UNITED ARAB EMIRATES
MINISTRY OF HEALTH & PREVENTION

National Guidelines on the Management of Catheter-Related Blood Stream Infections in Adults

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1. Introduction

Intravascular catheters are integral to the modern practices and are usually inserted in critically-ill patients for the administration of fluids, blood products, medication, nutritional solutions, and for hemodynamic monitoring.

Central-venous-catheter-related bloodstream infections (CRBSIs) are an important cause of hospital-acquired infection associated with morbidity, mortality, and cost. Consequences depend on associated organisms, underlying pre-morbid conditions, timeliness, and appropriateness of the treatment/interventions received.

2. Purpose & Scope:

2.1 The National Antimicrobial Stewardship Committee has compiled this guideline on the management central-venous-catheter-related bloodstream infections (CRBSIs) in adults to provide healthcare professionals with evidence-based information and recommendations for the optimal management of these serious infections. The guideline is based on the best current clinical evidence, taking into consideration the antimicrobial resistance patterns and trends in the United Arab Emirates (UAE); however, they are not intended to replace clinical expertise when making treatment decisions for individual patients, but rather help to focus decisions. This guideline is subject to revision and will be modified based on changes in international guidelines and UAE's national antibiogram.

2.2 The National Antimicrobial Stewardship Committee strongly recommends either adopting this guideline or developing/amending a facility-based guideline using this document as a reference tool.

3. Acknowledgment

This document was prepared by:

1. Dr. Moeena Zain, Consultant Infectious Diseases, American Hospital, Dubai, UAE
2. Dr. Duaa Jawhar- Infectious Disease Clinical Pharmacist, Saqr hospital, Ras Al Khaimah, Emirates Health Service, UAE
3. Dr. Alyaa Fadhil, Infectious Disease Clinical Pharmacist, Al-Zahra Private Hospital, Dubai, UAE
4. Dr. Zulfa Omar Al Deesi, Consultant Microbiologist, Head of Microbiology and Infection Control Unit , Latifa Hospital, Dubai, UAE
5. Dr Nehad Al Shirawi, Consultant Intensivist, Al Fujairah Hospital, Fujairah, Emirates Health Services, Chair of the National ASP Subcommittee, UAE
6. Dr Najiba Abdulrazzaq, Consultant Internist, Al Kuwait Hospital, Dubai, Head of Central IPC committee Emirates Health Services, Co-Chair of National AMR committee, UAE
7. Dr Pramod Chhabrani, Specialist Clinical Microbiology, Al Kuwait Hospital, Dubai, UAE

Reviewed by:

1. Dr. Ahmad Lutfi Subhi, Adult Infectious Disease Consultant, Al-Qassimi hospital, Sharjah, Chair of Central Antimicrobial stewardship committee, Emirates Health Service, UAE
2. Dr. Adnan AlAtoom, Consultant physician, clinical pathology and microbiology, Head of AJCH and Latifa laboratories, Dubai health.
3. Dr. Tehmina Khan, Consultant, Chief of Infectious Diseases, Sheikh Khalifa Medical City, Abu Dhabi, UAE

4. Policy statement:

4.1 These guidelines are applicable to adult patients presenting with clinical features and laboratory/radiological investigations compatible with the diagnosis of central-venous-catheter-related bloodstream infections (CRBSIs).

5. Definitions:

5.1 **Antibiotic Lock Therapy (ALT):** is a concentrated antibiotic solution that is injected into the catheter lumen to achieve high drug level that can eradicate the bacteria within the biofilm of the catheter.

5.2 **Central Venous Catheter (CVC):** Intravascular device that terminates at or close to the heart or one of the great vessels (Non-tunneled CVCs (subclavian, jugular, femoral), tunneled CVCs, dialysis catheter, peripherally inserted central catheters (PICCs), and implanted ports).

5.3 **Central venous catheter related bloodstream infections (CRBSIs):** An infection that originates from or is related to a central venous catheter.

6. Abbreviations:

6.1 **ALT:** Antibiotic lock therapy
6.2 **BSI:** Blood stream infections.
6.3 **CFU:** Colony forming unit.
6.4 **CoNS:** Coagulase negative *Staphylococcus.*
6.5 **CRE:** Carbapenem resistant *Enterobacterales.*
6.6 **CVC:** Central venous catheter.
6.7 **CRABSI:** Central venous catheter related bloodstream infection.
6.8 **DTP:** Differential time to positivity.
6.9 **E coli:** *Escherichia coli.*
6.10 **ESBL:** Extended Spectrum Beta Lactamase.
6.11 **G:** Grams.
6.12 **GI:** Gastrointestinal tract
6.13 **HIV:** Human immunodeficiency virus.
6.14 **HIT:** heparin induced thrombocytopenia .
6.15 **ICU:** Intensive care unit.
6.16 **ID:** Infectious disease.
6.17 **IE:** Infective endocarditis
6.18 **IMP:** Imipenemase.
6.19 **IV:** Intravenous.
6.20 **Kg:** Kilograms.
6.21 **KPC:** *Klebsiella pneumoniae* Carbapenemase.
6.22 **MDR:** Multidrug resistant.
6.23 **Mg:** Milligrams.
6.24 **MBL:** Metallo Beta Lactamase.
6.25 **MIC**: Minimum inhibitory concentration.
6.26 **MRSA:** Methicillin resistant *Staphylococcus aureus.*
6.27 **MSSA:** Methicillin sensitive *Staphylococcus aureus.*
6.28 **NDM-1:** New Delhi Metallo beta Lactamase-1.
6.29 **OXA-48:** Oxacillinase-48.
6.30 **PCR:** Polymerase chain reaction.
6.31 **PICC**: peripherally inserted central catheters.
6.32 **UTI:** Urinary tract infection.
6.33 **TMP-SMZ:** Trimethoprim Sulfamethoxazole.
6.34 **VRE:** Vancomycin resistant *Enterococcus.*
6.35 **VAD***:* Venous access devices.

7. Risk Factors for CRBSI:

7.1 Risk factors for CRBSI can be divided into host-related and catheter-related factors. Those are summarized in table 1.

7.2 Risk factors for CRBSI caused by Gram-negative organisms include:

- Hematopoietic stem cell transplant.
- Liver failure.
- Serum albumin less than 3 g/dL.
- Solid organ transplant.
- Diabetes.
- Pulmonary disease.
- Chronic hemodialysis.
- HIV infection.
- Treatment with glucocorticoids.

8. Sources of Infection in CRBSI:

8.1 There are several sources for CRBSI that include:

8.1.1 **Skin Colonization:** The most common source of CRBSI is colonization of the intracutaneous and intravascular portions of the catheter by microorganisms from the patient's skin and occasionally the hands of health care workers (on insertion or as a result of manipulation).

8.1.2 **Intraluminal Contamination:** Intraluminal and/or hub contamination is an important source of BSI CVCs that are in place for more than two weeks or in patients with a surgically implanted device.

8.1.3 **Hematogenous Seeding:** Hematogenous seeding of the device can occur during a BSI originating from another focus of infection, often from a gastrointestinal site.

8.1.4 **Infusion Contamination:** Administration of contaminated infusion or additives, such as a contaminated heparin flush, can result in a BSI.

9. Microbiology of CRBSI:

9.1 Generally Gram-positive organisms (coagulase-negative *Staphylococci, Enterococci,* and *Staphylococcus aureus*, are the most common, followed by Gram-negatives (*Klebsiella*, *Enterobacter, Pseudomonas, E. coli*, *Acinetobacter)*, and *Candida* species. Table 2 outlines the most common organisms in special population and Table 9 outlines number of top 20 blood isolate in UAE 2023.

9.2 The frequency of specific Gram-negative bacilli responsible for bacteremia differs by whether the onset of the infection is in the hospital or community and by the likely primary source of infection.

- Hospital-onset Gram-negative bacilli
  - *E. coli*.

- *K. pneumoniae*.
- *P. aeruginosa.*
- *Proteus* species.
- Other Gram-negative bacteria.

- Community-onset Gram-negative
  - *E. coli.*
  - *K. pneumoniae.*
  - *Proteus mirabilis.*
  - *Enterobacter* species.
  - *P. aeruginosa. (rare)*

9.3 The frequency of Gram-negative bacilli in ICU patients, caused by *P. aeruginosa* is frequently higher. Patients in the ICU frequently are on or have recently been on antibiotics, which increase the risk of infections with P. aeruginosa and other nonfermenting Gram-negative bacilli, such as *Acinetobacter s*pecies, that have intrinsic or acquired resistance to commonly used agents. ICU-onset Gram-negative related CRBSI include:

- *P. aeruginosa.*
- *Enterobacter* species.
- *K. pneumoniae.*
- *E. coli.*
- *Serratia marcescens.*

9.4 Rapid diagnostics from a positive blood culture significantly reduces time to identification of microorganisms and has clinical impact on the management of patients with suspected bloodstream infection.

9.5 If the catheter tip culture is positive but the blood cultures are negative, antibiotic treatment (e.g. 5–7 days) shall be given to patients with catheter tip cultures positive for *S. aureus* and negative blood cultures if the patient shows systemic signs of infection or signs of local infection.

9.6 In non-neutropenic patients or those without valvular heart disease, the presence of a catheter tip culture positive for *Candida* spp. and negative or unavailable blood cultures should be assessed on an individual basis before starting systematic antifungal treatment. Antifungal treatment should not be prescribed for patients without systemic signs of infection.

9.7 No clear recommendations can be given for catheters colonized with other microorganisms.

9.8 Follow-up blood cultures

9.8.1 In both MSSA and MRSA CRBSI, blood cultures should be obtained after 48- 72 hours of antibiotic therapy and every 72 hours until the first negative result.

9.8.2 Blood cultures in CRBSI due to *Candida* spp should be obtained every 48 hours until the first negative blood culture.

9.8.3 For other causative microorganisms of CRBSI and if catheter salvage is attempted, follow-up blood cultures should be obtained 72 hours after starting appropriate

antibiotic therapy. If persistent bacteremia is documented, catheter removal is required.

9.8.4 It is not necessary to routinely perform follow-up blood cultures in patients with CRBSI due to microorganisms other than S. aureus or Candida spp if the catheter has been removed.

9.8.5 The microbiological diagnosis of CRBSI is shown in Table 3, and the interpretation of these results is summarized in Table 4

10. Principles of Treatment:

10.1 In general, management of CRBSI consists of catheter removal and systemic antibiotic therapy.

10.2 **Complicated or Uncomplicated CRBSI:** For infections due to organisms other than *Staphylococcus aureus*, we consider uncomplicated infections to meet the following criteria:

- Catheter is removed (or retained but showing clear clinical response within 48-72hours)
- Negative blood cultures after 48-72hours of appropriate antimicrobial therapy
- No evidence of suppurative thrombophlebitis
- No metastatic infection (e.g. Osteomyelitis, septic arthritis, epidural abscess)
- No evidence of endocarditis confirmed by absence of vegetations on echocardiography
- Patient is not immunocompromised to the degree that would alter the course (not severely neutropenic, not a transplant recipient, no prosthetic intravascular devices)

For infections due to *S. aureus*, an additional criterion for uncomplicated CRBSI is an echocardiogram without evidence of endocarditis.

10.3 **Indications for ID consultation**:

ID consultation shall be pursued in the following circumstances:

- Infection due to *Staphylococcus aureus*, *Pseudomonas aeruginosa,* drug-resistant Gram-negative bacilli, or *Candida* spp.
- Patients who are unable to undergo catheter removal.
- Patients with endovascular implant or orthopedic hardware.
- Patients with complications of bloodstream infection such as infective endocarditis (IE), septic thrombophlebitis, metastatic musculoskeletal infection, mycotic aneurysm, or vascular graft infection.

11. Empiric Antimicrobial Management of CRBSI:

11.1 **Empiric Treatment for CRBSI:** The antibiotic choice for empirical therapy for suspected CRBSI depends on an individual patient's risk factors for infection, underlying diseases, known allergies, documented past colonization or infection with resistant organisms, and likely pathogens associated with the specific CVC type.

11.2 Empiric antibiotic therapy for treatment of CRBSI should be guided by Gram stain results, if available and positive for microorganisms.

11.3 **Empiric Gram positive Therapy:** Vancomycin /Teicoplanin are recommended for empirical therapy in health care settings with an elevated prevalence of MRSA; for institutions in which the preponderance of MRSA isolates have Vancomycin MIC values >2 µg/mL, alternative agents, such as daptomycin, shall be used. In UAE, in general VRE rates are low. Linezolid is not an appropriate agent for empiric therapy of CRBSI.

11.4 **Empiric Gram Negative Therapy**: Empirical coverage for Gram-negative bacilli shall 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). Empirical coverage for multidrug-resistant Gram-negative bacilli, including *Pseudomonas aeruginosa,* shall be considered for patients who are neutropenic, septic, or known to be colonized with such pathogens.

11.5 For patients with hemodynamic instability and in health care settings where local resistance suggests < 90 percent susceptibility to antipseudomonal Beta-Lactams, administration of a second antipseudomonal agent (such as an Aminoglycoside) is appropriate while awaiting culture results; once susceptibilities are known, monotherapy shall be considered.

11.6 In patients without neutropenia, severe burns, or hemodynamic instability, it is reasonable to use a third/fourth generation cephalosporin (guided by the local antibiogram) combined with an aminoglycoside or monotherapy with another agent active against Gram-negative bacteria. Routine empiric coverage for *Pseudomonas* is generally not required.

11.7 Patients known to be colonized with drug-resistant organisms (e.g., within the past 6 months) shall receive empiric antibiotic therapy selected accordingly.

11.8 In addition to coverage for Gram-positive pathogens, empirical therapy for suspected CRBSI involving femoral catheters in critically ill hemodynamic unstable patients shall include coverage for Gram-negative bacilli and *Candida* species.

11.9 Consider empiric combination therapy with 2 anti-pseudomonal therapy if any of the following present:

- Immunocompromised patient.
- Health care exposure in prior three to six months.
- Infection with *P. aeruginosa* in prior three to six months.
- Institutional prevalence of resistant Gram-negative bacilli >20%.

11.10 **Empiric Antifungal Therapy:** Empirical coverage for suspected catheter-related candidemia shall be used for septic patients who receive parenteral nutrition or

have had prolonged broad-spectrum antibiotics, a hematologic malignancy, any transplant, or colonization due to *Candida* species at multiple sites.

11.11 For empirical treatment of suspected catheter related candidemia an echinocandin is recommended as initial therapy. Fluconazole can be considered as alternative in non-critically ill patients who are considered unlikely to have a fluconazole-resistant Candida species or without azole exposure in the previous 3 months. Transition from an echinocandin to fluconazole usually within 5–7 days after initiation is recommended for patients who are clinically stable, have isolates that are susceptible to fluconazole, and have negative repeat blood cultures following initiation of antifungal therapy. Among patients with suspected azole and echinocandin resistant Candida infections, lipid formulation amphotericin B is recommended.

11.12 **Duration of Treatment:** Duration of treatment often changes with whether the infection is uncomplicated or complicated. Duration of therapy should be determined by the clinical response of the patient in addition to the primary source and extent of infection. Recommended duration of therapy for candidemia without obvious metastatic complications is for 2 weeks after documented clearance of Candida species from the bloodstream and resolution of symptoms attributable to candidemia)

11.13 For patients with uncomplicated *Enterobacteriaceae* bacteremia who respond appropriately to antibiotic therapy (see section on complicated CRBSI above), a 7- rather than 14-day course is suggested.

11.14 Four to 6 weeks of antibiotic therapy should be administered to patients with persistent fungemia or bacteremia after catheter removal (e.g. occurring >72 h after catheter removal) and to patients who are found to have infective endocarditis, suppurative thrombophlebitis, or osteomyelitis.

12. Targeted Antimicrobial Management of CRBSI:

12.1 Once microbiology results are available, antimicrobial treatment should be tailored to the results.

12.2 Table 5 summarizes targeted antimicrobial management for CRBSI caused by Gram-positive organisms and table 6 for that caused by Gram-negative organisms.

13. Selecting a Catheter Management Strategy:

13.1 **Removal**: Catheter removal (in addition to administration of systemic antimicrobial therapy) is warranted in the following circumstances, given high likelihood of progressive infection with antibiotic therapy alone:

- Sepsis.
- Hemodynamic instability.

- Presence of concomitant endocarditis or evidence of metastatic infection.
- Presence of suppurative thrombophlebitis.
- Presence of a propagating clot.
- Persistent bacteremia after 72 hours of appropriate antimicrobial therapy.
- Subcutaneously tunneled central venous catheter tunnel tract infection or subcutaneous port reservoir infection.
- Infection with the following pathogens, given relatively high virulence and relatively low likelihood of treatment response with antibiotic therapy alone:
  - *S. aureus.*
  - *P. aeruginosa.*
  - Drug-resistant Gram-negative bacilli.
  - *Candida* spp.
  - *Mycobacteria* spp

13.2 In patients with CRBSI due to S. aureus, catheter retention has been associated with a low success rate; most patients eventually relapse and require removal of the catheter.

13.3 The Gram-negative bacilli most associated with CRBSI are those that form biofilms, including *Klebsiella, Pseudomonas, and Acinetobacter* species; catheters should be removed for infections with these organisms.

13.4 In patients with CRBSI due to organisms of relatively low virulence that are difficult to eradicate (such as *Bacillus* spp, *Micrococcus* spp, or *Cutibacterium* spp [formerly *Propionibacterium* spp]), catheter removal may be warranted if bacteremia persists and blood culture contamination has been ruled out (e.g., based on multiple positive culture results with at least one sample drawn from a peripheral vein).

13.5 Catheter removal is not necessary for patients with unexplained fever who are hemodynamically stable in the absence of documented bloodstream infection.

13.6 Catheter salvage also should not be attempted for long-term catheters when there are signs or symptoms of exit site or tunnel infections, or a pocket infection.

13.7 **Salvage:** Catheter salvage refers to retention of the catheter while treating the CRBSI. This may occur if f catheter removal is not feasible (eg, there is no alternative access site or sites are limited, the patient has a bleeding diathesis, patient declines removal, or quality of life issues take priority over the need for catheter reinsertion at another site). Antibiotic lock therapy (ALT) in addition to systemic antimicrobial therapy should be given if catheter salvage is attempted.

13.8 Catheter Salvage may be attempted in:

- CRBSI due CoNS and drug-susceptible Enterobacteriaceae (eg, *E. coli, Klebsiella* species, *Enterobacter* species) which is uncomplicated.
- In patients with CRBSI due to *Enterococcus* spp, catheter removal is preferred; however, catheter salvage may be attempted in patients for whom catheter removal is not readily feasible

13.9 Guidewire exchange of the catheter should not be performed in patients with a condition warranting catheter removal.

13.10 Table 7 summarizes catheter management strategies.

14. Antibiotics Lock therapy

14.1 Antibiotic lock therapy (ALT) provides a concentrated antibiotic solution into the catheter lumen to achieve high drug level that can eradicate the bacteria within the biofilm of the catheter.

14.2 Antibiotic lock solution should be withdrawn (not flushed into the vein) before utilizing the catheter for intravenous access to avoid systemic exposure of high concentrations of antibiotics and/or anticoagulants.

14.3 The selection of antibiotic for ALT shall be guided by the antimicrobial susceptibility of the infecting organism.

14.4 Heparin can be added to ALT solutions to help maintain catheter patency; unless the patient has a contraindication to heparin, heparin-induced thrombocytopenia (HIT) or high bleeding risk).

14.5 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.

14.6 Table 8 outlines antimicrobial lock therapy.

15. Procedure and Responsibility:

	Procedure	Responsibilities
14.1	Assessment of patient's risk factors for infection, underlying diseases, documented allergies, past colonization or infection with resistant organisms shall be considered in decision to treat CRBSI and selection of empiric therapy. (Table 1-2)	Physician
14.2	IV Vancomycin/Teicoplanin is preferred as empiric Gram positive antibiotic choice. Linezolid is reserve antibiotic as per WHO-AWaRe classification and not an appropriate agent for management of CRBSI empirically.	Physician
14.3	Intravenous Ceftriaxone is preferred as empiric Gram-negative antibiotic in absence of neutropenia, severe burns, or hemodynamic instability. Antipseudomonal Beta-Lactams with/without Aminoglycoside can be considered for hemodynamic instability patients while awaiting culture results.	Physician
14.4	Empiric Antifungal can be considered for septic patients who receive parenteral nutrition, have had prolonged broad-spectrum antibiotics, hematologic malignancy, any transplant, or colonization due to Candida species at multiple sites. Echinocandin is preferred as initial therapy. Fluconazole can be considered as alternative in non-	Physician

	critically ill patients who are considered unlikely to have a fluconazole-resistant Candida species or without azole exposure in the previous 3 months. In patient with Echinocandin transition to fluconazole is recommended within 5–7 days after initiation for patients who are clinically stable, have isolates that are susceptible to fluconazole, and have negative repeat blood cultures.	
14.5	Consider streamline of empiric antibiotic therapy with respect of culture and sensitivity report (Table 5-6)	Physician
14.6	Catheter removal highly recommended as part of management of CRBSI. (Table 7)	Physician
14.7	Antibiotic lock therapy shall be considered whenever catheter removal is not applicable. The selection of agent to be guided by culture and sensitivity report (Table 8)	Physician Clinical Pharmacist / Pharmacotherapy specialist
14.8	Obtain blood culture sample prior start antibiotic and as per best practice recommendation (Table 3)	Nurse Phlebotomy Technician
14.9	Review antibiotic order for appropriateness in selection, dose, duration and provide feedback accordingly. Recommend for culture streamline upon release of culture result. Provide guidance in therapeutic drug monitoring service. Ensure availability of antibiotic agents for the treatment of CRBSI.	Clinical Pharmacist / Pharmacotherapy specialist
14.10	Facility Antibiotic Stewardship committee shall adapt the guideline with respect of facility antibiogram, and assure adequate effort to make it accessible e.g. integration in electronic medical record, facility intranet.	Facility Antibiotic Stewardship committee

16. References:

16.1 Mermel, L. A., Allon, M., Bouza, E., etal (2009). Clinical practice guidelines for the diagnosis and management of intravascular catheter-related infection: 2009 Update by the Infectious Diseases Society of America. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America, 49(1), 1–45.

16.2 Evans, L., Rhodes, A., Alhazzani, W., etal (2021). Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock 2021. Critical care medicine, 49(11), e1063–e1143.

16.3 Holland TL, Raad I, Boucher HW, etal. (2018) Staphylococcal Bacteremia Investigators. Effect of Algorithm-Based Therapy vs Usual Care on Clinical Success and Serious Adverse Events in Patients with Staphylococcal Bacteremia: A Randomized Clinical Trial. JAMA. Sep 25;320(12):1249-1258.

16.4 Mandells, Mandell, Douglas, and Bennett's: Principles and Practice of Infectious Diseases, Ninth Edition, Chapter 300, pg 3570-3571

16.5 Heil, E. L., Bork, J. T., Abbo, L. M., etal. (2021). Optimizing the Management of Uncomplicated Gram-Negative Bloodstream Infections: Consensus Guidance Using a Modified Delphi Process. Open forum infectious diseases, 8(10), ofab434.

16.6 Rijnders, B. J., Peetermans, W. E., Verwaest, C., etal. (2004). Watchful waiting versus immediate catheter removal in ICU patients with suspected catheter-related infection: a randomized trial. Intensive care medicine, 30(6), 1073–1080.

16.7 Krishnasami, Z., Carlton, D., Bimbo, L., etal (2002). Management of hemodialysis catheter-related bacteremia with an adjunctive antibiotic lock solution. Kidney international, 61(3), 1136–1142.

16.8 Luther, M. K., Mermel, L. A., & LaPlante, K. L. (2017). Comparison of linezolid and vancomycin lock solutions with and without heparin against biofilm-producing bacteria. American journal of health-system pharmacy: AJHP: official journal of the American Society of Health-System Pharmacists, 74(9), e193–e201.

16.9 Vercaigne, L. M., Sitar, D. S., Penner, S. B., etal (2000). Antibiotic-heparin lock: in vitro antibiotic stability combined with heparin in a central venous catheter. Pharmacotherapy, 20(4), 394–399.

16.10 LaPlante, K. L., & Mermel, L. A. (2007). In vitro activity of daptomycin and vancomycin lock solutions on staphylococcal biofilms in a central venous catheter model. Nephrology, dialysis, transplantation: official publication of the European Dialysis and Transplant Association - European Renal Association, 22(8), 2239–2246.

16.11 Lee, M. Y., Ko, K. S., Song, J. H., & Peck, K. R. (2007). In vitro effectiveness of the antibiotic lock technique (ALT) for the treatment of catheter-related infections by Pseudomonas aeruginosa and Klebsiella pneumoniae. The Journal of antimicrobial chemotherapy, 60(4), 782–787.

16.12 Lee, J. Y., Ko, K. S., Peck, K. R., etal (2006). In vitro evaluation of the antibiotic lock technique (ALT) for the treatment of catheter-related infections caused by staphylococci. The Journal of antimicrobial chemotherapy, 57(6), 1110–1115.

16.13 Girand HL. Lock therapy for treatment and prevention of intravascular non-hemodialysis catheter-related infection. UpToDate. Jul 2024

16.14 Raad, I., Chaftari, A. M., Zakhour, R., etal (2016). Successful Salvage of Central Venous Catheters in Patients with Catheter-Related or Central Line-Associated Bloodstream Infections by Using a Catheter Lock Solution Consisting of Minocycline, EDTA, and 25% Ethanol. Antimicrobial agents and chemotherapy, 60(6), 3426–3432.

16.15 Justo, J. A., & Bookstaver, P. B. (2014). Antibiotic lock therapy: review of technique and logistical challenges. Infection and drug resistance, 7, 343–363.

16.16 Mermel, L. A., Allon, M., Bouza, E., etal (2009). Clinical practice guidelines for the diagnosis and management of intravascular catheter-related infection: 2009 Update by the Infectious Diseases Society of America. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America, 49(1), 1–45.

16.17 Chaves, F., Garnacho-Montero, J., Del Pozo, J. L., etal. (2018). Executive summary: Diagnosis and Treatment of Catheter-Related Bloodstream Infection: Clinical Guidelines of the Spanish Society of Clinical Microbiology and Infectious Diseases (SEIMC) and the Spanish Society of Intensive Care Medicine and Coronary Units

(SEMICYUC). Enfermedades infecciosas y microbiologia clinica (English ed.), 36(2), 112–119.

16.18 Calderwood MS. Intravascular non-hemodialysis catheter-related infection: Treatment. UpToDate. Jul 2024

16.19 Ha, S., Huh, K., Chung, D. R., etal. (2022). Efficacy of teicoplanin in bloodstream infections caused by Enterococcus faecium: posthoc analysis of a nationwide surveillance. International journal of infectious diseases: IJID: official publication of the International Society for Infectious Diseases, 122, 506–513.

16.20 McCarthy, A., Rao, J. S., Byrne, M., etal. (1998). Central venous catheter infections treated with teicoplanin. European journal of haematology. Supplementum, 62, 15–17.

16.21 Tufariello JM, Lowy FD. Infection due to coagulase-negative staphylococci: treatment. Connor RF, ed. UpToDate. Waltham, MA: UpToDate Inc. http://www.uptodate.com. Accessed December 17, 2025.

16.22 Jumah, M. T. B., Vasoo, S., Menon, S. R., etal. (2018). Pharmacokinetic/Pharmacodynamic Determinants of Vancomycin Efficacy in Enterococcal Bacteremia. Antimicrobial agents and chemotherapy, 62(3), e01602-17.

16.23 Nakakura, I., Sakakura, K., Imanishi, K., etal (2019). Association between vancomycin pharmacokinetic/pharmacodynamic parameters, patient characteristics, and mortality in patients with bacteremia caused by vancomycin-susceptible Enterococcus faecium: a single-center retrospective study. Journal of pharmaceutical health care and sciences, 5, 8.

16.24 Kang, C. I., Kim, S. H., Park, W. B etal (2005). Bloodstream infections caused by antibiotic-resistant Gram-negative bacilli: risk factors for mortality and impact of inappropriate initial antimicrobial therapy on outcome. Antimicrobial agents and chemotherapy, 49(2), 760–766.

16.25 Graff, L. R., Franklin, K. K., Witt, L., etal. (2002). Antimicrobial therapy of Gram-negative bacteremia at two university-affiliated medical centers. The American journal of medicine, 112(3), 204–211.

16.26 Vidal, F., Mensa, J., Almela, M., etal. (2003). Bacteraemia in adults due to glucose non-fermentative Gram-negative bacilli other than P. aeruginosa. QJM: monthly journal of the Association of Physicians, 96(3), 227–234.

16.27 Shorr, A. F., Tabak, Y. P., Killian, A. D., etal. (2006). Healthcare-associated bloodstream infection: A distinct entity? Insights from a large U.S. database. Critical care medicine, 34(10), 2588–2595.

16.28 Luzzaro, F., Viganò, E. F., Fossati, D., etal. (2002). Prevalence and drug susceptibility of pathogens causing bloodstream infections in northern Italy: a two-year study in 16 hospitals. European journal of clinical microbiology & infectious diseases: official publication of the European Society of Clinical Microbiology, 21(12), 849–855.

16.29 Sievert, D. M., Ricks, P., Edwards, J. R., etal. (2013). Antimicrobial-resistant pathogens associated with healthcare-associated infections: summary of data reported to the National Healthcare Safety Network at the Centers for Disease

Control and Prevention, 2009-2010. Infection control and hospital epidemiology, 34(1), 1–14.

16.30 Adams-Sapper, S., Sergeevna-Selezneva, J., Tartof, S., etal. (2012). Globally dispersed mobile drug-resistance genes in Gram-negative bacterial isolates from patients with bloodstream infections in a US urban general hospital. Journal of medical microbiology, 61(Pt 7), 968–974.

16.31 Perez, F., Endimiani, A., Ray, A. J., etal. (2010). Carbapenem-resistant Acinetobacter baumannii and Klebsiella pneumoniae across a hospital system: impact of post-acute care facilities on dissemination. The Journal of antimicrobial chemotherapy, 65(8), 1807–1818.

16.32 Won, S. Y., Munoz-Price, L. S., Lolans, K., etal. (2011). Emergence and rapid regional spread of Klebsiella pneumoniae carbapenemase-producing Enterobacteriaceae. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America, 53(6), 532–540.

16.33 Rodríguez-Baño, J., Picón, E., Gijón, P., etal. (2010). Community-onset bacteremia due to extended-spectrum beta-lactamase-producing Escherichia coli: risk factors and prognosis. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America, 50(1), 40–48.

16.34 Qureshi, Z. A., Paterson, D. L., Peleg, A. Y., etal. (2012). Clinical characteristics of bacteraemia caused by extended-spectrum β-lactamase-producing Enterobacteriaceae in the era of CTX-M-type and KPC-type β-lactamases. Clinical microbiology and infection: the official publication of the European Society of Clinical Microbiology and Infectious Diseases, 18(9), 887–893.

16.35 Paterson, D. L., Ko, W. C., Von Gottberg, A., etal. (2004). Antibiotic therapy for Klebsiella pneumoniae bacteremia: implications of production of extended-spectrum beta-lactamases. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America, 39(1), 31–37.

16.36 Centers for Disease Control and Prevention (CDC) (2009). Guidance for control of infections with carbapenem-resistant or carbapenemase-producing Enterobacteriaceae in acute care facilities. MMWR. Morbidity and mortality weekly report, 58(10), 256–260.

16.37 Stewart, A. G., Paterson, D. L., Young, B., etal. (2021). Meropenem Versus Piperacillin-Tazobactam for Definitive Treatment of Bloodstream Infections Caused by AmpC β-Lactamase-Producing Enterobacter spp, Citrobacter freundii, Morganella morganii, Providencia spp, or Serratia marcescens: A Pilot Multicenter Randomized Controlled Trial (MERINO-2). Open forum infectious diseases, 8(8), ofab387.

16.38 Kalil, A. C., Metersky, M. L., Klompas, M., etal. (2016). Management of Adults with Hospital-acquired and Ventilator-associated Pneumonia: 2016 Clinical Practice Guidelines by the Infectious Diseases Society of America and the American Thoracic Society. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America, 63(5), e61–e111.

16.39 Hamrick, J. C., Docquier, J. D., Uehara, T., etal. (2020). VNRX-5133 (Taniborbactam), a Broad-Spectrum Inhibitor of Serine- and Metallo-β-Lactamases, Restores Activity

of Cefepime in Enterobacterales and Pseudomonas aeruginosa. Antimicrobial agents and chemotherapy, 64(3), e01963-19.

16.40 Jean, S. S., Gould, I. M., Lee, W. S., etal. (2019). New Drugs for Multidrug-Resistant Gram-Negative Organisms: Time for Stewardship. Drugs, 79(7), 705–714.

16.41 Livermore, D. M., Meunier, D., Hopkins, K. L., Doumith, M., Hill, R., Pike, R., Staves, P., & Woodford, N. (2018). Activity of ceftazidime/avibactam against problem Enterobacteriaceae and Pseudomonas aeruginosa in the UK, 2015-16. The Journal of antimicrobial chemotherapy, 73(3), 648–657.

16.42 Falagas, M. E., Tansarli, G. S., Ikawa, K., etal. (2013). Clinical outcomes with extended or continuous versus short-term intravenous infusion of carbapenems and piperacillin/tazobactam: a systematic review and meta-analysis. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America, 56(2), 272–282.

16.43 Livermore, D. M., Mushtaq, S., Meunier, D., etal. (2017). Activity of ceftolozane/tazobactam against surveillance and 'problem' Enterobacteriaceae, Pseudomonas aeruginosa and non-fermenters from the British Isles. The Journal of antimicrobial chemotherapy, 72(8), 2278–2289.

16.44 Tsuji, B. T., Pogue, J. M., Zavascki, A. P., etal. (2019). International Consensus Guidelines for the Optimal Use of the Polymyxins: Endorsed by the American College of Clinical Pharmacy (ACCP), European Society of Clinical Microbiology and Infectious Diseases (ESCMID), Infectious Diseases Society of America (IDSA), International Society for Anti-infective Pharmacology (ISAP), Society of Critical Care Medicine (SCCM), and Society of Infectious Diseases Pharmacists (SIDP). Pharmacotherapy, 39(1), 10–39.

16.45 Falagas, M. E., & Kasiakou, S. K. (2006). Use of international units when dosing colistin will help decrease confusion related to various formulations of the drug around the world. Antimicrobial agents and chemotherapy, 50(6), 2274–2275.

16.46 Kassamali, Z., Rotschafer, J. C., Jones, R. N., etal. (2013). Polymyxins: wisdom does not always come with age. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America, 57(6), 877–883.

16.47 Nation, R. L., Li, J., Cars, O., etal. (2014). Consistent global approach on reporting of colistin doses to promote safe and effective use. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America, 58(1), 139–141.

16.48 Nation, R. L., Garonzik, S. M., Thamlikitkul, V., etal (2017). Dosing guidance for intravenous colistin in critically-ill patients. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America, 64(5), 565–571.

16.49 Chaves, F., Garnacho-Montero, J., Del Pozo, J. L., etal. (2018). Executive summary: Diagnosis and Treatment of Catheter-Related Bloodstream Infection: Clinical Guidelines of the Spanish Society of Clinical Microbiology and Infectious Diseases (SEIMC) and the Spanish Society of Intensive Care Medicine and Coronary Units (SEMICYUC). Enfermedades infecciosas y microbiologia clinica (English ed.), 36(2), 112–119.

16.50 Lorente, L., Lecuona Fernandez, M., González-Mesa, A., etal. (2024). Adding vortexing to the Maki technique provides no benefit for the diagnosis of catheter

colonization or catheter-related bacteremia. World journal of critical care medicine, 13(1), 89085.

16.51 Baang, J. H., Inagaki, K., Nagel, J., etal. (2023). Inpatient Diagnosis and Treatment of Catheter-Related Bloodstream Infection. Michigan Medicine University of Michigan.

16.52 Haddadin, Y., Annamaraju, P., & Regunath, H. (2022). Central Line–Associated Blood Stream Infections. In StatPearls. Treasure Island (FL): StatPearls Publishing.

16.53 M. Milupi.Management of Catheter Related Bloodstream Infection (CRBSI), including Antibiotic Lock Therapy.2021 , NHS Foundation

16.54 European Medicine Agency (EMA). European Medicines Agency completes review of polymyxin-based medicine. Published October 24, 2014.

16.55 Tamma, P., Heil, E., Justo, J. etal. (2024) Infectious Diseases Society of America 2024 Guidance on the Treatment of Antimicrobial-Resistant Gram-Negative Infections, Clinical Infectious Diseases;ciae403

16.56 Senok A, etal Clinical Impact of the BIOFIRE Blood Culture Identification 2 Panel in Adult Patients with Bloodstream Infection: A Multicentre Observational Study in the United Arab Emirates. Diagnostics (Basel). 2023 Jul 21;13(14):2433.

16.57 Rhoads DD, etal. Multicenter Evaluation of the BIOFIRE Blood Culture Identification 2 Panel for Detection of Bacteria, Yeasts, and Antimicrobial Resistance Genes in Positive Blood Culture Samples. J Clin Microbiol. 2023 Jun 20;61(6):e0189122.

16.58 Peri, A.M., etal. Performance of BioFire Blood Culture Identification 2 Panel (BCID2) for the detection of bloodstream pathogens and their associated resistance markers: a systematic review and meta-analysis of diagnostic test accuracy studies. BMC Infect Dis 22, 794 (2022).

16.59 Ruiz-Aragón J, Ballestero-Téllez M, Gutiérrez-Gutiérrez B, etal. Direct bacterial identification from positive blood cultures using matrix-assisted laser desorption/ionization time-of-flight (MALDI-TOF) mass spectrometry: A systematic review and meta-analysis. (2018) Enferm Infecc Microbiol Clin (Engl Ed). Oct;36(8):484-492.

16.60 Yo CH, Shen YH, Hsu WT, etal. (2022) MALDI-TOF mass spectrometry rapid pathogen identification and outcomes of patients with bloodstream infection: A systematic review and meta-analysis. Microb Biotechnol.15(10):2667-2682.

16.61 Nafcillin [package insert]. Dayton, NJ: AuroMedics Pharma LLC; 2013.

16.62 Ampicillin [package insert]. New York, NY: Pfizer Inc; 2010.

16.63 Ceftriaxone [package insert]. Lake Forest, IL: Hospira Worldwide Inc; 2015.

16.64 The Sanford Guide to antimicrobial therapy mobile app. USA.2024

16.65 Association for Professionals in Infection Control and Epidemiology, central line-associated bloodstream infection prevention bundle, October 2024

16.66 Centers for Disease Control and Prevention. Intravascular Catheter-related Infection (BSI) Prevention Guidelines. April 12, 2024.

16.67 Buetti N, Marschall J, Drees M, et al. Strategies to prevent central line-associated bloodstream infections in acute-care hospitals: 2022 Update. Infection Control & Hospital Epidemiology. 2022;43(5):553-569. doi:10.1017/ice.2022.87.

16.68 Infusion Nurses Society. Infusion Therapy Standards of Practice, 9th Edition. 2024.

16.69 Miller JM, Binnicker MJ, Campbell S, etal. Guide to Utilization of the Microbiology Laboratory for Diagnosis of Infectious Diseases: 2024 Update by the Infectious Diseases Society of America (IDSA) and the American Society for Microbiology (ASM). Clin Infect Dis. 2024 Mar 5:ciae104.

16.70 Gilbert DN, Chambers HF, Saag M , et al. Sanford guide antimicrobial therapy. USA, App Version: 7.1.1; 2025

17. Tools/Attachments Forms:

17.1 Table 1: Risk Factors for CRBSIs
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18. Key Performance Indicators:

18.1 Infection prevention and control measures, along with antimicrobial stewardship programs, shall be implemented across all healthcare facilities. These programs require consistent and systematic monitoring to evaluate both compliance and effectiveness. Monitoring of antibiotic usage shall be conducted, with feedback provided by the ASP team (e.g., in real-time, weekly, or every 3 to 6 months), along with data on resistance surveillance and outcome metrics.

Table 1: Risk Factors for Catheter Related Blood Stream Infections

Host-Related	• Chronic illness • Bone marrow transplantation • Immune deficiency, especially neutropenia • Malnutrition • Total parenteral nutrition administration • Previous blood-stream infection • Extremes of age • Loss of skin integrity, as with burns
Catheter-Related	• Duration of catheterization • Type of catheter material • Conditions of insertion • Catheter-site care • Skill of the catheter inserter • Number of lumens in the catheter • Thrombosis of the catheter • Repeated catheterization • Increased manipulation of the catheter • Presence of septic foci elsewhere

Table 2: Microbiology of CRBSI in Special Population

Burn	• *Pseudomonas aeruginosa*
Hematologic and nonhematologic malignancies	• Gram-negative organisms
Needleless access devices	• *Pseudomonas* species • *Klebsiella* species • *Stenotrophomonas (Xanthomonas)* species • *Acinetobacter* species • *Serratia marcescens*
High concentration of glucose in intravenous hyperalimentation	• *Candida* species

Table 3: Microbiological Samples

Source of Sample	Method	Comments
Blood cultures	• Paired blood cultures set (within 15 min of each other) with the same volume of blood should be drawn from a peripheral site and the central line if catheter infection is suspected. • If the catheter has more than one lumen, then through each lumen in addition to the peripheral set. • Blood culture should be obtained from dialysis circuit if patient is on hemodialysis.	• In any patient with a CVC and clinical suspicion for line infection, blood cultures should be drawn. • Do not draw blood cultures via a CVC in situations where a CRBSI is not suspected (e.g., surveillance cultures in an asymptomatic patient, or cultures performed to evaluate a specific infection, such as blood cultures done to evaluate a suspected pneumonia). • Blood cultures should be obtained before the initiation of antibiotics, unless the patient is unstable or critically ill (necessitating immediate initiation of antimicrobials, regardless of whether blood cultures have been obtained). • Unless there is an urgent need for central vascular access, new central vascular catheter placement should be delayed until at least 48 hours after the first negative blood cultures when treating any bacteremia, including CVC-related bacteremia. • Whenever possible, paired blood samples from the CVC and a peripheral vein should be obtained for a CRBSI diagnosis in hemodialysis patients. • Peripheral blood samples should be obtained from veins that are not intended for future creation of dialysis fistulae or grafts. • The veins of the hand for outpatients and hand or femoral veins for hospital inpatients should be used to obtain peripheral blood cultures. • If a blood sample cannot be drawn from a peripheral vein, two separate samples should be drawn, 10–15 min apart, through the CVC or the dialysis circuit connected to the catheter.

Line Tip	If the line is being removed: send the distal 5cm of the line tip plus a peripheral blood culture	• The most reliable diagnostic methodologies are the semiquantitative (roll plate) or quantitative (vortex or sonication methods) catheter culture techniques. • Qualitative cultures (culture of the catheter tip by broth immersion) are unreliable for distinguishing between contamination and infection and are not therefore suitable for the diagnosis of CRBSI.
Skin Swab	• When catheter infection is suspected if exit site is red, painful and there is exudate or discharging pus at the catheter insertion site, it should be sent for Gram staining and culture. • Blood cultures should also be drawn.	
Venous access devices removed for suspected CRBSI	• Venous access devices (VAD) removed for suspected CRBSI should be sent to the microbiology laboratory. • Routine processing should include a combination of cultures from different parts of the VAD, including a culture after septum sonication and semiquantitative catheter tip cultures.	

Table 4: Interpretation of Microbiological Results

Type of Culture	Interpretation
Paired Blood Culture	• Numerous diagnostic techniques for catheter cultures have been described and may provide adjunctive evidence of catheter-associated BSI; however, all have potential pitfalls that make interpretation of results problematic. • Isolation of the same organism with a shorter time to positive culture (>2 hours earlier) in the central line sample than the peripheral sample differential time to positivity (DTP) indicates a high probability of catheter-associated BSI . • An optimal DTP cut-off for the diagnosis of catheter-related candidemia has not been established. • The interpretation of DTP should consider adherence to the procedural technique used and the type of microorganism.
Line Tip	• The presence of 15 CFU per plate or more by semiquantitative culture (Maki et al. roll-plate method) is indicative of significant catheter colonization. • For quantitative culture methods based on vortexing or flushing the internal surface, a count of 10^3 CFU/segment or more reflects significant catheter colonization. • For quantitative culture methods based on sonication, counts above 10^2 CFU/segment indicate significant catheter colonization. • Isolation of the same organism from percutaneous blood culture and quantitative (>15 CFU) culture of the catheter tip indicates a high probability of catheter-associated BSI .

Table 5: Targeted Antimicrobials for CRBSI caused by Gram Positive Organisms

Organisms	Patient without Penicillin Allergy	Patients with Severe Penicillin Allergy	Comments
Coagulase-negative *Staphylococci* (CoNS)	**Methicillin susceptible** Nafcillin IV 2 g q4h **OR** Oxacillin IV 2 g q4h **OR** Cefazolin IV 2 g q8h **Methicillin resistant** Vancomycin IV **OR** Teicoplanin IV *Alternatives:* Daptomycin IV 6-10 mg/kg q24h **OR** Linezolid IV 600mg q12h	**Methicillin susceptible** Vancomycin IV **OR** Teicoplanin IV **OR** TMP-SMZ IV **Methicillin resistant** Same as without penicillin allergy	**Duration** **(A) Short term CVC** *Uncomplicated:* - Catheter changed 5-7 days from first negative blood culture - Catheter retained 10-14 days (Systemic antibiotic + lock therapy) *Complicated** - Catheter changed 4-6 weeks; osteomyelitis (adult) 6-8 Weeks **(B) Long term CVC** *Uncomplicated:* - Catheter retained 10-14 days (systemic antibiotic + lock therapy) *Complicated* ▪ Septic thrombosis, endocarditis, *osteomyelitis:* - Catheter change 4-6 weeks; osteomyelitis (adult) 6-8 Weeks ▪ Tunnel infection, port abscess: - Catheter change 7-10 days
Staphylococcus aureus	**Methicillin susceptible** Nafcillin IV 2 g q4h **OR** Oxacillin IV 2 g q4h **OR** Flucloxacillin IV 2 g q6h **OR** Cefazolin IV 2 g q8h **Methicillin resistant** Vancomycin IV **OR** Teicoplanin IV *Alternatives:* Daptomycin IV 8-10 mg/kg Q24h **OR**	**Methicillin susceptible** Vancomycin IV **OR** Teicoplanin IV **Methicillin resistant** Same as without penicillin allergy	**Duration** **(A) Short term CVC** *Uncomplicated:* - Catheter changed ≥ 14 days from first negative blood culture *Complicated** - Catheter changed 4-6 weeks; osteomyelitis (adult) 6-8 Weeks **(B) Long term CVC** *Uncomplicated:* - Catheter change 4-6 weeks *Complicated* ▪ Septic thrombosis, endocarditis, osteomyelitis: - Catheter change 4-6 weeks;

	Linezolid IV 600mg Q12h ***Treatment failure*** Daptomycin IV 8-10 mg/kg Q24h +Ceftaroline IV 600mg q8h		osteomyelitis (adult) 6-8 Weeks ▪ Tunnel infection, port abscess: - Catheter change 7-10 days
Enterococcus	**<u>Ampicillin susceptible</u>** Ampicillin IV 2g q4-6h +/- Gentamicin IV 1 mg/kg q8h **OR** Penicillin G IV 3-5 million-unit Q4h +/- Gentamicin IV 1 mg/kg q8h **OR** Ampicillin IV 2g Q4 hours + Ceftriaxone IV 2g Q12h¥ **<u>Ampicillin susceptible, Vancomycin resistant</u>** Ampicillin IV 2g q4-6h **OR** Penicillin G IV 3-5 million-unit Q4h **<u>Ampicillin resistant, Vancomycin susceptible</u>** Vancomycin IV +/- Gentamicin IV 1 mg/kg q8h **OR** Teicoplanin IV +/- Gentamicin IV 1 mg/kg q8h *Alternatives:* Linezolid IV 600mg Q12h **OR** Daptomycin IV 8-12 mg/kg Q24h **<u>Ampicillin resistant, Vancomycin resistant</u>** Linezolid IV 600mg q12h **OR** Daptomycin IV 8-12 mg/kg Q24h +/- Ampicillin IV 2g Q4h	**<u>Ampicillin susceptible</u>** Vancomycin IV **OR** Teicoplanin IV **<u>Ampicillin susceptible, Vancomycin resistant</u>** Linezolid IV 600mg Q12h **OR** Daptomycin IV 8-12 mg/kg Q24h **<u>Ampicillin resistant, Vancomycin susceptible</u>** Same as without penicillin allergy **<u>Ampicillin resistant, Vancomycin resistant</u>** Same as without penicillin allergy	**Duration** **(A) Short term CVC** *<u>Uncomplicated:</u>* - Catheter changed 7-14 days from first negative blood culture *<u>Complicated*</u>* - Catheter changed 4-6 weeks; osteomyelitis (adult) 6-8 Weeks **(B) Long term CVC** *<u>Uncomplicated:</u>* - Catheter retained 7-14 days (systemic antibiotic + lock therapy) *<u>Complicated</u>* ▪ Septic thrombosis, endocarditis, osteomyelitis: - Catheter change 4-6 weeks; osteomyelitis (adult) 6-8 Weeks ▪ Tunnel infection, port abscess: - Catheter change 7-10 days

CVC: central venous catheter, AC: arterial catheter, TMP-SMZ: trimethoprim-sulfamethoxazole
*endocarditis, osteomyelitis, thrombophlebitis, etc.
¥ Ampicillin + Ceftriaxone combination warranted in setting of critical illness and/or patient with heart valve disease

Table 6: Targeted Antimicrobials for CRBSI caused by Gram Negative Organisms

Organisms	Patient without Penicillin Allergy	Patients with Severe Penicillin Allergy	Comments
Citrobacter koseri	**Community-acquired infection:** Cefepime IV 2g q12h **OR** Ceftriaxone IV 2g once daily **Health care-associated infection:** Cefepime IV 2g q8h **OR** Ertapenem IV 1 g once daily	Aztreonam IV 2 g q8h **OR** Ciprofloxacin IV 400mg q8-12h **OR** TMP-SMZ IV	7-14 days
Enterobacter aerogenes	**Community-acquired infection:** Cefepime IV 2g q12h **Health care-associated infection:** Cefepime IV 2g q8h **OR** Ertapenem IV 1 g once daily	Ciprofloxacin IV 400mg q8-12h	7-14 days Catheter related bacteremia
Enterobacter cloacae	**Community-acquired infection:** Cefepime IV 2g q12h **Health care-associated infection:** Cefepime IV 2g q8h **OR** Ertapenem IV 1 g once daily	Ciprofloxacin IV 400mg q8-12h	7-14 days Catheter or device related bacteremia
Proteus mirabilis	**Community-acquired infection:** Cefepime IV 2g BID **OR** Ceftriaxone IV 2g once daily **Health care-associated infection:** Cefepime IV 2g q8h **OR** Ertapenem IV 1 g once daily	Aztreonam IV 2 g q8h **OR** Ciprofloxacin IV 400mg q8-12h	7-14 days Catheter related bacteremia
E. coli	Piperacillin-tazobactam IV 4.5 g q6h **OR** IV Ertapenem 1 g once daily	Ciprofloxacin IV 400mg q8-12h	7-14 days Bacteremia/sepsis secondary to UTI, GI/biliary tract, venous catheters.
Klebsiella Pneumoniae	Piperacillin-tazobactam IV 4.5 g q6h **OR** Ertapenem IV 1 g once daily	Aztreonam IV 2 g q8h **OR** Ciprofloxacin IV 400mg q8-12h	7-14 days Associated with primary organ system infection, peripheral, or central venous catheters.
Morganella Morganii	**Community-acquired infection:** Cefepime IV 2g q12h **Health care-associated infection:**	Ciprofloxacin IV 400mg q8-12h	7 days For patients with adequate source control

	Cefepime IV 2g q8h **OR** Piperacillin-tazobactam IV 4.5 g q6h		
Klebsiella oxytoca	**Community-acquired infection:** Ceftriaxone IV 2g once daily **OR** Cefepime IV 2g q12h **Health care-associated infection:** Ceftriaxone IV 2g once daily **OR** Cefepime IV 2g q8h **OR** Piperacillin-tazobactam IV 4.5 g q6h	Aztreonam IV 2 g every 8 hours **OR** Ciprofloxacin IV 400mg q8-12h	7-14 days Associated with primary organ system infection, peripheral, or central venous catheters.
Serratia Marcescens	**Community-acquired infection:** Cefepime IV 2g q12h **OR** Ceftriaxone IV 2g once daily **Health care-associated infection:** Cefepime IV 2g q8h **OR** Ertapenem IV 1 g once daily	Aztreonam IV 2 g q8h **OR** Ciprofloxacin IV 400mg q8-12h	7-14 days Catheter related bacteremia Amikacin susceptibility is usually maintained and often capable of synergy with antipseudomonal beta-lactam.
Pseudomonas aeruginosa	Piperacillin-tazobactam IV 4.5 g q6h **OR** Cefepime IV 2g q8h ± Aminoglycoside IV once daily **OR** Meropenem IV 1g q8h	Aztreonam IV 2 g q8h **OR** Ciprofloxacin IV 400mg q8-12h	• Aminoglycoside should not be used as monotherapy • Patient with burns, pregnancy, critical illnesses may require higher dose of aminoglycoside
Bloodstream Infections based on Resistance Gene Identified			
Organisms	**Patient without Penicillin Allergy**	**Patients with Severe Penicillin Allergy**	**Comments**
Extended-Spectrum Beta-Lactamases producers (ESBL)	Ertapenem IV 1g daily **OR** Meropenem IV 1-2g q8h **OR** Imipenem-cilastatin IV 500mg Q6h	Desensitization **OR** Ciprofloxacin IV 400mg Q8-12h **OR** Levofloxacin IV 500mg-750mg daily **OR** TMP-SMX IV 8 to 20 mg/kg/day (trimethoprim component) divided q6-12h **OR**	7-14 days • Desensitization is only used in type-1 hypersensitivity reactions. • Avoid Ertapenem if serum albumin <2.5 g/dL

		Tigecycline IV (only if primary site of infection is intra-abdominal)	
Carbapenem-Resistant *Enterobacterales* (CRE) with identified resistant genes	**KPC:** Ceftazidime-avibactam IV 2.5 g q8h **OR** IV.Imipenem-cilastatin-relebactam 1.25 g q6h	Colistin IV 300 mg base activity (CBA) loading dose followed 12 hours later with 150 to 180 mg CBA twice daily **+** Tigecycline IV 200 mg once, then 100 mg q12h (only if primary site of infection is intra-abdominal)	• Infectious disease consultation encouraged
	MBL: (eg: NMD-1, IMP): Ceftazidime-avibactam IV 2.5 g q8h **+** Aztreonam IV 2 g q8h **(infused over 3 hours at the same time)** **OR** Cefiderocol IV 2g q8h	IV Colistin 300 mg base activity (CBA) loading dose followed 12 hours later with 150 to 180 mg CBA q12h **+** Tigecycline IV 200 mg once, then 100 mg q12h (only if primary site of infection is intra-abdominal)	
	OXA-48-like: Ceftazidime-avibactam IV 2.5 g q8h **OR** Cefiderocol IV 2g q8h	Colistin IV 300 mg base activity (CBA) loading dose followed 12 hours later with 150 to 180 mg CBA q12h **+** Tigecycline IV 200 mg once, then 100 mg q12h (only if primary site of infection is intra-abdominal)	
Pseudomonas aeruginosa MDR	Ceftazidime-avibactam IV 2.5 g q8h **OR** Ceftazidime-avibactam IV 2.5 g q8h **+** Aztreonam IV 2 g q8h **(infused over 3 hours at the same time)** **OR** Ceftolozane-tazobactam IV 3 g q8h **OR** Imipenem-cilastatin-relebactam IV 1.25 g q6h	Aztreonam IV 2 g q8h **OR** Ciprofloxacin IV 400mg q8h	• Infectious disease consultation encouraged • Extended infusion beta-lactams may lead to an improved outcome or less resistance when treating MDR organisms, options include infusion over 3-4 hours of usual dose vs. continuous infusion of the total daily dose.

Colistimethate Sodium Conversion		
Colistimethate Sodium (unit)	**Colistimethate Sodium (mg)**	**Colistin-Base Activity (mg)**
~12,500 units	1 mg	0.4 mg
150,000 units	~12 mg	5 mg
~1,000,000 units	~80 mg	34 mg
4,500,000 units	~360 mg	150 mg
9,000,000 units	~720 mg	300 mg

~: around , 1 mg colistin base activity (CBA) = ~ 30,000 IU colistimethate sodium

Table 7: Catheter Management Strategies

Strategy	Indications /Conditions
Removal	• Sepsis. • Hemodynamic instability. • Presence of concomitant endocarditis. • Evidence of metastatic infection. • Presence of suppurative thrombophlebitis. • Presence of a propagating clot. • Persistent bacteremia after 72 hours of appropriate antimicrobial therapy. • Subcutaneously tunneled central venous catheter tunnel tract infection. • Subcutaneous port reservoir infection. • Infection with *S. aureus, P. aeruginosa,* Drug-resistant Gram-negative bacilli, *Candida* spp. Or *Mycobacteria* spp). • Biofilm forming organisms including (*Klebsiella, Pseudomonas*, and *Acinetobacter* species). • Low virulence that are difficult to eradicate (*Bacillus* spp, *Micrococcus* spp, or *Cutibacterium* spp), if bacteremia persists and blood culture contamination has been ruled out. • Long-term catheters when there are signs or symptoms of exit site or tunnel infections, or a pocket infection.
Salvage	• CoNS • Dug-susceptible Enterobacteriaceae (eg, *E. coli, Klebsiella* species, *Enterobacter* species) which is uncomplicated. • *Enterococcus* spp.

Table 8: Antibiotic Lock Therapy

Antibiotic agent	Antibiotic concentration (Therapeutic)	Heparin concentration	Maximum dwell time (duration of stability) **	Preparation#
Antibiotics for Gram Positive Organism				
Vancomycin	2.5 mg/mL	2500 units/mL	72 hours	• vancomycin (0.5 mL of 10 mg/mL solution diluted in normal saline) plus heparin (0.5 mL of 10,000 units per mL solution) with 1 mL of normal saline for a final concentration of vancomycin 2.5 mg/mL and heparin 2500 units/mL in a 2 mL solution • vancomycin (1 mL of 10 mg/mL solution diluted in normal saline) plus heparin (1 mL of 10,000 units per mL solution) for a final concentration of vancomycin 5 mg/mL and heparin 5000 units/mL in a 2 mL solution
	5 mg/mL	5000 units/mL	72 hours	
	5 mg/mL	none	72 hours	
Cefazolin	5 mg/mL	2500 units/mL	72 hours	• cefazolin (1 mL of 10 mg/mL solution diluted in normal saline) plus heparin (0.5 mL of 10,000 units per mL solution) with 0.5 mL of normal saline for a final concentration of cefazolin 5 mg/mL and heparin 2500 units/mL in a 2 mL solution • cefazolin (1 mL of 20 mg/mL solution diluted in normal saline) plus heparin (1 mL of 10,000 units per mL solution) for a final concentration of cefazolin 10 mg/mL and heparin 5000 units/mL in a 2 mL solution
	5 mg/mL	none	48 hours	
	10 mg/mL	5000 units/mL	72 hours	
Daptomycin	5 mg/mL	5000 units/mL	72 hours	• daptomycin (1 mL of 10 mg/mL solution diluted in lactated Ringer's) plus heparin (1 mL of 10,000 units per mL solution) for a final concentration of daptomycin 5 mg/mL and heparin 5000 units/mL in a 2 mL solution
	5 mg/mL	none	72 hours	
Nafcillin	100 mg/mL	none	12 hours	

Ampicillin	10 mg/mL	none	8 hours	• Ampicillin to be diluted with normal saline, lactated ringers, or sterile water for injection to achieve 8-hour stability; the stability of ampicillin is limited if diluted with 5% dextrose in water
Antibiotics for Gram negative Organisms				
Gentamicin	1 mg/mL	2500 units/mL	72 hours	• Gentamicin (0.5 mL of 4 mg/mL solution diluted in normal saline) plus heparin (0.5 mL of 10,000 units per mL solution) plus 1 mL of normal saline solution for a final concentration of gentamicin 1 mg/mL and heparin 2500 units/mL in a 2 mL solution • Gentamicin (1 mL of 10 mg/mL solution diluted in normal saline) plus heparin (1 mL of 10,000 units per mL solution) for a final concentration of gentamicin 5 mg/mL and heparin 5000 units/mL in a 2 mL solution
	5 mg/mL	5000 units/mL	72 hours	
	5 mg/mL	none	72 hours	
Ceftazidime	10 mg/mL	5000 units/mL	48 hours	• Ceftazidime (1 mL of 20 mg/mL solution diluted in normal saline) plus heparin (1 mL of 10,000 units per mL solution) for a final concentration of ceftazidime 10 mg/mL and heparin 5000 units/mL in a 2 mL solution
	1 - 10 mg/mL	none	48 hours	
Cefepime	1 - 10 mg/mL	none	48 hours	
Ciprofloxacin	1 - 5 mg/mL	none	48 hours	
Ceftriaxone	100 mg/mL	none	48 hours	

** While antibiotics may remain stable in lock solutions based on their physical and chemical stability, we favour limiting the maximum dwell time to 24 - 48 hours, since antibiotic concentrations in the catheter may fall to subtherapeutic levels over time. Minimum dwell time can range between of 2 - 12 hours.

Dilutions are standardized to a 2 mL volume, if larger volumes required to fill the catheter lumen quantities shall be adjusted accordingly.

Table 9: Number of top 20 blood isolate in UAE 2023*

S.No.	Organisms	Number of Isolates (N=9,157)	%
1.	***Escherichia coli***	1,491	16.3
2.	*Staphylococcus epidermidis*	1,392	15.2
3.	*Klebsiella pneumoniae ssp. pneumoniae*	985	10.8
4.	***Staphylococcus aureus ssp. aureus***	884	9.7
5.	*Staphylococcus hominis ssp. hominis*	790	8.6
6.	*Staphylococcus capitis ssp. capitis*	578	6.3
7.	*Pseudomonas aeruginosa*	429	4.7
8.	*Staphylococcus, coagulase negative*	368	4.0
9.	*Staphylococcus haemolyticus*	334	3.6
10.	*Enterococcus faecalis*	278	3.0
11.	*Streptococcus pneumoniae*	263	2.9
12.	*Micrococcus luteus*	215	2.3
13.	*Candida auris*	211	2.3
14.	*Streptococcus mitis*	178	1.9
15.	*Serratia marcescens*	155	1.7
16.	*Enterobacter cloacae*	136	1.5
17.	*Salmonella typhi*	135	1.5
18.	*Candida albicans*	128	1.4
19.	*Streptococcus agalactiae*	112	1.2
20.	*Acinetobacter baumannii*	95	1.0

Table 10: Percent susceptible Blood isolates (%S) for *Staphylococcus aureus* (N=884), UAE 2023*

Antibiotics	Number (N) of Isolates Tested	% Susceptible
Clindamycin	688	86.3
Oxacillin	686	65.3
Erythromycin	686	62.4
Vancomycin	686	99.9
Trimethoprim/Sulfamethoxazole	685	81.6
Linezolid	685	99.7
Gentamicin	684	93.3
Rifampicin	684	99.4
Tetracycline	684	87.3
Moxifloxacin	683	65.6
Tigecycline	681	99.7
Levofloxacin	442	64.5
Ciprofloxacin	377	65.8
Daptomycin	226	100.0
Doxycycline	206	97.1

*Data source: UAE National AMR Surveillance System. Data shown is from 319 surveillance sites (88 hospitals,231 centers/clinics), 2023 data.

Table 11: Percent susceptible Blood isolates (%S) for *Escherichia coli* (N= 1491), UAE 2023*

Antibiotics	Total Number (N) of Isolates Tested	% Susceptible
Meropenem	1091	97.9
Gentamicin	1087	83.9
Ceftazidime	1083	66.4
Trimethoprim/Sulfamethoxazole	1082	51.3
Piperacillin/Tazobactam	1081	86.6
Ciprofloxacin	1079	34.5
Imipenem	993	98.2
Amoxicillin/Clavulanic acid	953	67.9
Amikacin	917	88.3
Cefepime	911	70.7
Ertapenem	706	95.8
Ceftriaxone	561	48.8
Cefotaxime	539	51.4

*Data source: UAE National AMR Surveillance System. Data shown is from 319 surveillance sites (88 hospitals,231 centers/clinics), 2023 data.

Table 12: Infection control prevention measure for CRBSI

CLABSI Prevention Bundle

The CLABSI Prevention Bundle presents the best evidence-based practices to prevent central line-associated bloodstream infections (CLABSI) and enhance patient safety. **Healthcare facilities may incorporate additional evidence-based elements tailored to their specific needs and settings.**

To ensure high compliance and effectiveness, facilities should prioritize:

- Continuous training of healthcare personnel
- Ongoing adherence monitoring
- Periodic policy reviews

These measures help maintain best practices and sustain effective CLABSI prevention strategies over time:

Central line insertion bundle
1. Perform hand hygiene before catheter insertion 2. Select the subclavian site to minimize infectious complications unless clinically contraindicated 3. Use an alcoholic chlorhexidine antiseptic for skin preparation unless contraindicated 4. Adhere to maximum sterile barrier precautions during catheter insertion 5. Maintain sterile field/technique during catheter insertion
Central line maintenance bundle
1. Perform hand hygiene before and after touching or accessing a device 2. Daily review of necessity of central line and remove unnecessary lines. Inspect the dressing and insertion site at least daily or per institutional policy. Flush per institutional policy 3. Disinfect catheter hubs, needleless connectors, and injection ports before each access with alcohol or other facility-approved pad. Disinfectant caps may be used per institutional policy 4. Ensure daily bathing with an antiseptic wipe or solution (such as chlorhexidine gluconate). If antiseptic is contraindicated, ensure daily bathing with soap and water 5. Change IV tubing, needleless access devices, and all add-on devices (such as extension sets and filters) per institutional policy. Label the tubing and ensure tubes are within 'use-by' date 6. Change transparent dressings every 7 days and sterile gauze dressings at least every 2 days. Change the dressing more often if it becomes wet, loose, or visibly soiled. Label the dressing with the date and time changed or per institutional policy 7. Use a securement method, such as an adhesive or integrated securement device, to stabilize and secure the device. 8. Educate patients about the signs and symptoms of an infection and how to protect themselves