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Guideline Summary NGC-7382

Guideline Title

Clinical practice guidelines for the diagnosis and management of intravascular catheter-related infection: 2009 update by the Infectious Diseases Society of America.

Bibliographic Source(s)

Mermel LA, Allon M, Bouza E, Craven DE, Flynn P, O'Grady NP, Raad II, Rijnders BJ, Sherertz RJ, Warren DK. Clinical practice guidelines for the diagnosis and management of intravascular catheter-related infection: 2009 update by the Infectious Diseases Society of America [published erratum: Clin Infect Dis 2010 Feb 1;50:457]. Clin Infect Dis 2009 Jul 1;49(1):1-45. [281 references] PubMed

Guideline Status

This is the current release of the guideline.

This guideline updates previous versions: Mermel LA, Farr BM, Sherertz RJ, Raad II, O'Grady N, Harris JS, Craven DE. Guidelines for the management of intravascular catheter-related infections. Clin Infect Dis 2001 May 1;32(9):1249-72. [210 references]

Mermel LA, Farr BM, Sherertz RJ, Raad II, O'Grady N, Harris JS, Craven DE. Guidelines for the management of intravascular catheter-related infections. Infect Control Hosp Epidemiol 2001 Apr;22(4):222-42. [210 references]

Mermel LA, Farr BM, Sherertz RJ, Raad II, O'Grady N, Harris JS, Craven DE. Guidelines for the management of intravascular catheter-related infections. J Intraven Nurs 2001 Jun;24(3):180-205. [210 references]

FDA Warning/Regulatory Alert

Note from the National Guideline Clearinghouse: This guideline references a drug(s) for which important revised regulatory and/or warning information has been released.

- July 26, 2011 (updated October 21, 2011) – Zyvox (linezolid): The U.S. Food and Drug Administration (FDA) has received reports of serious central nervous system (CNS) reactions when the antibacterial drug linezolid (Zyvox) is given to patients taking psychiatric medications that work through the serotonin system of the brain (serotonergic psychiatric medications. A list of the serotonergic psychiatric medications that can interact with linezolid can be found in the Drug Safety Communication. Safety information about this potential drug interaction and important drug usage recommendations for emergency and non-emergency situations are being added to the drug labels for serotonergic psychiatric medications and linezolid.

Scope

Disease/Condition(s)

Intravascular catheter-related infections

- Catheter-related bloodstream infections
- Sepsis
- Infective endocarditis

Guideline Category

Diagnosis

Evaluation

Management

Treatment

Clinical Specialty

Anesthesiology

Cardiology

Critical Care

Infectious Diseases

Internal Medicine

Nephrology

Nursing

Oncology

Pediatrics

Pulmonary Medicine

Surgery

Intended Users

Advanced Practice Nurses

Nurses

Physician Assistants

Physicians

Guideline Objective(s)

- To provide recommendations for the management of infectious complications of intravascular catheters, particularly catheter-related bloodstream infection (CRBSI)
- To update the 2001 Infectious Diseases Society of America guidelines for management of intravascular catheter-related infections

Target Population

Patients with intravascular catheters or implantable devices

Interventions and Practices Considered

Diagnosis

1. Intravenous catheter cultures
2. Blood cultures

Management/Treatment

1. Antimicrobial therapy (empirical and pathogen-specific), including: amikacin, amphotericin B, ampicillin, ampicillin-sulbactam, anidulafungin, aztreonam, carbapenem, caspofungin, cefazolin, cefepime, cefotaxime, cefuroxime, ceftriaxone, ceftazidime, cephalosporin, clavulanate, ciprofloxacin, daptomycin, ertapenem, fluconazole, gentamicin, imipenem, imipenem-cilastatin, ketoconazole, levofloxacin, linezolid, meropenem, methicillin, mezlocillin, micafungin, nafcillin, oxacillin, penicillin, penicillin G, piperacillin, quinupristin/dalfopristin, rifampin, sulbactam, ticarcillin, tobramycin, trimethoprim-sulfamethoxazole, vancomycin, and voriconazole
2. Antibiotic lock therapy
3. Removal of central venous catheter or implantable device
4. Transesophageal echocardiography to evaluate for infective endocarditis
5. Evaluation for complications, such as insertion site or pocket infection, suppurative thrombophlebitis, sepsis, endocarditis, persistent bacteremia, or metastatic infection
6. Urokinase and other thrombolytic agents, such as streptokinase (considered but not recommended)
7. Catheter guidewire exchange
8. Unique aspects of treatment of pediatric patients
9. Unique aspects of treatment of infections related to hemodialysis catheters
10. Detection and management of an outbreak of catheter-related bloodstream infection

Major Outcomes Considered

- Sensitivity and specificity of diagnostic techniques
- Cure rates
- Patient morbidity and mortality
- Incidence of complications, such as insertion site or pocket infection, suppurative thrombophlebitis, sepsis, endocarditis, persistent bacteremia, or metastatic infection

Methodology

Methods Used to Collect/Select the Evidence

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

For the 2009 update, the Expert Panel completed the review and analysis of data published from January 2001 through June 2008. Data published after June 2008 were also considered in the final preparation of the guideline. Computerized literature searches of the PubMed database were performed with combinations of the following search terms: "catheter-related," "infections," "cultures," "management," "treatment," "peripheral," "non-tunneled," "central venous catheter,"

"arterial catheter," "implanted catheter," "pediatric," "hemodialysis," "antibiotic lock," "bacteremia" "suppurative thrombophlebitis," "endocarditis," and "outbreak."

Number of Source Documents

Not stated

Methods Used to Assess the Quality and Strength of the Evidence

Expert Consensus

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Quality of Evidence

I. Evidence from ≥1 properly randomized, controlled trial

II. Evidence from ≥1 well-designed clinical trial, without randomization; from cohort or case-controlled analytic studies (preferably from >1 center); from multiple time series, or from dramatic results from uncontrolled experiments

III. Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees

Adapted from Canadian Task Force on the Periodic Health Examination.

Methods Used to Analyze the Evidence

Review of Published Meta-Analyses

Systematic Review

Description of the Methods Used to Analyze the Evidence

In evaluating the evidence regarding the management of intravascular catheter–related infections, the Expert Panel followed a process used in the development of other Infectious Diseases Society of America (IDSA) guidelines. The process included a systematic weighting of the quality of the evidence and the grade of recommendation (see "Rating Scheme for the Strength of the Evidence" and "Rating Scheme for the Strength of the Recommendations" fields).

Methods Used to Formulate the Recommendations

Expert Consensus

Description of Methods Used to Formulate the Recommendations

The Infectious Diseases Society of America (IDSA) Standards and Practice Guidelines Committee convened a multidisciplinary panel of experts in the management of intravascular catheter-related infections. Expert Panel participants included representatives from the following collaborating organizations: European Society of Clinical Microbiology and Infectious Diseases, Pediatric Infectious Diseases Society, American Society of Nephrology, Society for Critical Care Medicine, and the Society for Healthcare Epidemiology of America.

The Expert Panel met face-to-face on 1 occasion and via teleconference on 8 occasions to complete the work of the guideline. The purpose of the meetings was to discuss the questions to be addressed, make writing assignments, and discuss recommendations.

Rating Scheme for the Strength of the Recommendations

Strength of Recommendation

A. Good evidence to support a recommendation for or against use

B. Moderate evidence to support a recommendation for or against use

C. Poor evidence to support a recommendation

Adapted from Canadian Task Force on the Periodic Health Examination.

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

External Peer Review

Internal Peer Review

Description of Method of Guideline Validation

All members of the Expert Panel participated in the preparation and review of the draft guideline. Feedback from external peer reviewers was obtained. All collaborating organizations were also asked to provide feedback and endorse the guidelines. The guideline was reviewed and approved by the Infectious Disease Society of America (IDSA)

Standards and Practice Guidelines Committee and the Board of Directors prior to dissemination.

Recommendations

Major Recommendations

Definitions of the quality of evidence (I-III) and strength of recommendation (A-C) are repeated at the end of the "Major Recommendations" field.

Diagnosis: When and How Should Catheter Cultures and Blood Cultures Be Done?

Intravenous Catheter Cultures: Recommendations

General

1. Catheter cultures should be done when a catheter is removed because of suspected catheter-related bloodstream infection (CRBSI); catheter cultures should not be obtained routinely **(A-II)**.
2. Qualitative broth culture of catheter tips is not recommended **(A-II)**.
3. For central venous catheters (CVCs), culture the catheter tip, not the subcutaneous segment **(B-III)**.
4. For cultures of an antiseptic-impregnated catheter tip, use specific inhibitors in the culture media **(A-II)**.
5. Growth of >15 colony-forming units (cfu) from a 5-cm segment of the catheter tip by semiquantitative (roll-plate) culture or growth of $>10^2$ colony-forming units from a catheter by quantitative (sonication) broth culture reflects catheter colonization **(A-I)**.
6. When catheter-related infection is suspected and there is a catheter exit site exudate, swab the drainage to obtain samples for culture and Gram staining **(B-III)**.

Short-term Catheters, Including Arterial Catheters

7. For short-term catheter tip cultures, the roll plate technique is recommended for routine clinical microbiological analysis **(A-II)**.
8. For suspected pulmonary artery catheter-related infection, culture the introducer tip **(A-II)**.

Long-term Catheters

9. Semiquantitative growth of <15 colony-forming units/plate of the same microbe from both the insertion site culture and catheter hub culture strongly suggests that the catheter is not the source of a bloodstream infection **(A-II)**.
10. If a venous access subcutaneous port is removed because of suspected CRBSI, send the port to the microbiology laboratory for qualitative culture of the port reservoir contents, in addition to the catheter tip **(B-II)**.

Blood Cultures: Recommendations

11. Obtain blood cultures prior to initiation of antibiotic therapy (see figure 1 in the original guideline document) **(A-1)**
12. Where available, a phlebotomy team should draw the blood samples for culture **(A-II)**.
13. Skin preparation for percutaneously drawn blood samples should be carefully done with either alcohol or tincture of iodine or alcoholic chlorhexidine (>0.5%), rather than povidone-iodine; allow adequate skin contact and drying time to mitigate blood culture contamination **(A-I)**.
14. If a blood sample is obtained through a catheter, clean the catheter hub with either alcohol or tincture of iodine or alcoholic chlorhexidine (>0.5%) and allow adequate drying time to mitigate blood culture contamination **(A-I)**.
15. For suspected CRBSI, paired blood samples drawn from the catheter and from a peripheral vein should be cultured before initiation of antimicrobial therapy, and the bottles should be appropriately marked to reflect the site from which the cultures were obtained **(A-II)**.
16. If a blood sample for culture cannot be drawn from a peripheral vein, it is recommended that ≥2 blood samples should be obtained through different catheter lumens **(B-III)**. It is unclear whether blood samples for culture should be obtained through all catheter lumens in such circumstances **(C-III)**.
17. A definitive diagnosis of CRBSI requires that the same organism grow from at least 1 percutaneous blood sample culture and from the catheter tip **(A-I)** or that 2 blood samples for culture be obtained (1 from a catheter hub and 1 from a peripheral vein) that meet CRBSI criteria for quantitative blood cultures or differential time to positivity (DTP) **(A-II)**. Alternatively, 2 quantitative blood cultures of samples obtained through 2 catheter lumens in which the colony count for the blood sample drawn through one lumen is at least 3-fold greater than the colony count for the blood sample obtained from the second lumen should be considered to indicate possible CRBSI **(B-II)**. In this circumstance, the interpretation of blood cultures that meet the DTP criteria is an unresolved issue **(C-III)**.
18. For quantitative blood cultures, a colony count of microbes grown from blood obtained through the catheter hub that is at least 3-fold greater than the colony count from blood samples obtained from a peripheral vein best defines CRBSI **(A-II)**.
19. For DTP, growth of microbes from blood drawn from a catheter hub at least 2 h before microbial growth is detected in blood samples obtained from a peripheral vein best defines CRBSI **(A-II)**.
20. Quantitative blood cultures and/or DTP should be done before initiation of antimicrobial therapy and with the same volume of blood per bottle **(A-II)**.
21. Evidence is insufficient to recommend that blood cultures be routinely obtained after discontinuation of antimicrobial therapy for CRBSI **(C-III)**.

How Should Catheter-Related Infections Be Managed in General?

22. When denoting the duration of antimicrobial therapy, day 1 is the first day on which negative blood culture results are obtained **(C-III)**.

23. Vancomycin is recommended for empirical therapy in health care settings with an increased prevalence of methicillin-resistant staphylococci; for institutions with a preponderance of methicillin-resistant *Staphylococcus aureus* (MRSA) isolates that have vancomycin minimum inhibitory concentration (MIC) values ≥2 μg/mL, alternative agents, such as daptomycin, should be used **(A-II)**.

24. Linezolid should not be used for empirical therapy (i.e., in patients suspected but not proven to have CRBSI) **(A-I)**.

25. Empirical coverage for gram-negative bacilli should be based on local antimicrobial susceptibility data and the severity of disease (e.g., a fourth-generation cephalosporin, carbapenem, or β-lactam/β-lactamase combination, with or without an aminoglycoside) **(A-II)**.

26. Empirical combination antibiotic coverage for multi-drug-resistant (MDR) gram-negative bacilli, such as *Pseudomonas aeruginosa*, should be used when CRBSI is suspected among neutropenic patients, severely ill patients with sepsis, or patients known to be colonized with such pathogens, until the culture and susceptibility data are available and de-escalation of antibiotic therapy can be performed **(A-II)**.

27. In addition to coverage for gram-positive pathogens, empirical therapy for suspected CRBSI involving femoral catheters in critically ill patients should include coverage for gram-negative bacilli and *Candida* species **(A-II)**.

28. Empirical therapy for suspected catheter-related candidemia should be used for septic patients with any of the following risk factors: total parenteral nutrition, prolonged use of broad-spectrum antibiotics, hematologic malignancy, receipt of bone marrow or solid-organ transplant, femoral catheterization, or colonization due to *Candida* species at multiple sites **(B-II)**.

29. For empirical treatment of suspected catheter-related candidemia, use an echinocandin or, for selected patients, fluconazole **(A-II)**. Fluconazole can be used for patients without azole exposure in the previous 3 months and in health care settings where the risk of *C. krusei* or *C. glabrata* infection is very low **(A-III)**.

30. Antibiotic lock therapy should be used for catheter salvage **(B-II)**; however, if antibiotic lock therapy cannot be used in this situation, systemic antibiotics should be administered through the colonized catheter **(C-III)**.

31. Four to 6 weeks of antibiotic therapy should be administered to patients with persistent fungemia or bacteremia after catheter removal (i.e., occurring >72 h after catheter removal) (**A-II** for *S. aureus* infection; **C-III** for infection due to other pathogens), to patients who are found to have infective endocarditis or suppurative thrombophlebitis, and to pediatric patients with osteomyelitis; 6-8 weeks of therapy should be used for the treatment of osteomyelitis in adults (see figures 2 and 3 in the original guideline document) **(A-II)**.

32. Long-term catheters should be removed from patients with CRBSI associated with any of the following conditions: severe sepsis; suppurative thrombophlebitis; endocarditis; bloodstream infection that continues despite >72 h of antimicrobial therapy to which the infecting microbes are susceptible; or infections due to *S. aureus*, *P. aeruginosa*, fungi, or mycobacteria **(A-II)**. Short-term catheters should be removed from patients with CRBSI due to gram-negative bacilli, *S. aureus*, enterococci, fungi, and mycobacteria **(A-II)**.

33. For patients with CRBSI for whom catheter salvage is attempted, additional blood cultures should be obtained, and the catheter should be removed if blood culture results (e.g., 2 sets of blood cultures obtained on a given day; 1 set of blood cultures is acceptable for neonates) remain positive when blood samples are obtained 72 h after the initiation of appropriate therapy **(B-II)**.

34. For long-term and short-term CRBSI due to less virulent microbes that are difficult to eradicate (e.g., *Bacillus* species, *Micrococcus* species, or Propionibacteria), catheters should generally be removed after blood culture contamination is ruled out on the basis of multiple positive culture results, with at least 1 blood culture sample drawn from a peripheral vein **(B-III)**.

35. In uncomplicated CRBSI involving long-term catheters due to pathogens other than *S. aureus*, *P. aeruginosa*, *Bacillus* species, *Micrococcus* species, Propionibacteria, fungi, or mycobacteria, because of the limited access sites in many patients who require long-term intravascular access for survival (e.g., patients undergoing hemodialysis or with short-gut syndrome), treatment should be attempted without catheter removal, with use of both systemic and antimicrobial lock therapy **(B-II)**.

36. After a positive blood culture result is reported that may represent CRBSI, automated standardized treatment advice can be formulated to improve compliance with Infectious Diseases Society of America (IDSA) guidelines **(B-II)**.

37. Urokinase and other thrombolytic agents are not recommended as adjunctive therapy for patients with CRBSI **(B-I)**.

38. If a catheterized patient has a single positive blood culture that grows coagulase-negative *Staphylococcus* species, then additional cultures of blood samples obtained through the suspected catheter and from a peripheral vein should be performed before the initiation of antimicrobial therapy and/or catheter removal to be certain that the patient has true bloodstream infection and that the catheter is the likely source **(A-II)**.

What Are the Unique Aspects of Treating Patients Who Have Short-Term Peripheral Venous Catheters?

39. Peripheral intravenous catheters with associated pain, induration, erythema, or exudate should be removed **(A-I)**.

40. Any exudate at the insertion site should be submitted for Gram staining, routine culture, and additional culture for fungi and acid-fast organisms, as indicated, when assessing immunocompromised patients **(A-II)**.

What Are the Unique Aspects of Treating Patients with Nontunneled CVCs and Arterial Catheters?

41. For patients who are hospitalized in the intensive care unit with a new onset of fever but without severe sepsis or evidence of bloodstream infection, obtain blood samples for culture from the nontunneled CVC, the arterial catheter (if present), and percutaneously, instead of performing routine catheter removal **(B-II)**. Consider culture of samples obtained from the insertion site and catheter hubs, if available, as noted above **(A-II)**.

42. The CVC and arterial catheter, if present, should be removed and cultured if the patient has unexplained sepsis

or erythema overlying the catheter insertion site or purulence at the catheter insertion site **(B-II)**.

43. For patients with unexplained fever, if blood culture results are positive, the CVC or arterial catheter was exchanged over a guidewire, and the catheter tip has significant growth, then the catheter should be removed and a new catheter placed in a new site **(B-II)**.

What Are the Unique Aspects of Treating Patients with Long Term CVCs or Implanted Catheter-Related Infections That Are Not Associated with Hemodialysis Catheters?

44. Patients with tunnel infection or port abscess require removal of the catheter, incision and drainage if indicated, and 7-10 days of antibiotic therapy **(A-II)** in the absence of concomitant bacteremia or candidemia.

45. For patients with suspected exit site infection, obtain cultures of any drainage from the exit site and blood cultures **(A-II)**.

46. Uncomplicated exit site infections (i.e., those without systemic signs of infection, positive blood culture results, or purulence) should be managed with topical antimicrobial agents on the basis of the exit site culture results (e.g., mupirocin ointment for *S. aureus* infection and ketoconazole or lotrimin ointment for *Candida* infection) **(B-III)**.

47. If an uncomplicated exit site infection fails to resolve with topical therapy or if it is accompanied by purulent drainage, then systemic antibiotics should be administered on the basis of the antimicrobial susceptibility of the causative pathogen; the catheter should be removed if treatment with systemic antibiotics fails **(B-II)**.

48. If other vascular sites are unavailable and/or the patient is at increased risk for bleeding diathesis in the setting of CRBSI not complicated by an exit site or tunnel infection, then exchange the infected catheter over a guidewire **(B-III)**. In such situations, an antimicrobial-impregnated catheter with an anti-infective intraluminal surface should be considered for catheter exchange **(B-II)**.

What Are the Unique Aspects of Treating Pediatric Patients with Catheter-Related Infection?

49. Indications for catheter removal for children are similar to those for adults (see recommendations 30-32 above), unless there are unusual extenuating circumstances (e.g., no alternative catheter insertion site). However, the benefits of catheter removal must be weighed against the difficulty of obtaining alternate venous access for an individual patient **(A-II)**.

50. Children treated without catheter removal should be closely monitored with clinical evaluation and additional blood cultures; the device should be removed if there is clinical deterioration or persistent or recurrent CRBSI **(B-III)**.

51. In general, empirical antibacterial therapy for children with CRBSI should be similar to that for adults (see recommendations 21–23 above) **(A-II)**.

52. Antibiotic lock therapy should be used for catheter salvage **(B-II)**; however, if antibiotic lock therapy cannot be used in this situation, systemic antibiotics should be administered through the colonized catheter **(C-III)**.

What Are the Unique Aspects of Managing Patients Who Are Receiving Hemodialysis through Catheters for Whom Catheter-Related Infection Is Suspected or Proven?

53. Peripheral blood samples should be obtained for culture from vessels that are not intended for future use in creating a dialysis fistula (e.g., hand veins) (see table 7 in the original guideline document) **(A-III)**.

54. When a peripheral blood sample cannot be obtained, blood samples may be drawn during hemodialysis from bloodlines connected to the CVC **(B-II)**.

55. In patients with suspected CRBSI for whom blood cultures have been obtained and for whom antibiotic therapy has been initiated, antibiotic therapy can be discontinued if both sets of blood cultures have negative results and no other source of infection is identified **(B-II)**.

56. When a peripheral blood sample cannot be obtained, no other catheter is in place from which to obtain an additional blood sample, there is no drainage from the insertion site available for culture, and there is no clinical evidence for an alternate source of infection, then positive results of culture performed on a blood sample obtained from a catheter should lead to continuation of antimicrobial therapy for possible CRBSI in a symptomatic hemodialysis patient **(B-II)**.

57. The infected catheter should always be removed for patients with hemodialysis CRBSI due to *S. aureus*, *Pseudomonas* species, or *Candida* species and a temporary (nontunneled catheter) should be inserted into another anatomical site **(A-II)**. If absolutely no alternative sites are available for catheter insertion, then exchange the infected catheter over a guidewire **(B-II)**.

58. When a hemodialysis catheter is removed for CRBSI, a long-term hemodialysis catheter can be placed once blood cultures with negative results are obtained **(B-III)**.

59. For hemodialysis CRBSI due to other pathogens (e.g., gram-negative bacilli other than *Pseudomonas* species or coagulase-negative staphylococci), a patient can initiate empirical intravenous antibiotic therapy without immediate catheter removal. If the symptoms persist or if there is evidence of a metastatic infection, the catheter should be removed **(B-II)**. If the symptoms that prompted initiation of antibiotic therapy (fever, chills, hemodynamic instability, or altered mental status) resolve within 2–3 days and there is no metastatic infection, then the infected catheter can be exchanged over a guidewire for a new, long-term hemodialysis catheter **(B-II)**.

60. Alternatively, for patients for whom catheter removal is not indicated (i.e., those with resolution of symptoms and bacteremia within 2-3 days after initiation of systemic antibiotics and an absence of metastatic infection), the catheter can be retained, and an antibiotic lock can be used as adjunctive therapy after each dialysis session for 10–14 days **(B-II)**.

61. Empirical antibiotic therapy should include vancomycin and coverage for gram-negative bacilli, based on the local antibiogram (e.g., third-generation cephalosporin, carbapenem, or β-lactam/β-lactamase combination) **(A-II)**.

62. Patients who receive empirical vancomycin and who are found to have CRBSI due to methicillin-susceptible *S. aureus* should be switched to cefazolin **(A-II)**.

63. For cefazolin, use a dosage of 20 mg/kg (actual body weight), rounded to the nearest 500-mg increment, after dialysis **(A-II)**.

64. A 4-6-week antibiotic course should be administered if there is persistent bacteremia or fungemia (i.e., >72 h in duration) after hemodialysis catheter removal or for patients with endocarditis or suppurative thrombophlebitis, and 6-8 weeks of therapy should be administered for the treatment of osteomyelitis in adults (see figures 3 and 4 in the original guideline document) **(B-II)**.

65. Patients receiving dialysis who have CRBSI due to vancomycin-resistant enterococci can be treated with either daptomycin (6 mg/kg after each dialysis session) or oral linezolid (600 mg every 12 h) **(B-II)**.

66. It is not necessary to confirm negative culture results before guidewire exchange of a catheter for a patient with hemodialysis-related CRBSI if the patient is asymptomatic **(B-III)**.

67. Surveillance blood cultures should be obtained 1 week after completion of an antibiotic course for CRBSI if the catheter has been retained **(B-III)**. If the blood cultures have positive results, the catheter should be removed and a new, long-term dialysis catheter should be placed after additional blood cultures are obtained that have negative results **(B-III)**.

What Is Antibiotic Lock Therapy and How Is It Used to Treat Patients with Catheter-Related Infection?

68. Antibiotic lock is indicated for patients with CRBSI involving long-term catheters with no signs of exit site or tunnel infection for whom catheter salvage is the goal **(B-II)**.

69. For CRBSI, antibiotic lock should not be used alone; instead, it should be used in conjunction with systemic antimicrobial therapy, with both regimens administered for 7-14 days **(B-II)**.

70. Dwell times for antibiotic lock solutions should generally not exceed 48 h before reinstallation of lock solution; preferably, reinstallation should take place every 24 h for ambulatory patients with femoral catheters **(B-II)**. However, for patients who are undergoing hemodialysis, the lock solution can be renewed after every dialysis session **(B-II)**.

71. Catheter removal is recommended for CRBSI due to *S. aureus* and *Candida* species, instead of treatment with antibiotic lock and catheter retention, unless there are unusual extenuating circumstances (e.g., no alternative catheter insertion site) **(A-II)**.

72. For patients with multiple positive catheter-drawn blood cultures that grow coagulase-negative staphylococci or gram-negative bacilli and concurrent negative peripheral blood cultures, antibiotic lock therapy can be given without systemic therapy for 10–14 days **(B-III)**.

73. For vancomycin, the concentration should be at least 1000 times higher than the MIC (e.g., 5 mg/mL) of the microorganism involved **(B-II)**.

74. At this time, there are insufficient data to recommend an ethanol lock for the treatment of CRBSI **(C-III)**.

Are There Pathogen-Specific Treatment Recommendations?

Coagulase-Negative *Staphylococcus* Species

75. For uncomplicated CRBSI, treat with antibiotics for 5-7 days if the catheter is removed and for 10-14 days, in combination with antibiotic lock therapy, if the catheter is retained **(B-III)**.

76. Alternatively, patients with uncomplicated CRBSI can be observed without antibiotics if they have no intravascular or orthopedic hardware, the catheter is removed, and additional blood cultures (performed on samples collected when the patient is not receiving antibiotics) are obtained after catheter withdrawal to confirm the absence of bacteremia **(C-III)**.

77. CRBSI due to *Staphylococcus lugdunensis* should be managed in a manner similar to CRBSI due to *S. aureus* **(B-II)**.

S. aureus

78. Patients with *S. aureus* CRBSI should have the infected catheter removed, and they should receive 4-6 weeks of antimicrobial therapy **(B-II)**, unless they have exceptions listed in recommendation 80 below.

79. Patients who are being considered for a shorter duration of therapy should have a transesophageal echocardiograph (TEE) obtained **(B-II)**.

80. Patients can be considered for a shorter duration of antimicrobial therapy (i.e., a minimum of 14 days of therapy) if the patient is not diabetic; if the patient is not immunosuppressed (i.e., not receiving systemic steroids or other immunosuppressive drugs, such as those used for transplantation, and is nonneutropenic); if the infected catheter is removed; if the patient has no prosthetic intravascular device (e.g., pacemaker or recently placed vascular graft); if there is no evidence of endocarditis or suppurative thrombophlebitis on TEE and ultrasound, respectively; if fever and bacteremia resolve within 72 h after initiation of appropriate antimicrobial therapy; and if there is no evidence of metastatic infection on physical examination and sign- or symptom-directed diagnostic tests **(A-II)**.

81. If a TEE is performed, it should be done at least 5-7 days after onset of bacteremia to minimize the possibility of false-negative results **(B-II)**.

82. Short-term catheters should be removed immediately for patients with *S. aureus* CRBSI **(A-II)**.

83. For *S. aureus* CRBSI involving long-term catheters, the catheters should be removed unless there are major contraindications (e.g., there is no alternative venous access, the patient has significant bleeding diathesis, or quality of life issues take priority over the need for reinsertion of a new catheter at another site) **(A-II)**.

84. In the rare circumstance that the catheter is retained for a patient with *S. aureus* CRBSI involving a long-term catheter, the patient should receive systemic and antibiotic lock therapy for 4 weeks **(B-II)**. Catheter guidewire exchange should be done, if possible, and if it is done, an antimicrobial-impregnated catheter with an anti-infective intraluminal surface should be considered for catheter exchange **(B-II)**.

85. An additional TEE should be obtained for patients with persistent fever or bloodstream infection >72 h after catheter withdrawal and initiation of appropriate antibiotic therapy if the patient had an earlier TEE obtained and it was without evidence of endocarditis and if there is no evidence of an undrained metastatic infection **(A-II)**.

86. Patients whose catheter tip grows *S. aureus* but whose initial peripheral blood cultures have negative results

should receive a 5-7-day course of antibiotics and close monitoring for signs and symptoms of ongoing infection, including additional blood cultures, as indicated **(B-II)**.

87. Transthoracic echocardiograph findings are insufficient to rule out infective endocarditis **(A-II)**.

88. After a catheter has been removed as a result of *S. aureus* CRBSI, placement of a new catheter can proceed when additional blood cultures show no growth **(B-II)**.

***Enterococcus* Species**

89. Removal of infected short-term intravascular catheters is recommended **(B-II)**.

90. Removal of infected long-term catheters should be done in cases of insertion site or pocket infection, suppurative thrombophlebitis, sepsis, endocarditis, persistent bacteremia, or metastatic infection **(B-II)**.

91. Ampicillin is the drug of choice for ampicillin-susceptible enterococci; vancomycin should be used if the pathogen is resistant to ampicillin **(A-III)**.

92. The role of combination therapy (i.e., a cell wall–active antimicrobial and an aminoglycoside) for treating enterococcal CRBSI without endocarditis is unresolved **(C-II)**.

93. A 7- to 14-day course of therapy is recommended for uncomplicated enterococcal CRBSI in which the long-term catheter is retained and antibiotic lock is used or when the short-term catheter is removed **(C-III)**.

94. For enterococcal CRBSI, a TEE should be done if the patient has signs and symptoms that suggest endocarditis (e.g., new murmur or embolic phenomena); prolonged bacteremia or fever, despite appropriate antimicrobial therapy (e.g., bacteremia or fever >72 h after the onset of appropriate antibiotic therapy); radiographic evidence of septic pulmonary emboli; or the presence of a prosthetic valve or other endovascular foreign bodies **(B-III)**.

95. Patients with enterococcal CRBSI involving a long-term catheter for whom the catheter is retained should have follow-up blood cultures and catheter removal if persistent bacteremia (>72 h after the initiation of appropriate antibiotic therapy) is detected **(B-II)**.

96. Antibiotic lock therapy should be used in addition to systemic therapy if the catheter is retained **(C-II)**.

97. In cases of CRBSI due to ampicillin- and vancomycin-resistant enterococci, linezolid or daptomycin may be used, based on antibiotic susceptibility results **(B-II)**.

Gram-Negative Bacilli

98. Patients with possible CRBSI should receive empirical antibiotic therapy to cover gram-negative bacilli if they are critically ill, if they have sepsis, if they are neutropenic, if they have a femoral catheter in place, or if they have a known focus of gram-negative bacillary infection **(A-II)**.

99. Patients who are critically ill with suspected CRBSI and who have recent colonization or infection with an multi-drug-resistant gram-negative pathogen should receive 2 antimicrobial agents of different classes with gram-negative activity as initial therapy **(AII)**. De-escalation of the initial regimen to a single appropriate antibiotic is recommended once culture and susceptibility results are available **(A-II)**.

100. In patients with gram-negative bacillary CRBSI involving a long-term catheter and persistent bacteremia or severe sepsis despite systemic and antibiotic lock therapy, the device should be removed, an evaluation for endovascular infection and metastatic infection should be pursued, and the duration of antibiotic therapy should be extended beyond 7-14 days on the basis of the findings of these studies **(C-III)**.

***Candida* Species**

101. Catheters should be removed in cases of CRBSI due to *Candida* species **(A-II)**.

102. For patients with candidemia and a short-term CVC for whom no source of candidemia is obvious, the catheter should be removed and the catheter tip sent for culture **(A-II)**. Alternatively, for patients with limited venous access, exchange the catheter over a guidewire and perform catheter cultures **(BII)**. If the catheter is colonized with the same species of *Candida* as found in a percutaneous blood culture, the CVC should be removed **(A-II)**.

103. Antifungal therapy is recommended for all cases of CRBSI due to *Candida* species, including cases in which clinical manifestations of infection and/or candidemia resolve after catheter withdrawal and before initiation of antifungal therapy **(A-II)**.

Other Gram-Positive Microorganisms

104. Diagnosis of CRBSI due to *Corynebacterium*, *Bacillus* and *Micrococcus* species requires at least 2 positive results of blood cultures performed on samples obtained from different sites **(A-II)**.

105. For the management of these infections, catheter removal is indicated for patients with a short-term CVC, and it is also indicated for patients with an infected long-term catheter or implanted port, unless there are no alternative intravascular access sites **(B-III)**.

How Should You Manage Supportive Thrombophlebitis?

106. Suppurative thrombophlebitis should be suspected in patients with persistent bacteremia or fungemia (i.e., patients whose blood culture results remain positive after 72 h of adequate antimicrobial therapy) without another source of intravascular infection (e.g., endocarditis) **(A-II)**.

107. A diagnosis of suppurative thrombophlebitis requires the presence of positive blood culture results plus the demonstration of a thrombus by radiographic testing (e.g., computed tomography, ultrasonography, or other methods) **(A-II)**.

108. Surgical resection of the involved vein for patients with suppurative thrombophlebitis should be limited to patients with purulent superficial veins or patients in whom the infection extends beyond the vessel wall, as well as patients who experience failure of conservative therapy with an appropriate antimicrobial regimen **(A-II)**.

109. The role of heparin use in this setting is unresolved **(C-III)**.

110. Patients with suppurative thrombophlebitis due to CRBSI should receive a minimum of 3-4 weeks of antimicrobial therapy **(B-III)**.

How Is Persistent Bloodstream Infection and Infective Endocarditis Managed?

111 Catheter withdrawal is required in the management of catheter-related infective endocarditis **(A-II)**.

112 TEE should be done for patients with CRBSI who have any of the following: a prosthetic heart valve, pacemaker, or implantable defibrillator; persistent bacteremia or fungemia and/or fever >72 h after initiation of appropriate antibiotic therapy and catheter removal, in addition to a search for metastatic foci of infection, as indicated; and any case of *S. aureus* CRBSI in which duration of therapy less than 4-6 weeks is being considered **(A-II)**.

113 Unless the clinical condition of the patient dictates otherwise, perform a TEE at least 5-7 days after the onset of bacteremia or fungemia and consider repeating the TEE for patients with a high index of suspicion for infective endocarditis in whom the initial TEE had negative findings **(B-II)**.

114 Assess for suppurative thrombophlebitis as noted above **(B-II)**.

115 Infective endocarditis cannot be ruled out by negative transthoracic echocardiograph findings alone **(B-II)**.

How Would You Detect and Manage an Outbreak of CRBSI?

116 When extrinsic contamination of infusate or catheter flush or lock solutions is suspected, public health authorities should be alerted and the suspected product should be set aside for culture **(A-II)**.

117 Establish a case definition for patients who are likely to have been exposed, including a time period, risk factors, and location of the patients **(A-II)**.

118 A case-control study should be used to establish risk factors for infection and to help elucidate potential sources of contamination **(B-II)**.

119 Establish relatedness of the suspected organisms by reviewing the antibiotic susceptibility patterns, followed by molecular fingerprinting, such as pulsed-field gel electrophoresis, polymerase chain reaction, or multilocus sequence typing **(A-II)**.

120 Investigation of contamination involves a thorough review of potential breaches in infection control practices in the hospital pharmacy and at the point of delivery of the infusate. This requires interviews with health care personnel and observation of practices in the health care setting **(A-II)**.

121 Cultures of potential point-source contaminants in the environment should be performed, including intravenous medications administered to patients **(A-II)**.

122 During the investigation, heightened surveillance to detect new cases should be instituted **(A-II)**.

123 Following identification of a source, there should be ongoing surveillance to confirm eradication of the source of infection **(A-II)**.

Definitions:

Quality of Evidence

I. Evidence from ≥1 properly randomized, controlled trial

II. Evidence from ≥1 well-designed clinical trial, without randomization; from cohort or case-controlled analytic studies (preferably from >1 center); from multiple time series, or from dramatic results from uncontrolled experiments

III. Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees

Strength of Recommendation

A. Good evidence to support a recommendation for or against use

B. Moderate evidence to support a recommendation for or against use

C. Poor evidence to support a recommendation

Adapted from Canadian Task Force on the Periodic Health Examination.

Clinical Algorithm(s)

The original guideline contains clinical algorithms for:

- Methods for the diagnosis of acute fever for a patient suspected of having short-term central venous catheter infection or arterial catheter infection
- Management of patients with short-term central venous catheter-related or arterial catheter-related bloodstream infection
- Treatment of a patient with a long-term central venous catheter or a port-related bloodstream infection
- Catheter-related bloodstream infection among patients who are undergoing hemodialysis with tunneled catheters

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The type of supporting evidence is identified and graded for each recommendation (see "Major Recommendations").

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

- Accurate diagnosis of catheter-related bloodstream infections (CRBSI)
- Prevention of CRBSIs, which would decrease hospital costs and lengths of stay
- Appropriate and effective treatment and management of CRBSIs
- Timely detection and appropriate management of CRBSI outbreaks

Potential Harms

- False-positive results of blood culture can occur because of contamination issues.
- Treatment of catheter-associated fungemia without removal of the catheter has a low success rate and is associated with higher mortality.
- Aminoglycosides carry a substantial risk of inducing irreversible ototoxicity.
- Not all antibiotic-heparin combinations can be used for antibiotic lock, because precipitation occurs when some antibiotics are mixed with heparin, especially with increasing antibiotic concentrations.
- Inappropriate initial antibiotic therapy can result in increased morbidity and mortality.

Contraindications

Contraindications

Major contraindications to the removal of a long-term catheter due to *Staphylococcus aureus* catheter-related bloodstream infection (CRBSI) are no alternative venous access, the patient has significant bleeding diathesis, or quality of life issues take priority over the need for reinsertion of a new catheter at another site.

Qualifying Statements

Qualifying Statements

It is important to realize that guidelines cannot always account for individual variation among patients. They are not intended to supplant physician judgment with respect to particular patients or special clinical situations. The Infectious Disease Society of America (IDSA) considers adherence to these guidelines to be voluntary, with the ultimate determination regarding their application to be made by the physician in the light of each patient's individual circumstances.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Implementation Tools

Audit Criteria/Indicators

Clinical Algorithm

Personal Digital Assistant (PDA) Downloads

For information about availability, see the *Availability of Companion Documents* and *Patient Resources* fields below.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

Living with Illness

IOM Domain

Effectiveness

Identifying Information and Availability

Bibliographic Source(s)

Mermel LA, Allon M, Bouza E, Craven DE, Flynn P, O'Grady NP, Raad II, Rijnders BJ, Sherertz RJ, Warren DK. Clinical practice guidelines for the diagnosis and management of intravascular catheter-related infection: 2009 update by the Infectious Diseases Society of America [published erratum: Clin Infect Dis 2010 Feb 1;50:457]. Clin Infect Dis 2009 Jul 1;49(1):1-45. [281 references] PubMed

Adaptation

Not applicable: The guideline was not adapted from another source.

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Guideline Developer(s)

Infectious Diseases Society of America - Medical Specialty Society

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Infectious Diseases Society of America (IDSA)

Guideline Committee

Infectious Diseases Society of America (IDSA) Practice Guidelines Committee

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Financial Disclosures/Conflicts of Interest

All members of the Expert Panel complied with the Infectious Diseases Society of America (IDSA) policy on potential conflicts of interest, which requires disclosure of any financial or other interest that might be construed as constituting an actual, potential, or apparent conflict. Members of the Expert Panel were provided with the IDSA's conflict of interest disclosure statement and were asked to identify ties to companies developing products that might be affected by promulgation of the guidelines. Information was requested regarding employment, consultancies, stock ownership, honoraria, research funding, expert testimony, and membership on company advisory committees. The Expert Panel made decisions on a case-by-case basis as to whether an individual's role should be limited as a result of a conflict. Potential conflicts of interest are listed below.

L.A.M. has received research funding from Angiotech and Theravance and has served as a consultant to Cadence, Ash Access Technology, and CorMedix.

M.A. is a consultant for Angiotech and Covidien.

E.B. has served on advisory boards for or received research or conference funds from Pfizer, Merck Sharp and Dohme, Cerexa, Cardinal-Health, Sanofi-Aventis, GlaxoSmithKline, Astellas and Astra-Zeneca.

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B.J.A.R. has received research grants from Schering-Plough and Gilead Sciences; has served as a speaker for Bayer, Schering-Plough, Pfizer, and Tibotec; and has served as a consultant to Pfizer and Schering-Plough.

P.F. has clinical research contracts with MedImmune and Tibotec.

I.I.R. has received research grants from Cubist, Schering-Plough, Versicor, Enzon, Cook Medical, Schering-Plough, and Wyeth; has served on the speaker bureaus of Merck, Pfizer, Cook, and Schering-Plough; has served as a consultant to Clorox, Cubist, and Cook; and has received royalties related to patent licensed to American Medical Systems, Horizon Medical Products, and TyRx on which he is a coinventor.

D.K.W. has served on the Pfizer speaker's bureau; has received research funding from GeneOhm Sciences, Verimetrix, and Astellas Pharma; and has served as a consultant to 3M Healthcare.

N.P.O. and R.J.S.: no conflicts.

Guideline Endorser(s)

American Society of Nephrology - Professional Association

European Society of Clinical Microbiology and Infectious Diseases - Medical Specialty Society

Pediatric Infectious Diseases Society - Medical Specialty Society

Society for Healthcare Epidemiology of America - Professional Association

Society of Critical Care Medicine - Professional Association

Guideline Status

This is the current release of the guideline.

This guideline updates previous versions: Mermel LA, Farr BM, Sherertz RJ, Raad II, O'Grady N, Harris JS, Craven DE.

Guidelines for the management of intravascular catheter-related infections. Clin Infect Dis 2001 May 1;32(9):1249-72. [210 references]

Mermel LA, Farr BM, Sherertz RJ, Raad II, O'Grady N, Harris JS, Craven DE. Guidelines for the management of intravascular catheter-related infections. Infect Control Hosp Epidemiol 2001 Apr;22(4):222-42. [210 references]

Mermel LA, Farr BM, Sherertz RJ, Raad II, O'Grady N, Harris JS, Craven DE. Guidelines for the management of intravascular catheter-related infections. J Intraven Nurs 2001 Jun;24(3):180-205. [210 references]

Guideline Availability

Electronic copies: Available from the Infectious Diseases Society of America (IDSA) Web site.

Print copies: Available from Dr. Leonard Mermel, Div. of Infectious Diseases, Rhode Island Hospital, 593 Eddy St., Providence, RI 02903 (lmermel@lifespan.org).

Availability of Companion Documents

The following are available:

- A Personal Digital Assistant (PDA) version of the guideline is available from the Infectious Diseases Society Web site.

Additionally, suggested performance measures are provided in the original guideline document.

Patient Resources

None available

NGC Status

This summary was completed by ECRI on September 17, 2001. The information was verified by the guideline developer as of November 21, 2001. This summary was updated by ECRI Institute on December 11, 2009. The information was verified by the guideline developer on February 1, 2010. This summary was updated by ECRI Institute on August 18, 2010 following the U.S. Food and Drug Administration advisory on Cubicin (daptomycin). This summary was updated by ECRI Institute on November 22, 2011 following the U.S. Food and Drug Administration (FDA) advisory on Zyvox (linezolid).

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