



PROVINCIAL STANDARDS & GUIDELINES



Prevention, Treatment, & Monitoring of Vascular Access-related Infection in HD Patients

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Approved by the BC Renal Hemodialysis Committee

Table of Contents

1.0 Scope.....	1
2.0 Recommendations and Rationale	1
Table 1: Treatment of Catheter-Related Bloodstream Infection	8
3.0 References.....	11
4.0 Sponsors.....	12

IMPORTANT INFORMATION

This BC Renal guideline/resource was developed to support equitable, best practice care for patients with chronic kidney disease living in BC. The guideline/resource promotes standardized practices and is intended to assist renal programs in providing care that is reflected in quality patient outcome measurements. Based on the best information available at the time of publication, this guideline/resource relies on evidence and avoids opinion-based statements where possible; refer to www.bcrenalagency.ca for the most recent version.

For information about the use and referencing of BC Renal guidelines/resources, refer to <http://bit.ly/28SFr4n>.



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1.0 Scope

VA-related infections are a leading cause of morbidity, mortality, and costs in hemodialysis (HD) patients. This guideline provides recommendations for the prevention, management and monitoring of VA related infections in AV fistulas (AVFs), AV grafts (AVGs), and catheters.

Related Guidelines (BC, Canada, or International):

- BC Renal. Available at BCRenalAgency.ca ► [Health Professionals](#) ► [Clinical Resources](#) ► [Vascular Access](#) ► [Resources](#):
 - Rope Ladder Cannulation of AV Fistulas and Grafts.
 - Buttonhole Cannulation of AV Fistulas and Grafts.
 - Insertion and Removal of Tunneled Permanent HD Catheters.
 - BC Recommendations for VA for Patients with HD as Primary Modality.
 - Selection of Permanent HD Access and Order of Placement.
- Association for the Professionals in Infection Control and Epidemiology, Guide to Elimination of Infections in Hemodialysis, 2010. Available at https://apic.org/Resource_/EliminationGuideForm/7966d850-0c5a-48ae-9090-a1da00bcf988/File/APIC-Hemodialysis.pdf
- Canadian Association of Nephrology Nurses and Technologists (CANNT). Nursing Recommendations for the Management of Vascular Access in Adult HD Patients, 2015 Update. www.cannt.ca/en/standards-of-practice/vascular-access-guidelines (available for purchase).
- Canadian Society of Nephrology Guidelines. Report of the Canadian Society of Nephrology Vascular Access Working Group, 2012 Available at www.ncbi.nlm.nih.gov/pubmed/22273524
- Centre for Disease Control (US), Recommendations for Preventing Transmission of

Infections Among Chronic Hemodialysis Patients, April 27, 2001 and 2016 Update. Available at www.cdc.gov/dialysis/guidelines/index.html

- Centre for Disease Control (US), Guidelines for the Prevention of Intravascular Catheter-Related Infections, 2011. Available at www.cdc.gov/hai/pdfs/bsi-guidelines-2011.pdf
- European Society of Vascular Surgery (ESVS), Vascular Access: Clinical Practice Guidelines, 2018. Available at [www.ejves.com/article/S1078-5884\(18\)30080-7/abstract](http://www.ejves.com/article/S1078-5884(18)30080-7/abstract)
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- National Kidney Foundation. KDOQI Clinical Practice Guideline for Vascular Access: 2018. AJKD Submission draft April 2019.
- United Kingdom Renal Association. Clinical practice guideline: Vascular Access for Haemodialysis, 6th edition, 2015. Available at <https://renal.org/wp-content/uploads/2017/06/vascular-access.pdf>

2.0 Recommendations and Rationale

Recommendation 1: For several reasons, which include the risk of infection, the order of preference for HD access for adults who require chronic HD is AV fistula, then AV graft, then catheter (evidence), as appropriate to the patient.

A **Fistula First** philosophy is paramount, and every effort should be made to create a native AV fistula (AVF) for patients requiring chronic hemodialysis access.

Of the three types of accesses, AVFs have the lowest rates of thrombosis and infection and require the fewest interventions, resulting in the longest access survival rate.

The lower rate of infection of AVFs when compared to AVGs and catheters is consistent with the results of a large Canadian study, as well as local BC data:

- Canadian study: Study of 184 bloodstream infections in 133,158 dialysis treatments demonstrated an infection rate of 0.2/1,000 dialysis procedures for AVFs, with an increase of 2.5 times for AVGs, 15.5 times for tunneled, cuffed catheters, and 22.5 times for uncuffed catheters (Taylor et al, 2002).
- BC data: Consolidated infection rates¹ for bloodstream infections in patients on chronic dialysis for the period April 2014 - Sept 2018 demonstrated the following:
 - AVFs: 0.006 infections per 365 days (n=46 for the 4.5-year period)
 - AVGs: 0.022 infections per 365 days (n=18 for the 4.5-year period)
 - Catheters: 0.060 infections per 365 days (n=301 for the 4.5-year period)

¹ Note: Infections are entered manually into PROMIS by each health authority. It is likely the numbers provided are underreported.

Recommendation 2: Prevent vascular access-related infections by:

All Vascular Accesses:

1. Limiting the performance of vascular access-related procedures and dressing changes to trained dialysis staff or caregivers.
2. Using routine precautions and aseptic technique in caring for HD patients.
3. Educating patients on ways to prevent infection, as follows:

All Accesses:

- Personal hygiene and careful hand washing.
- Wearing clothing that enables easy viewing of the access when coming to dialysis.
- Recognizing and acting on the signs of local and systemic infection.
- Whom to call in case of questions or concerns.

AV Fistulas and AV Grafts:

- Washing fistula or graft area carefully with warm water and antibacterial soap daily and before HD.

Catheters:

- Wearing a mask when catheter is being accessed or when dressing is being changed.
- Taking care of the catheter dressing (i.e., keeping the dressing dry and what to do if the dressing peels off, gets soiled or gets wet).
- Staying healthy with a catheter (i.e., minimize touching of the catheter, not using sharp objects like scissors near the tubing, not opening the catheter, etc).

AV Fistulas and Grafts:

4. Prior to initiating dialysis, ensure the access limb is washed with soap and water using friction (usually done by the patient prior to coming to the HD unit).

5. When cannulating an AVF or AVG:
 - Use clean gloves (changed just prior to needling) and appropriate cleaning procedure (back and forth friction motion) and antiseptic solution.
 - Allow skin to dry thoroughly prior to needling (time to dry depends on type of solution).

Preferred solutions in order of priority are:

- 2% chlorhexidine/70% isopropyl alcohol (tincture)²
- 2% chlorhexidine with 4% or no alcohol (aqueous) (use if concern re alcohol sensitivity or impact of alcohol on skin or graft/catheter)
- 10% povidone iodine (use if sensitivity to chlorhexidine and/or alcohol)
- Topical sodium hypochlorite (e.g., Anasept®) (use if sensitivity to all antiseptics)

Notes re: antiseptics:

- KDOQI Clinical Practice Guideline for Vascular Access (2018) suggests the use of a chlorhexidine-based solution (chlorhexidine gluconate 1% or 2% or 70% alcohol solution). If chlorhexidine is contraindicated (sensitivity, allergy), povidone-iodine 10% in 70% ethanol should be used.
- The Center for Disease Control and Prevention guideline (CDC, 2011) suggests the use of the following antiseptic solutions: >0.5% chlorhexidine with alcohol, 70% alcohol or 10% povidone-iodine. They conclude there is not enough evidence to recommend one antiseptic over the others.
- The Society for Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (ISDA) joint guideline (Marschall, 2014) suggest that antiseptic solutions of alcoholic chlorhexidine may have additional residual activity (up to 24 hours) when compared with 70% alcohol.

6. Not cannulating red or excoriated sections on the fistula or graft.

Catheters:

7. When inserting or assisting with insertion of a central venous catheter (CVC):
 - Use maximal sterile barrier precautions (staff: cap covering all hair, mask covering mouth and nose, sterile gown and sterile gloves; patient: sterile drape draped from head to toe with a small opening for catheter insertion).
 - Cleanse the insertion site with an appropriate antiseptic solution. Allow to dry thoroughly prior to catheter insertion. Preferred solutions in priority order:
 - 2% chlorhexidine/70% isopropyl alcohol (tincture) (see footnote 2).
 - 2% chlorhexidine with 4% or no alcohol (aqueous) (use if concern re alcohol sensitivity or impact of alcohol on skin or graft/catheter).
 - 10% povidone iodine (use if sensitivity to chlorhexidine and/or alcohol)
 - Topical sodium hypochlorite (e.g., Anasept®) (use if sensitivity to all antiseptics)
 - Place tunneled cuffed CVCs in the right internal jugular vein whenever possible (most direct route to the right atrium, lower risk for complications and maximizes potential sites for permanent accesses). Try not to use the subclavian vein (high risk for stenosis and high rate of infection) or femoral vein (high rate of infection). Do not place on the same side as a maturing permanent access (ESVS, 2018; CDC 2011; KDOQI, 2018).
 - Prophylactic systemic antibiotics are not required before insertion or during use of an intravascular catheter to prevent catheter colonization or catheter-related bloodstream infections (CRBSI) (CDC, 2011).

² Note: Recommendations in this document re the use of chlorhexidine are for children > 2 months of age; the literature makes no recommendations for the safety or efficacy of chlorhexidine in infants < 2 months old (unresolved issue; CDC, 2011 Guidelines for Prevention of Intravascular Catheter-Related Infections).

8. When connecting, disconnecting, and CVCs:

- Use a mask (staff and patient), eye protection (mask with visor or mask and eye protection) (staff) and gown (staff) for connect and disconnect procedures (CDC, 2011; CSN, 2006, 518; KDOQI, 2018).
- Use sterile equipment and supplies and a “no touch³” technique when handling the catheter and catheter ports and caring for the exit site.
- Maintain a sterile drape under the catheter ports.
- Use an antiseptic wipe and vigorously apply mechanical friction to clean the hubs of the catheter ports (“hub scrubs”). If Tego connectors present, use antiseptic wipe and vigorously apply mechanical friction to clean the connectors. Preferred solutions are the same as for cannulating AV fistulas and grafts.
- Use a separate antiseptic wipe for each clamp/ limb/port/Tego connector.
- Allow antiseptic to dry for maximal effect.
- Leave hubs “open” (i.e., uncapped and disconnected) for the shortest time possible.
- Use sterile normal saline in a syringe to flush the catheter lumens.
- Do not use HD catheters for blood drawing or applications other than HD except during dialysis or under emergency circumstances (consult a nephrologist).

Use of prophylactic antibiotic/antimicrobial locks:

The current consensus is that the use of *prophylactic* antibiotic/antimicrobial locks are not recommended for *preventing* catheter-related infections (KDOQI 2018). This consensus acknowledges mixed results reported in published studies. Special circumstances may apply, however, where prophylactic antibiotic/ antimicrobial locks may be of benefit, such as patients who have a history of multiple catheter-related infections despite optimal maximal adherence to aseptic technique (KDOQI 2018; CDC, 2011; CANNT, 2015).

9. When caring for the exit-site:

- Visually inspect the exit-site dressing every HD treatment for inflammation and/or signs of infection (KDOQI, 2018; CSN, 2006, S18). If required, change the dressing.
- Use sterile gauze or a sterile, transparent dressing (gauze is preferred if patient is diaphoretic or the site is bleeding, oozing, or showing signs of infection, or the skin is compromised; otherwise either dressings are acceptable). (CDC, 2011).
- If the rate of infection is not decreasing despite adherence to other strategies, consider the use of chlorhexidine sponge dressings to reduce the incidence of infection (CDC, 2011; Cochrane Review, 2015).
- Change transparent dressings every 7 days⁴ and gauze dressings every HD treatment (48 hours); change either type of dressing if damp, loosened, or soiled.
- Use a mask (staff and patient), eye protection (mask with visor or mask and eye protection) (staff), gown (staff) and gloves (staff) (non-sterile gloves to remove the dressing and sterile for the rest of the procedure) for dressing change procedures.
- Use an antiseptic wipe to cleanse the catheter exit site skin using a back and forth friction motion that covers a 10 cm x 10 cm. Preferred solutions are the same as for cannulating AV fistulas and grafts.

Use of prophylactic antibiotic/antimicrobial ointment:

The current consensus in BC is that the routine use of *prophylactic* antibiotic/antimicrobial ointment on the exit site is not recommended for *preventing* catheter related infections. Special circumstances may be appropriate such as their use in patients with a history of multiple Staph aureus catheter-related infections who have very limited available access options. Additionally, KDOQI (2018) suggests there may be some benefit to using a topical antiseptic or antibiotic

³ “No touch” refers to the ends of the catheter as it is important to keep these sterile.

⁴ Except in those pediatric patients in whom the risk for dislodging the catheter may outweigh the benefit of changing the dressing (CDC, 2011).

barrier at the exit site in addition to cleansing up to the point that the exit site is healed (expert opinion). Whether the benefit exists after exit sites are fully healed is unclear.

Recommendation 3: Recognize and treat vascular access-related infections using evidence-based protocols for AVFs, AVGs, and catheters.

AV Fistulas

Although infections of AVFs are rare, any episode is potentially fatal. Infection may be local at the puncture site, inclusive of the AVF (e.g., anastomotic infection, abscess formation, infected thrombus, or infected aneurysm), or systemic.

Clinical signs:

- Local signs (puncture site): tenderness, erythema (redness), warmth, edema, indurations, local serous or purulent discharge, repeated puncture site bleedings, abscess +/- hematoma. May or may not also have systemic signs of a bloodstream infection.
- Systemic signs: fever and chills, positive blood and/or wound culture, elevated C-reactive protein (CRP), and increased white blood cell (WBC) count.
- Even in the absence of local signs, infection may be present, especially in cases of unexplained sepsis, leukocytosis or fever.

Treatment:

- Puncture site infection without systemic signs:
 - Incision/drainage of abscess and up to 2 weeks of topical and/or oral antibiotics.
- All other infections:
 - IV antibiotics and surgical consult (consider fistula excision for infected thrombi +/- septic emboli).
 - Start empiric antibiotics (gram positive and negative coverage): Vancomycin 25 mg/kg IV post HD x 1 dose +/- Gentamicin 2.0 mg/

kg IV post HD x 1 dose (add gentamicin if acutely ill or hemodynamically unstable or if suspect gram negative infection). If allergy to gentamicin, use cefTAZidime 2 g IV post HD x 1 dose.

- Once results of culture are known, adjust antibiotics based on sensitivity results.
 - Type of antibiotic and dosage: See Table 1 (use same antibiotics and dosages to treat AVF/AVG infections as catheter infections).
 - Duration of antibiotic therapy: Usually 2 to 4 weeks for infected AVFs and AVGs depending on the presence of bacteremia and/or presence of metastatic infection (may be shorter if the AVF or AVG is surgically removed).

After resolution of an extensive infection, a new AVF can be constructed and the risk of re-infection is very low. A new AVF can be created in the same arm if there are suitable vessels remaining.

AV Grafts

Clinical signs:

The clinical signs of AVG infection are similar to those for AVFs. Infections may be local but not involving the graft, in the graft, or systemic. **Important to note is that old clotted grafts may be a silent source of infection.**

Treatment:

- Puncture site infection without systemic signs:
 - Topical and/or oral antibiotics until clear.
- All other infections:
 - IV antibiotics and surgical consult (consider graft segment explantation with bypass or total graft explantation for bacteremia, infected thrombi or anastomotic infection).
 - IV antibiotic protocol and duration is the same as per AVFs.
 - If the graft is infected or has been removed,

use a catheter for dialysis until another permanent access is in place. After resolution of the infection, resume use of the existing AVG or construct a new AVF or AVG on the other arm.

Catheters

Catheters infections may be at the exit site, within the tunnel (if tunneled catheter), and/or systemic (i.e., in the bloodstream and known as catheter-related bloodstream infection).

Clinical signs:

- Exit-site infection: Hyperemia, induration +/- tenderness, ≤ 2 cm the catheter exit site. May be associated with fever or purulent drainage from the exit site +/- bacteremia (IDSA, 2009).
 - Tunnel infection: Tenderness, erythema, +/- induration >2 cm from the catheter exit site and along the subcutaneous tunnel +/- bacteremia (IDSA, 2009).
 - Catheter-related bloodstream infection (CRBSI): bacteremia/fungemia (fever $>38^{\circ}\text{C}$, chills, hypotension, elevated WBC count) where there is no other apparent source for the CRBSI except the catheter. Culture of the surface of the catheter (tip, subcutaneous segment, and/or hub) and/or the skin is positive for the same organism as the blood culture.
 - Approximately 70% of pathogens are gram positive (Staphylococcus aureus is most common) and 30% gram negative.
 - Infection complications (i.e., metastatic infection) occur in 15 - 40% of CRBSI. Complications include endocarditis (most common), septic arthritis (diagnosed with joint aspiration), epidural abscess (diagnosed with magnetic resonance imaging, neurosurgery assessment recommended), vertebral osteomyelitis or discitis (diagnosed with bone scan, computed tomography or magnetic resonance imaging +/- CT guided percutaneous aspiration of the disk space), septic emboli
- and sepsis syndrome/shock. A CRBSI-related mortality rate is reported to be between 6% and 34%. A mortality rate from complicated Staphylococcus aureus infection can be 30% to 50%.

Treatment:

Uncuffed catheters:

- For any type of infection, remove the catheter and move to another site (preferably after a 48-hour rest). If bacteremia is present, see Table 1 for antibiotic protocol.

Tunneled, cuffed catheters:

- Exit site infection with no bacteremia:
 - Topical and/or oral antibiotics and proper exit site care. Replacement of catheter is not usually required.
 - Use empiric topical and/or oral antibiotics to cover gram-positive organisms. Modify antibiotic regimen once culture and sensitivity results are available.
 - Typically treated for 7-14 days depending on the microorganism and local practice.
- Tunnel infection with no bacteremia:
 - Catheter removal without catheter exchange over a guidewire.
 - Insertion of a new catheter at another site once blood cultures negative.
 - Incision and drainage if indicated.
 - Empiric antibiotics to cover both gram-positive and gram-negative organisms. Modify regimen once culture and sensitivity results are available. See Table 1 (same as for catheter-related bloodstream infection)
 - Typically treated for 10-14 days (in the absence of concurrent bacteremia) depending on the microorganism and local practice.
- Catheter-related bloodstream infection (positive blood culture): see [Table 1](#).
- Definitive management depends on the clinical presentation, the isolated microorganisms and

vascular access options of the patient.

- Systemic antibiotics: See Table 1.
- Antibiotic locks:
 - Consider using as an adjunctive therapy to systemic antibiotics when catheter salvage is being attempted.
 - In a review of 28 retrospective and prospective studies (n=1,596 patients), patients treated with systemic antibiotics and antibiotic locks had similar cure rates to those treated with systemic antibiotics and guidewire exchange. Recurrence of infection with the same organism was not different between these groups (Miller L et al, CJKHD, 2016).
- Catheter management:
 - Catheter removal needs to be balanced against the risk of re-insertion and availability of alternative insertion sites.
 - Catheter removal is recommended in the following situations:
 - Clinical assessment indicates:
 - Signs and symptoms of sepsis (acutely ill or hemodynamically unstable)
 - Temperature remains above 38°C in last 48 hours
 - Recent catheter-related infection (with same catheter)
 - Presence of exit site or tunnel infection
 - Uncuffed catheter
 - On immunosuppressant medications
 - Presence of prosthetic heart valve
 - Staphylococcus aureus, strep viridans, or fungi.
 - Endocarditis, other metastatic infection, persistent bacteremia after 72 hours or more of adequate antibiotic treatment and suppurative thrombophlebitis
 - Placement of a temporary catheter (in another anatomical site) is recommended for the short-term, followed by placement of a tunneled catheter after negative blood cultures have been obtained.
- Catheter salvage (continued use of the same catheter throughout an episode of CRBSI):
 - Can be considered in cases of uncomplicated bacteremia for hemodialysis patients with limited vascular access options.

Table 1: Treatment of Catheter-Related Bloodstream Infection
Page 1 of 2 (Algorithm)

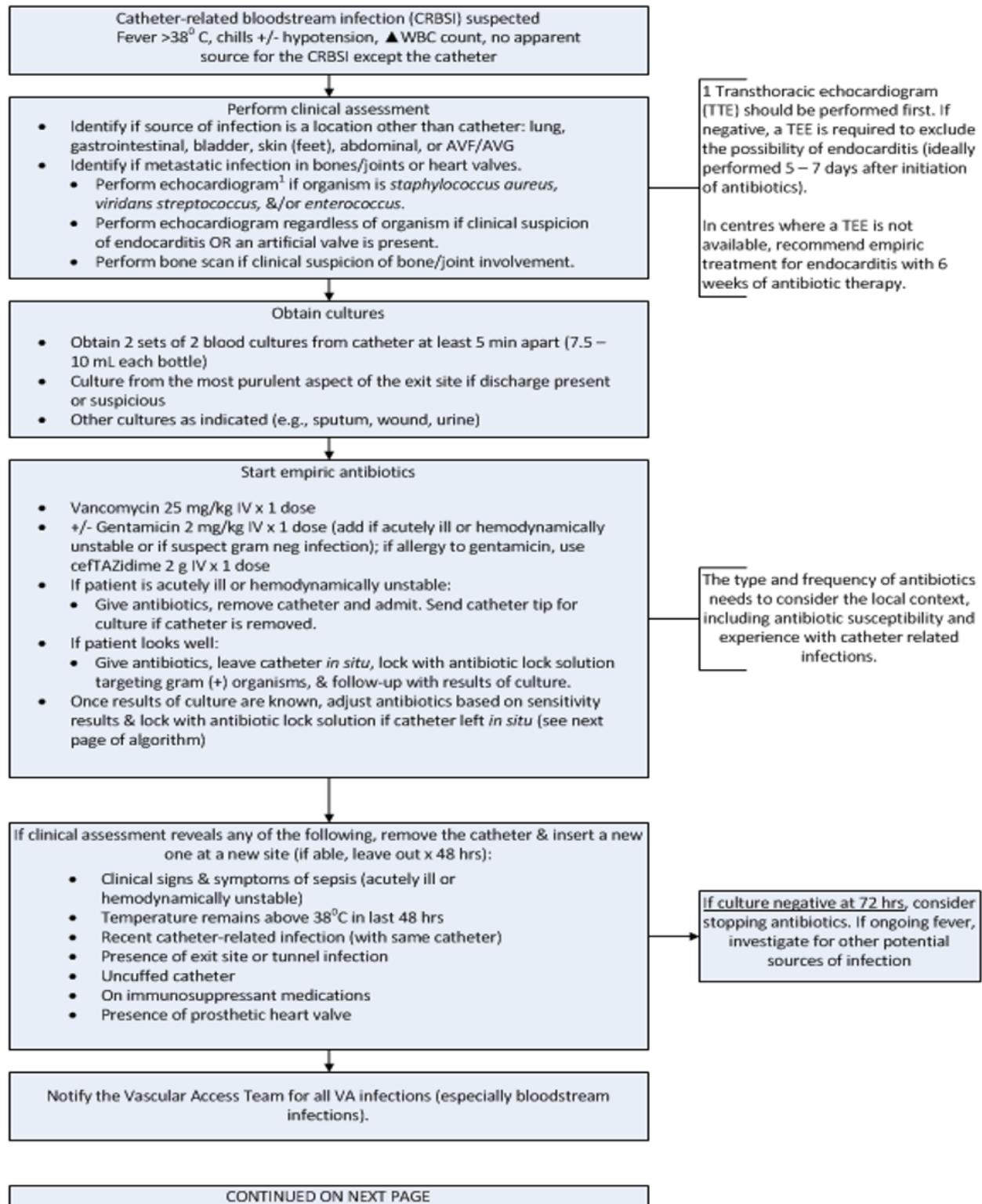
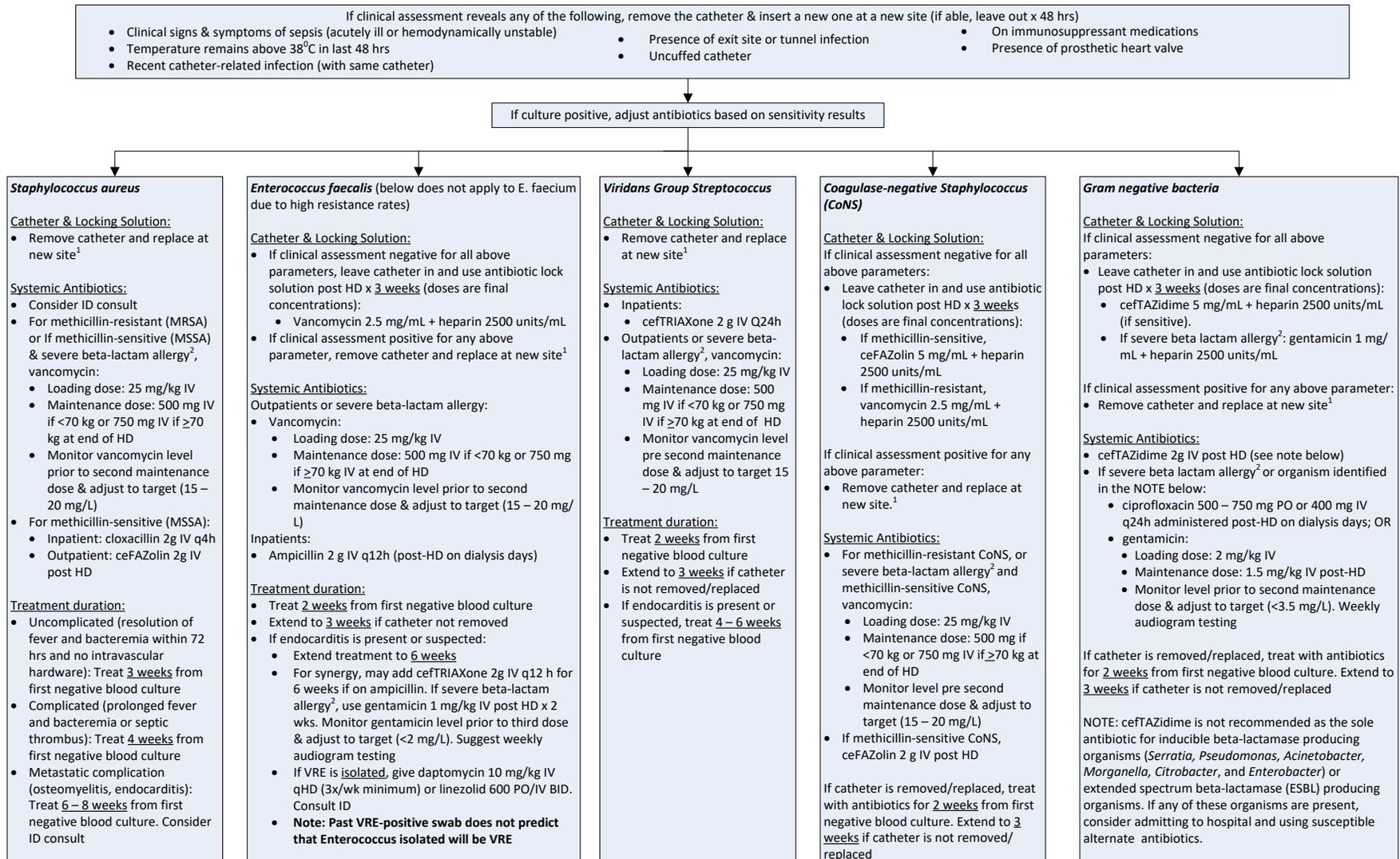


Table 1: Treatment of Catheter-Related Bloodstream Infection
Page 2 of 2 (Algorithm)



Note: If the culture is positive for a fungus (usually *Candida* spp.), remove catheter and replace at a different site. Consider consulting ID and initiate appropriate antimicrobial treatment and continue for at least 2 weeks following line removal. Draw repeat cultures 1 week after completion of antimicrobial therapy to ensure eradication of the organism

¹ Creating a new tunnel in the same site may be a preferred option for some patients.

² ceFAZolin, ceFTRIAXone and ceftAZidime can be safely administered to patients with penicillin allergy including anaphylaxis. DO NOT administer if delayed skin reaction to any beta lactam (e.g., drug reaction with eosinophilia and systemic symptoms, Stevens-Johnson syndrome, toxic epidermal necrolysis).

Recommendation 4: Establish province-wide surveillance systems to monitor VA related infections.

Infection rate: Laboratory confirmed access-related infections in chronic HD pts during a specified time period sorted by access type.

Access-related infections are identified in PROMIS as:

- Blood culture positive
- Exit site positive (AVF, AVG, or catheter)
- Catheter tip positive

If blood and an exit site and/or catheter tip cultures are positive for same patient, infection is counted as a blood infection.

If both exit site and catheter tip cultures are positive for same patient, catheter is counted as exit site infection.

If patient has an infection and has both a catheter and a fistula/graft in place, infection is counted as a catheter infection.

The denominator (months of fistula/graft/catheter access) is based on accumulated months of having the access whether the access is in active use or not. If patient has a catheter and fistula/graft in place, catheter and fistula/graft months are accumulated.

Table 2 outlines the provincial definition and target for VA related infection rate.

Table 2: Provincial Indicators for VA-related Infections

Indicator:	<ul style="list-style-type: none"> • Laboratory confirmed access-related infections in chronic HD pts during a specified time period sorted by access type.
Definition:	<ul style="list-style-type: none"> • Numerator: # of lab confirmed access related infections (blood, catheter tip, exit site) in chronic HD pts with a specified type of access during a specified time period. • Denominator: # of months with specified type of access during a specified time period.
Targets:	<ul style="list-style-type: none"> • AVFs: ≤ 0.01 episodes per 12 HD months in which AVFs were used ($\leq .01$ episode per patient year) • AVGs: ≤ 0.1 episodes per 12 HD months in which AVGs were used ($\leq .1$ episode per patient year) • Catheters: ≤ 0.5 episodes per 12 HD months in which AVGs were used ($\leq .5$ episode per patient year) <p>Source: CSN Guidelines, 2006.</p> <p>KDOQI 2018 CRBSI rate for all CVCs (cuffed or not, tunneled or not): $< 1.5/1000$ catheter days.</p>

3.0 References

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4.0 Sponsors

This provincial guideline was developed to support improvements in the quality of vascular access care delivered to patients with chronic kidney disease in BC. Based on the best information available at the time it was published, the guideline relies on evidence and avoids opinion-based statements where possible. When used in conjunction with pertinent clinical data, it is a tool health authorities and health professionals can use to develop local guidelines.

Developed by:

- An interdisciplinary group of VA Nurses, pharmacists and nephrologists.

Reviewed by:

- Vascular Access Educators Group (VAEG) (Mar 2008; updated Feb 2020)
- Renal Educators Group (REG) (Mar 2008; updated Sept 2019)
- BC Renal Pharmacy and Formulary (Mar 2008; updated Dec 2019)
- BC Renal Home Hemodialysis Committee (Mar 2008; updated Sept 2019)

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