications (eg, phlebitis and infiltration) occur.⁶¹⁻⁶⁴ Category IB

E. When adherence to aseptic technique cannot be ensured (ie, when catheters are inserted during a medical emergency), replace all catheters as soon as possible and after no longer than 48 hours.²⁹⁻³² Category II

F. Use clinical judgment to determine when to replace a catheter that could be a source of infection (eg, do not routinely replace catheters in patients whose only indication of infection is fever). Do not routinely replace venous catheters in patients who are bacteremic or fungemic if the source of infection is unlikely to be the catheter.⁶⁵ Category II

G. Replace any short-term CVC if purulence is observed at the insertion site, which indicates infection.^{65,66} Category IB

H. Replace all CVCs if the patient is hemodynamically unstable and CRBSI is suspected.^{65,66} Category II

I. Do not use guidewire techniques to replace catheters in patients suspected of having catheter-related infection.^{57,58} Category IB

IX. Replacement of administration sets,* needleless systems, and parenteral fluids

A. Administration sets

1. Replace administration sets, including secondary sets and add-on devices, no more frequently than at 72-hour intervals, unless catheter-related infection is suspected or documented.⁶⁷⁻⁷⁰ Category IA

2. Replace tubing used to administer blood, blood

*Administration sets include the area from the spike of tubing entering the fluid container to the hub of the vascular access device. However, a short extension tube may be connected to the catheter and may be considered a portion of the catheter to facilitate aseptic technique when changing administration sets.

products, or lipid emulsions (those combined with amino acids and glucose in a 3-in-1 admixture or infused separately) within 24 hours of initiating the infusion.⁷¹⁻⁷⁵ Category IB. If the solution contains only dextrose and amino acids, the administration set does not need to be replaced more frequently than every 72 hours.⁷² Category II

3. Replace tubing used to administer propofol infusions every 6 or 12 hours, depending on its use, per the manufacturer's recommendation.⁷⁶ Category IA

B. Needleless intravascular devices

1. Change the needleless components at least as frequently as the administration set.⁷⁷⁻⁸³ Category II

2. Change caps no more frequently than every 72 hours or according to manufacturers' recommendations.^{77,79,81,82} Category II

3. Ensure that all components of the system are compatible to minimize leaks and breaks in the system.⁸⁴ Category II

4. Minimize contamination risk by wiping the access port with an appropriate antiseptic and accessing the port only with sterile devices.^{79,81,84} Category IB

C. Parenteral fluids

1. Complete the infusion of lipid-containing solutions (eg, 3-in-1 solutions) within 24 hours of hanging the solution.^{71,72,75,85,86} Category IB

2. Complete the infusion of lipid emulsions alone within 12 hours of hanging the emulsion. If volume considerations require more time, the infusion should be completed within 24 hours.^{71,85,86} Category IB

3. Complete infusions of blood or other blood products within 4 hours of hanging the blood.^{87,90} Category II

4. No recommendation can be made for the hang time of other parenteral fluids. Unresolved issue.

X. Intravenous injection ports

A. Clean injection ports with 70% alcohol or an iodophor before accessing the system.^{80,91,92} Category IA

B. Cap all stopcocks when not in use.⁹¹ Category IB

XI. Preparation and quality control of intravenous admixtures

A. Admix all routine parenteral fluids in the pharmacy in a laminar-flow hood using aseptic technique.^{93,94} Category IB

B. Do not use any container of parenteral fluid that has visible turbidity, leaks, cracks, or particulate matter or if the manufacturer's expiration date has passed.⁹³ Category IB

C. Use single-dose vials for parenteral additives or medications when possible.^{93,95} Category II

D. Do not combine the leftover content of single-use vials for later use.^{93,95} Category IA

E. If multidose vials are used

1. Refrigerate multidose vials after they are opened if recommended by the manufacturer. Category II

2. Cleanse the access diaphragm of multidose vials with 70% alcohol before inserting a device into the vial.⁹² Category IA

3. Use a sterile device to access a multidose vial and avoid touch contamination of the device before pene-

trating the access diaphragm.^{91,96} Category IA

4. Discard multidose vial if sterility is compromised.^{91,96} Category IA

XII. In-line filters

Do not use filters routinely for infection control purposes.^{97,98} Category IA

XIII. Intravenous therapy personnel

Designate trained personnel for the insertion and maintenance of intravascular catheters.^{4,5,43,99} Category IA

XIV. Prophylactic antimicrobials

Do not administer intranasal or systemic antimicrobial prophylaxis routinely before insertion or during use of an intravascular catheter to prevent catheter colonization or bloodstream infection.¹⁰⁰⁻¹⁰³ Category IA

PERIPHERAL VENOUS CATHETERS, INCLUDING MIDLINE CATHETERS, IN ADULT AND PEDIATRIC PATIENTS

I. Selection of peripheral catheter

A. Select catheters on the basis of the intended purpose and duration of use, known complications (eg, phlebitis and infiltration), and experience of individual catheter operators.¹⁰⁴⁻¹⁰⁶ Category IB

B. Avoid the use of steel needles for the administration of fluids and medication that may cause tissue necrosis if extravasation occurs.^{104,105} Category IA

C. Use a midline catheter or peripherally inserted central catheter (PICC) when the duration of intravenous therapy will likely exceed 6 days.¹⁰⁶ Category IB

II. Selection of peripheral catheter insertion site

A. In adults, use an upper extremity instead of a lower extremity site for catheter insertion. Replace a catheter inserted in a lower extremity site to an upper extremity site as soon as possible.^{104,107} Category IA

B. In pediatric patients, the hand, the dorsum of the foot, or the scalp may be used as the catheter insertion site. Category II

C. Replacement of catheter

1. Evaluate the catheter insertion site daily, by palpation through the dressing to discern tenderness and by inspection if a transparent dressing is in use. Gauze and opaque dressings should not be removed if the patient has no clinical signs of infection. If the patient has local tenderness or other signs of possible CRBSI, an opaque dressing should be removed and the site inspected visually. Category II

2. Remove peripheral venous catheters if the patient develops signs of phlebitis (eg, warmth, tenderness, erythema, and palpable venous cord), infection, or a malfunctioning catheter.¹⁰⁸ Category IB

3. In adults, replace short, peripheral venous catheters at least every 72 to 96 hours to reduce the risk of phlebitis. If sites for venous access are limited and no evidence for phlebitis or infection is present, peripheral venous catheters can be left in place for longer periods, although the patient and the insertion sites must be closely monitored.^{60,108,109} Category IB

4. Do not routinely replace midline catheters to reduce the risk for infection.¹¹⁰ Category IB

5. In pediatric patients, leave peripheral venous catheters in place until intravenous therapy is completed, unless a complication (eg, phlebitis and infiltration) occurs.⁶¹⁻⁶⁴ Category IB

III. Catheter and catheter-site care

Do not routinely apply prophylactic topical antimicrobial or antiseptic ointment or cream to the insertion site of peripheral venous catheters.^{46,47} Category IA

CENTRAL VENOUS CATHETERS, INCLUDING PICCS, HEMODIALYSIS, AND PULMONARY ARTERY CATHETERS, IN ADULT AND PEDIATRIC PATIENTS

I. Surveillance

A. Conduct surveillance in ICUs and other patient populations to determine CRBSI rates, monitor trends in those rates, and assist in identifying lapses in infection control practices.¹¹¹⁻¹¹⁷ Category IA

B. Express ICU data as the number of catheter-associated BSIs per 1,000 catheter-days for both adults and children and stratify by birth-weight categories for neonatal ICUs to facilitate comparisons with national data in comparable patient populations and healthcare settings.¹¹¹⁻¹¹⁷ Category IB

C. Investigate events leading to unexpected life-threatening or fatal outcomes. This includes any process variation for which a recurrence would likely present an adverse outcome.¹¹⁸ Category IC

II. General principles

A. Use a CVC with the minimum number of ports or lumens essential for the management of the patient.¹¹⁹⁻¹²² Category IB

B. Use an antimicrobial- or antiseptic-impregnated CVC in adults whose catheter is expected to remain in place more than 5 days if, after implementing a comprehensive strategy to reduce rates of CRBSI, the CRBSI rate remains above the goal set by the individual institution based on benchmark rates and local factors. The comprehensive strategy should include the following three components: educating persons who insert and maintain catheters, use of maximal sterile barrier precautions, and a 2% chlorhexidine preparation for skin antisepsis during CVC insertion.¹²³⁻¹²⁸ Category IB

C. No recommendation can be made for the use of impregnated catheters in children. Unresolved issue.

D. Designate personnel who have been trained and exhibit competency in the insertion of catheters to supervise trainees who perform catheter insertion.^{1,2,4,6,11,12} Category IA

E. Use totally implantable access devices for patients who require long-term, intermittent vascular access. For patients requiring frequent or continuous access, a PICC or tunneled CVC is preferable.^{129,130} Category II

F. Use a cuffed CVC for dialysis if the period of temporary access is anticipated to be prolonged (eg, > 3 weeks).^{131,132} Category IB

G. Use a fistula or graft instead of a CVC for permanent access for dialysis.¹³³ Category IB

H. Do not use hemodialysis catheters for blood drawing or applications other than hemodialysis except during

dialysis or under emergency circumstances. Category II

I. Use povidone-iodine antiseptic 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.^{131,134,135} Category II

III. Selection of catheter insertion site

A. Weigh the risk and benefits of placing a 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).^{29,50,51,54} Category IA

B. Use a subclavian site (rather than a jugular or a femoral site) in adult patients to minimize infection risk for nontunneled CVC placement.^{29,50,51,136} Category IA

C. No recommendation can be made for a preferred site of insertion to minimize infection risk for a nontunneled CVC.¹³⁷⁻¹³⁹ Unresolved issue.

D. Place catheters used for hemodialysis and pheresis in a jugular or femoral vein rather than a subclavian vein to avoid venous stenosis if catheter access is needed.¹⁴⁰⁻¹⁴⁴ Category IA

IV. Maximal sterile barrier precautions during catheter insertion

A. Use aseptic technique, including the use of a cap, a mask, a sterile gown, sterile gloves, and a large sterile sheet, for the insertion of CVCs (including PICCs) or guidewire exchange.^{29,30} Category IA

B. Use a sterile sleeve to protect pulmonary artery catheters during insertion.¹⁴⁵ Category IB

V. Replacement of catheter

A. Do not routinely replace CVCs, PICCs, hemodialysis catheters, or pulmonary artery catheters to prevent catheter-related infections.^{57,58,146} Category IB

B. Do not remove CVCs or PICCs on the basis of fever alone. Use clinical judgment regarding the appropriateness of removing the catheter if infection is evidenced elsewhere or if a non-infectious cause of fever is suspected.^{65,147} Category II

C. Guidewire exchange

1. Do not use guidewire exchanges routinely for nontunneled catheters to prevent infection.^{58,148} Category IB

2. Use a guidewire exchange to replace a malfunctioning nontunneled catheter if no evidence of infection is present.^{58,148} Category IB

3. Use a new set of sterile gloves before handling the new catheter when guidewire exchanges are performed.^{28,30} Category II

VI. Catheter and catheter-site care

A. General measures

Designate one port exclusively for hyperalimentation if a multi-lumen catheter is used to administer parenteral nutrition.¹⁴⁹ Category II

B. Antibiotic lock solutions

Do not routinely use antibiotic lock solutions to prevent CRBSI. Use prophylactic antibiotic lock solution

only in special circumstances (eg, in treating a patient with a long-term cuffed or tunneled catheter or port who has a history of multiple CRBSIs despite optimal maximal adherence to aseptic technique).¹⁵⁰⁻¹⁵³ Category II

C. Catheter-site dressing regimens

1. Replace the catheter-site dressing when it becomes damp, loosened, or soiled or when inspection of the site is necessary.^{42,44,154} Category IA

2. Replace dressings used on short-term central catheter sites every 2 days for gauze dressings and at least every 7 days for transparent dressings, except in those pediatric patients in whom the risk of dislodging the catheter outweighs the benefit of changing the dressing.⁴⁴ Category IB

3. Replace dressings used on tunneled or implanted central catheter sites no more than once per week, until the insertion site has healed.⁴⁴ Category IB

4. 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.

D. No recommendation has been made for the use of chlorhexidine sponge dressings to reduce the incidence of infection. Unresolved issue.

E. Do not use chlorhexidine sponge dressings in neonates younger than 7 days or of a gestational age of less than 26 weeks.¹⁵⁵ Category II

F. No recommendation can be made for the use of sutureless securement devices. Unresolved issue.

G. Ensure that catheter-site care is compatible with the catheter material.^{156,157} Category IB

H. Use a sterile sleeve for all pulmonary artery catheters.¹⁴⁵ Category IB

ADDITIONAL RECOMMENDATIONS FOR PERIPHERAL ARTERIAL CATHETERS AND PRESSURE MONITORING DEVICES FOR ADULT AND PEDIATRIC PATIENTS

I. Selection of pressure monitoring system

Use disposable, rather than reusable, transducer assemblies when possible.¹⁵⁸⁻¹⁶² Category IB

II. Replacement of catheter and pressure monitoring system

A. Do not routinely replace peripheral arterial catheters to prevent catheter-related infections.^{59,146,163,164} Category II

B. Replace disposable or reusable transducers at 96-hour intervals. Replace other components of the system (including the tubing, continuous-flush device, and flush solution) at the time the transducer is replaced.^{29,159} Category IB

III. Care of pressure monitoring systems

A. General measures

1. Keep all components of the pressure monitoring system (including calibration devices and flush solution) sterile.^{158,165-167} Category IA

2. Minimize the number of manipulations of and entries into the pressure monitoring system. Use a closed-flush system (ie, continuous flush), rather than an open system (ie, one that requires a syringe and stopcock), to

maintain the patency of the pressure monitoring catheters.^{161,168} Category II

3. When the pressure monitoring system is accessed through a diaphragm rather than a stopcock, wipe the diaphragm with an appropriate antiseptic before accessing the system.¹⁶¹ Category IA

4. Do not administer dextrose-containing solutions or parenteral nutrition fluids through the pressure monitoring circuit.^{161,169,170} Category IA

B. Sterilization or disinfection of pressure monitoring systems

1. Use disposable transducers.^{161,169-172} Category IB

2. Sterilize reusable transducers according to the manufacturers' instructions if the use of disposable transducers is not feasible.^{161,169-172} Category IA

RECOMMENDATIONS FOR UMBILICAL CATHETERS

I. Replacement of catheters

A. Remove and do not replace umbilical artery catheters if any signs of CRBSI, vascular insufficiency, or thrombosis are present.¹⁷³ Category II

B. Remove and do not replace umbilical venous catheters if any signs of CRBSI or thrombosis are present.¹⁷³ Category II

C. No recommendation can be made for treating through an umbilical venous catheter suspected of being infected. Unresolved issue.

D. Replace umbilical venous catheters only if the catheter malfunctions. Category II

II. Catheter-site care

A. Cleanse the umbilical insertion site with an antiseptic before catheter insertion. Avoid tincture of iodine because of the potential effect on the neonatal thyroid. Other iodine-containing products (eg, povidone-iodine) can be used.^{38,174-177} Category IB

B. Do not use topical antibiotic ointment or creams on umbilical catheter insertion sites because of the potential to promote fungal infections and antimicrobial resistance.^{46,47} Category IA

C. Add low doses of heparin (0.25 to 1.0 u/mL) to the fluid infused through umbilical arterial catheters.¹⁷⁸⁻¹⁸⁰ Category IB

D. Remove umbilical catheters as soon as possible when no longer needed or when any sign of vascular insufficiency to the lower extremities is observed. Optimally, umbilical artery catheters should not be left in place more than 5 days.^{173,181} Category II

E. Umbilical venous catheters should be removed as soon as possible when no longer needed but can be used up to 14 days if managed aseptically.^{182,183} Category II

PERFORMANCE INDICATORS FOR PREVENTION OF CATHETER-ASSOCIATED BLOODSTREAM INFECTION

1. Implementation of educational programs that include didactic and interactive components for those who insert and maintain catheters.

2. Use of maximal sterile barrier precautions during catheter placement.
3. Use of chlorhexidine for skin antisepsis.
4. Rates of catheter discontinuation when the catheter is no longer essential for medical management.

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