Title: Medication Management- Antibiotic Lock Therapy and Prophylaxis	
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SECTION I: PURPOSE

Antibiotic catheter lock is a technique by which an antimicrobial solution is used to fill a catheter lumen and then allowed to dwell for a period of time while the catheter is idle. The purpose of this technique is:

- To treat and preserve long-term central venous catheters (CVC) with an associated bacterial infection which would otherwise require line removal.
- To prevent central line-associated bloodstream infections in patients with long-term catheters who have had a history of multiple bloodstream infections despite optimal maximal adherence to aseptic technique.

The purpose of this policy/procedure is to ensure safe and effective administration of antibiotic lock therapy/prophylaxis in the treatment and prevention of central line-associated bloodstream infections.

SECTION II: DEFINITIONS

CLABSI: central line-associated bloodstream infection
CVC: central venous catheter
ALT: antibiotic lock therapy – instillation of an antibiotic into a CVC and allowing the solution to dwell for a period of time to treat an infected catheter while the catheter is idle.
PAL: prophylactic antibiotic lock – instillation of an antibiotic into a catheter and allowing the solution to dwell for a period of time to prevent a CLABSI
PICC: peripherally-inserted central catheter
Short-term catheter: CVCs that are in situ for <14 days
Long-term catheter: CVCs that are in situ for ≥14 days

SECTION III: BACKGROUND

CVCs are an essential tool in the care of pediatric patients who have limited options for intravenous access and/or who require long-term intravenous access for parenteral nutrition, chemotherapy, blood products, and/or antimicrobial therapy.

While CVCs have significant benefits, they are also associated with an increased risk of complications. In the United States, approximately 250,000 cases of CLABSIs occur annually, ~80,000 occurring in intensive care units each year. The cost of these infections is substantial, both in terms of morbidity and the financial resources expended.

Most CLABSIs emanate from the insertion site, hub, or both. For long-term catheters, particularly tunneled catheters, the catheter hub is a prominent source of microbes causing bloodstream infection. Infection occurs when microorganisms create a biofilm on the surface of the CVC and then disseminate hematogenously. While systemic antimicrobial therapy can at times be successful in treating CLABSIs, persistent bacteremia during parenteral therapy and recurrent bacteremia after completion of parenteral therapy are more likely to occur when the CVC is retained. This likely reflects the presence of a biofilm on the CVC and the inability of most antibiotics to achieve the therapeutic concentrations needed to kill the sessile microbes growing in this biofilm, which requires antimicrobial concentrations 100 to 1000 times greater than the minimum inhibitory concentration (MIC). Due to the concern of treatment failure with systemic antimicrobial therapy alone, removal of the CVC is often considered. However, this approach is not ideal under all circumstances, particularly among pediatric patients who may have a critical need for ongoing intravenous access but have limited sites for access. Therefore, there is a substantial benefit in the safe salvage of CVCs for select patients.

Antibiotic lock therapy was introduced in 1988 as a method to treat CLABSIs (in conjunction with systemic antimicrobial therapy) and allow for the safe retention of CVCs. Because the majority of infections involving long-term catheters or totally implanted catheters are intraluminal, eradication of such infections

is attempted by filling the catheter lumen with a supratherapeutic concentration of antibiotic and leaving this to dwell for a period of time, thereby creating an antibiotic lock. This technique has been shown to improve the success rate of CVC salvage without relapse of infection. The use of antibiotic lock prophylaxis has also been shown to reduce the risk for primary CLABSIs in certain patient populations. While ethanol locks have been utilized in a similar fashion, this technique has certain limitations in that ethanol is incompatible with heparin and some types of CVCs, in particular those made of polyurethane.

The Infectious Disease Society of America (IDSA) recommends the use of antibiotic lock therapy for patients with CLABSIs involving long-term catheters for whom catheter salvage is the goal. In addition, IDSA recommends use of prophylactic antibiotic lock solutions in patients with long term catheters who have a history of multiple CLABSI despite optimal maximal adherence to aseptic technique.

SECTION IV: ELIGIBILITY CRITERIA

1. Patients qualify for ALT if **ALL** of the following conditions are met
    - Presence of long-term CVC with an associated bacterial infection
    - Desire or requirement to salvage the CVC
    - At least one positive blood culture obtained from a peripheral or central site
    - Uncomplicated CLABSI
    - ALT will always be used in combination with systemic antibiotic therapy (unless there is evidence of catheter colonization without bacteremia)
2. Patients qualify for PAL if **ALL** of the following conditions are met:
    - Presence of long-term CVC
    - History of multiple CLABSIs despite optimal maximal adherence to aseptic technique
3. Patients are excluded from ALT or PAL if **ONE** or more of the following conditions are met:
    - Signs of exit site or tunnel infections
    - Documented allergy/hypersensitivity reaction to heparin (heparin-induced-thrombocytopenia)
    - CLABSI due to *S. aureus*, *P. aeruginosa*, *Candida* species, and mycobacteria. Catheter removal is recommended for infections due to these organisms unless there are extenuating circumstances. In addition, for less virulent microbes that are difficult to eradicate (e.g., *Bacillus* species, *Micrococcus* species, or Propionibacteria), catheters should generally be removed after blood culture contamination is ruled out on the basis of multiple positive culture results.
    - Presence of complicated bloodstream infection such as severe sepsis, endocarditis, suppurative thrombophlebitis, or osteomyelitis. Appropriate therapy is systemic antimicrobial therapy and catheter removal.
4. Patients requiring linezolid and/or antifungal locks require ID/ASP approval.

SECTION V: ORDERING OF ALT/PAL BY PHYSICIAN

1. ALT and PAL require Infectious Disease or Antimicrobial Stewardship Program approval.
2. Ordering physician will place an order for "Antibiotic Lock" indicating the following:
    - CVC to undergo ALT/PAL
    - Antibiotic concentration (and corresponding anticoagulant concentration, if necessary) to be used for the lock (see Appendix A)
    - Volume to be instilled based on type of CVC (see Appendix B)
    - Dwell time: minimum 3-6 hours and maximum 24 hours (dwell times may vary depending on availability of venous access and the necessity to use the catheter)
    - Frequency of instillation: at least once or twice every 24 hours
    - For double lumen CVC, specify in the administration instructions whether to alternate lumens or to instill in only one specific lumen
    - Duration of ALT/PAL
        - ALT: for the duration of systemic antibiotic therapy, generally 7-14 days
        - PAL: variable (determined on a case by case basis)
3. Note: when CLABSI present, blood cultures should be drawn from the CVC daily until sterilization is documented.

SECTION VI: ADMINISTRATION OF ALT/PAL BY NURSING

1. Assess patency of CVC by attempting to flush and draw from the catheter or port.
2. Assemble 3-way stopcock: one port with a 10 mL syringe containing 10 mL of normal saline for injection, the other port with a 3 mL syringe containing the antibiotic lock solution.
3. Attach the assembled 3-way stopcock to needleless connector.
5. Unclamp catheter and gently flush catheter with normal saline. The minimum volume of normal saline should be at least twice the catheter volume. *If administering liposomal amphotericin, the catheter must be flushed with dextrose 5% ONLY as it is incompatible with normal saline.
6. Instill antibiotic lock solution into catheter.
7. Clamp the catheter and remove 3-way stopcock.
8. Place "High Risk Medication – Antibiotic Lock with Heparin, Do Not Flush" label on the catheter hub.
9. Leave antibiotic lock for ordered dwell time.
10. After the ordered dwell time, withdraw the antibiotic lock solution and discard
11. Flush the catheter with 10 mL of normal saline. *If withdrawing liposomal amphotericin, the cathter must be flushed with destrose 5% ONLY, as it is incompatible with normal saline.
12. Flush the catheter with Heparin per IV Lock and Flush protocol to prevent catheter occlusion.
13. Document on MAR and nursing progress records.
14. Document any side effects on nursing progress records.

Appendix A: Standardized Final Concentrations for ALT/PAL

Antibiotic concentration	Anticoagulant concentration	Beyond Use Date (BUD)
Amphotericin B (liposomal) 2.67 mg/mL	Heparin 66.67 units/mL	Immediate use
Ampicillin 10 mg/mL	Heparin 10 units/mL	30 hours
Cefazolin 10 mg/ml	Heparin 10 units/mL	30 hours
Ceftazidime 0.5 mg/mL	Heparin 100 units/mL	30 hours
Gentamicin 2.4 mg/mL	Sodium Citrate 4%	30 hours
Vancomycin 2 mg/mL	Heparin 10 units/mL	30 hours
Linezolid 1 mg/mL	Heparin 10 units/mL	30 hours
Ethanol 70%*		

*See separate Ethanol Lock Policy under Vascular Access

Appendix B: Standardized Volumes for ALT/PAL

Type of Catheter	Volume of antibiotic lock to be instilled per lumen
PICC ≤2 FR	1 mL
PICC ≥2.5 FR	2 mL
Non Tunneled CVC	2 mL
Apheresis catheters	<15 kg: 1 mL 15-30 kg: 1.5 mL >30 kg: 2 mL
Tunneled CVC	2 mL
Implanted Port SL	2 mL
Implanted Port DL	Vortex: 2.5 mL BARD: 2 mL

Appendix C: Pharmacy Preparation of ALT/PAL Solutions

Amphotericin B (liposomal)/Heparin

Amphotericin B (liposomal) 4 mg/mL	4 mL
Heparin 1000 units/mL	0.4 mL
Dextrose 5% in water	1.6 mL
Total	6 mL

Ampicillin/Heparin

Ampicillin 250 mg/mL	0.2 mL
Heparin 100 units/mL	0.5 mL
0.9% Sodium Chloride	4.3 mL
Total	5 mL

Cefazolin/Heparin

Cefazolin 100 mg/mL	1 mL
Heparin 100 units/mL	1 mL
0.9% Sodium Chloride	8 mL
Total	10 mL

Ceftazidime/Heparin

Ceftazidime 100 mg/mL	0.2 mL
Heparin 1000 units/mL	4 mL
0.9% Sodium Chloride	35.8 mL
Total	40 mL

Gentamicin/Sodium Citrate

Gentamicin 40 mg/mL	0.3 mL
Sodium Citrate 4%	4.7 mL
Total	5 mL

Vancomycin/Heparin

Vancomycin 5 mg/mL	2 mL
Heparin 100 units/mL	0.5 mL
0.9% Sodium Chloride	2.5 mL
Total	5 mL

Linezolid/Heparin

Linezolid 2 mg/mL	5 mL
Heparin 100 units/mL	1 mL
0.9% Sodium Chloride	4 mL

Total	10 mL

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Applicable and Regulatory Standards:

Approval Process:

Date	**Committee/Legal**	
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6/13/14, 8/9/17 (Revision)	Antimicrobial Stewardship Program Committee	
8/16/17 (Revision)	Infection Control Committee	
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