Flushing/Locking of Venous Access Devices – Adult/Pediatric – Inpatient/Ambulatory Clinical Practice Guideline

EXECUTIVE SUMMARY ................................................................. 3
SCOPE ......................................................................................... 3
METHODOLOGY ........................................................................... 4
DEFINITIONS ................................................................................. 4
INTRODUCTION ............................................................................. 5
RECOMMENDATIONS .................................................................... 5
UW HEALTH IMPLEMENTATION ............................................... 15
REFERENCES ............................................................................... 15
APPENDIX A MODIFIED GRADING OF RECOMMENDATIONS ASSESSMENT, DEVELOPMENT, AND EVALUATION (GRADE) ......................................................... 17

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Executive Summary
Guideline Overview
This clinical practice guideline is intended to promote the use of standardized processes for flushing and locking of venous access devices with the goal of decreasing the risk of complications arising from occlusion, infection, or mixing of incompatible fluids.

The clinical interventions and practices recommended in this guideline assist the user in selecting the appropriate medication, volume and frequency of flushing and locking based on the population and the type of venous catheter device.

Key Practice Recommendations
1. Flushing of venous access devices is performed after each medication infusion or blood draw.
2. Venous access devices should be locked when used intermittently.
3. Selection of flushing/llocking fluid is based on multiple factors: adverse events, efficacy, patient medical history and beliefs, device type.
4. Patency of VAD should be assessed regularly with appropriate action taken for partially or fully occluded lines.
5. General flushing should include a turbulent flushing technique using a 10mL syringe and appropriate fluid.
6. General locking should include positive fluid displacement maintenance, avoiding heparin when patient has history of heparin induced thrombocytopenia (HIT), and selecting an antibiotic lock solution for salvage on an infected long-term central venous access device.

Companion Documents
1. UW Health Central Venous Access Device Occlusion- Adults/Pediatric/Neonatal-Inpatient/Ambulatory Guideline
2. UW Health Anti-Infective Lock Therapy – Adult/Pediatric – Inpatient/Ambulatory Guideline

Scope
Disease/Condition(s): Provides recommendations for nurses, physicians, and radiologic technologists who care for inpatients and outpatients with central venous access devices, peripheral venous access devices, implanted ports, hemodialysis catheters and apheresis lines.

Clinical Specialty: All specialties

Intended Users: Nurses, pharmacists, radiologic technologists.

Objective(s): This clinical practice guideline is intended to promote the use of a standardized process for the flushing and locking of venous access devices with an objective of decreasing the risk of complications.

Target Population: The target populations include inpatients and outpatients with central venous access devices, peripheral venous access devices, implanted ports, hemodialysis catheters and apheresis lines.
Interventions and Practices Considered

The clinical interventions and practices recommended in this guideline are for VAD maintenance. Practices considered include routine VAD assessment and appropriate flushing and locking depending on population targeted, type of line, appropriate fluid volume and necessary frequency.

Major Outcomes Considered

Line complications: occlusions, infections, fluid incompatibilities

Methodology

1. This guideline reflects the findings of a comprehensive literature review including external guidelines related to the maintenance of venous access devices.
2. A modified Grading of Recommendations Assessment, Development and Evaluation (GRADE) developed by the American Heart Association and American College of Cardiology (Appendix A) has been used to assess the Quality and Strength of the Evidence in this Clinical Practice Guideline.

Definitions

<table>
<thead>
<tr>
<th>Type of Device</th>
<th>Common Catheter Length</th>
<th>Insertion Location</th>
<th>Duration of Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Umbilical Venous and Arterial Catheter (UVC/UAC)</td>
<td>&lt; 5 cm</td>
<td>Inserted through the umbilical vein and joins the left portal vein or umbilical artery and joins arteries either at the thoracic or lumbar vertebral bodies</td>
<td>Short-term access up to 7 days after birth</td>
</tr>
<tr>
<td>Peripheral (PIV)</td>
<td>&lt; 3 in</td>
<td>Terminates in a vein of the forearm or hand, location may vary in pediatric patients</td>
<td>Short-term access &lt; 1 week</td>
</tr>
<tr>
<td>Midline</td>
<td>3 – 8 in</td>
<td>Peripheral device terminating in the basilic, cephalic or brachial vein distal to the shoulder</td>
<td>Access needed for ≤ 29 days, not appropriate for vesicant administration</td>
</tr>
<tr>
<td>Non-Tunneled Central</td>
<td>≥ 8 cm</td>
<td>Percutaneous device terminating in the superior or inferior vena cava</td>
<td>Short term access when peripheral not suitable, ex. resuscitation and central venous pressure monitoring</td>
</tr>
<tr>
<td>Peripherally Inserted Central (PICC)</td>
<td>≥ 20 cm</td>
<td>Peripheral device terminating in the superior or inferior vena cava</td>
<td>Medium-term (up to 6 months) access</td>
</tr>
<tr>
<td>Tunneled Central</td>
<td>≥ 8 cm</td>
<td>Implanted into the subclavian, internal jugular, or femoral veins</td>
<td>Frequent medium-term (up to 6 months) access and a PICC line is contraindicated</td>
</tr>
<tr>
<td>Implanted Central (Port)</td>
<td>≥ 8 cm</td>
<td>Tunneled under skin with port accessed by needle; implanted in subclavian or internal jugular vein terminating in the superior vena cava</td>
<td>Infrequent long-term (&gt; 6 months) access</td>
</tr>
<tr>
<td>Dialysis and Apheresis</td>
<td>≥ 15 cm</td>
<td>Non-cuffed catheter placed in the neck or chest terminating in the superior or inferior vena cava</td>
<td>Long or short term access for the maintenance of dialysis therapy</td>
</tr>
</tbody>
</table>
**Introduction**
Venous access devices (VADs) are commonly utilized when providing care for patients in the hospital setting to administer medications, fluids, blood products, nutrition and to withdraw blood for testing. Selection of the VAD must be tailored to each patient’s needs related to the type, duration, and frequency of the infusions being administered. It is imperative that these lines be diligently maintained to avoid potential complications. Catheter occlusion, resulting from precipitate, mechanical or thrombotic causes, is the most common non-infectious complication resulting from long-term use of central VADs. Due to the combination of venous stasis, enhanced blood coagulation and alterations or trauma to vessel walls, thrombotic occlusions may develop within or around the device, or in the surrounding vessel. Bloodstream infections are another major complication, with the development of biofilm precipitating these events. Flushing and locking helps to retain catheter patency by preventing fibrin buildup, separating incompatible fluids or medications, and assists in reducing catheter infection by limiting biofilm growth.

**Recommendations**

Recommendations for flushing and locking
1. **Flushing Purpose: (UW Health Class I, Level of Evidence A)**
   Flushing should be performed: prior to each infusion to assess VAD function, after each infusion to prevent mixing of incompatible medications and solutions, and after blood sampling.

2. **Locking Purpose (UW Health Class I, Level of Evidence A)**
   Locking should be performed in an intermittently used VAD to maintain device patency and prevent occlusion.

3. A summary of UW Health flushing and locking recommendations for specific populations are provided at the end of this document.

**Table 1. Available flushing and locking solutions**

<table>
<thead>
<tr>
<th>NICU ONLY</th>
<th>Available Flushing and Locking Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium chloride 0.9%</td>
<td>2 ml</td>
</tr>
<tr>
<td>Heparin 1 unit/ml</td>
<td>2 ml</td>
</tr>
<tr>
<td></td>
<td>AFCH pharmacy only</td>
</tr>
<tr>
<td>ALL PATIENT CARE AREAS EXCEPT THE NICU</td>
<td></td>
</tr>
<tr>
<td>Sodium chloride 0.9%</td>
<td>10 ml</td>
</tr>
<tr>
<td>Heparin 10 units/ml</td>
<td>5 ml</td>
</tr>
<tr>
<td>Heparin 100 units/ml</td>
<td>5 ml</td>
</tr>
<tr>
<td>Sodium citrate 4%</td>
<td>2.5 ml</td>
</tr>
<tr>
<td>Dextrose 5%</td>
<td>5 ml</td>
</tr>
<tr>
<td>Ethanol 50%</td>
<td>2.5 ml</td>
</tr>
<tr>
<td>DIALYSIS</td>
<td></td>
</tr>
<tr>
<td>Heparin 1000 units/ml</td>
<td>10 ml</td>
</tr>
<tr>
<td></td>
<td>Central pharmacy</td>
</tr>
</tbody>
</table>
4. Multiple factors should be considered when choosing a solution to flush and lock venous access devices. *(UW Health Class I, Level of Evidence C)*

4.1. Adverse drug effects of heparin

4.1.1. Heparin

4.1.1.1. Iatrogenic hemorrhage

4.1.1.2. Heparin-induced thrombocytopenia (HIT) and heparin-induced thrombocytopenia and thrombosis (HITT)*

4.2. Efficacy of solution

4.2.1. Consider patient’s thrombus and infection risks

4.3. Patient concern and beliefs

4.3.1. Heparin is derived from animal sources: bovine lungs and porcine intestines. Consider vegetarian, Muslim, Jewish and other populations who may not condone use of pork and/or beef products

4.4. The presence of a valve in the VAD*10

4.4.1. It is appropriate to lock a VAD with a valve with 0.9% normal saline

4.4.2. Non-valved VADs require the use of a heparin locking solution

4.5. Compatibility of the flushing solution with the medication being administered.

4.5.1. When the medication is incompatible with 0.9% sodium chloride (USP), 5% dextrose in water should be used. Dextrose flushes should be followed by a 0.9% normal saline flush because dextrose can provide nutrients for biofilm growth if left in the catheter. *(UW Health Class I, Level of Evidence C)*

5. Do not use heparin as a locking solution in those patients who should not receive it, including patients with the following *(UW Health Class I, Level of Evidence A)*

5.1. Heparin allergy

5.2. Low platelet count (<160,000/uL)

5.3. Hemophilia

5.4. History, risk or presence of heparin-induced thrombocytopenia (HIT)*

5.5. Adult cardiothoracic surgery patients (per UW policy)*9,11,12

5.6. Patients on D6/5

D. Recommendations for Line Care

1. Perform appropriate hand hygiene and scrub the needleless connector for a minimum of 15 seconds. *(UW Health Class I, Level of Evidence B)*

2. Patency Assessment

2.1. The nurse should aspirate the catheter for blood return as a component of assessing catheter function prior to administration of medications and solutions. *(UW Health Class I, Level of Evidence C)*

2.2. If resistance is met and/or no blood return noted, the nurse should take further steps to assess patency of catheter prior to the administration of medications and solutions. *(UW Health Class I, Level of Evidence C)*

2.3. A VAD should never be forcibly flushed or flushed against resistance. In order to prevent damage, the patency of the VAD should be assessed using a 10 ml syringe. *(UW Health Class III, Level of Evidence C)*
3. Clinicians should be aware of the reasons for a VAD occlusion\(^2\) (*UW Health Class I, Level of Evidence C*)
   3.1. Partial occlusion – presents as sluggish or lack of blood return, however the VAD often flushes and infuses without difficulty. Causes for partial occlusions include:
      3.1.1. A fibrin sheath and/or fibrin tail has developed.
      3.1.2. The catheter tip is malpositioned.
      3.1.3. Lipid accumulation.
   3.2. A complete occlusion – exists when blood return is absent and the line is unable to be used for infusion or flushing. Causes of complete occlusions include:
      3.2.1. Mechanical failure of the VAD
      3.2.2. Medication precipitation
      3.2.3. Thrombus
   3.3. Thrombotic occlusion are caused by fibrin build up within or around central VADs or surrounding vessel and may result in either partial or complete occlusions. For management of occluded central lines at UW Health see [UW Health Central Venous Access Device Occlusion- Adults/Pediatric/Neonatal- Inpatient/Ambulatory Clinical Practice Guideline].

4. Infection: to prevent (in appropriate circumstances) or manage device related bacteremia see [UW Health Anti-Infective Lock Therapy – Adult/Pediatric – Inpatient/Ambulatory Guideline].

E. Recommendations for General Flushing
   1. The “Push-Pause” (“Stop-Start”) technique should be used to flush the VAD.
      1.1. The “Push-Pause” is a turbulent flushing technique that is speculated to allow the flushing solution to scrub or clean the inside of the device wall by pushing small boluses of fluid from the flushing syringe with pauses in between until the desired volume has been inserted. (*UW Health Class IIa, Level of Evidence C*)
   2. Syringes of 10ml volume should be used when flushing catheters to avoid excessive pressure that may lead to catheter rupture or dislodging of clots generated by smaller syringes.\(^1,2\) (*UW Health Class IIa, Level of Evidence C*)
   3. Flushing should be performed: (*UW Health Class IIa, Level of Evidence C*)
      3.1. After blood sampling
      3.2. When converting from continuous to intermittent therapies
      3.3. Before and after medication administration
      3.4. Before and after administration of blood components
      3.5. Before and after intermittent therapy
      3.6. For maintenance of a capped line to assess patency\(^2\)
   4. Single-use systems include single-dose vials and prefilled syringes and are the preferred choices for flushing and locking.\(^2\) (*UW Health Class I, Level of Evidence C*)
   5. A minimum volume of twice the internal volume of the catheter system is recommended; however a larger volume may be needed for blood sampling or blood transfusion procedures.\(^1,2\) (*UW Health Class IIa, Level of Evidence C*)

F. Recommendations for General Locking
   1. Positive fluid displacement within the lumen of the catheter should be maintained to prevent reflux of blood upon Luer disconnection. This is accomplished with either a
flushing technique or a needleless connector designed to overcome blood reflux.² (UW Health Class III, Level of Evidence C)

1.1. UW Health uses neutral needleless connector devices therefore blood reflux is not dependent on flushing technique. To prevent blood from entering the tip, the line should be clamped while injecting the last 0.5 ml of solution prior to removing the syringe from the connector.

2. Heparin is contraindicated in patients with HIT, heparin allergy or patients with an uncontrollable active bleeding state, except when this is due to disseminated intravascular coagulation²,¹⁴ (UW Health Class III, Level of Evidence A)

2.1. If the presence of HIT is suspected or confirmed all heparin products should be discontinued.² (UW Health Class I, Level of Evidence A)

3. Alternative locking solutions may be considered in patients with HIT including, but not limited to, ethanol, sodium citrate, or normal saline. These solutions do not have a labeled indication for maintaining catheter patency.² (UW Health Class IIa, Level of Evidence A)

4. Antibiotic lock solution may be used for salvage of an infected long-term CVAD in the absence of a tunnel or port-pocket infection.² (UW Health Class III, Level of Evidence C)

4.1. Use of antibiotic lock solution is not recommended as a routine prophylactic measure due to the possibility of development of resistant strains of microorganisms and adverse reactions to the high concentration of lock solution.² (UW Health Class III, Level of Evidence C)

4.2. For more information about treating an infection in a long-term VAD see the UW Health Anti-Infective Lock Therapy – Adult/Pediatric – Inpatient/Ambulatory Guideline
**Table 2. Summary of Flushing and Locking Recommendations for Adult Patients (UW Health Class I, Level of Evidence C)**

<table>
<thead>
<tr>
<th>Vascular Access Device</th>
<th>Flushing Frequency</th>
<th>Flushing Medication*</th>
<th>Locking Medication</th>
<th>Catheter Capacity per Lumen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral (PIV)</td>
<td>Before and after each access or every 8 hours if not in use</td>
<td>0.9 % Sodium Chloride 10 ml</td>
<td>0.9% Sodium Chloride 1 mL</td>
<td>1 mL</td>
</tr>
<tr>
<td>Midline</td>
<td>Before and after each access or every 8 hours if not in use</td>
<td>0.9 % Sodium Chloride 10 ml</td>
<td>0.9% Sodium Chloride 1 mL</td>
<td>1.5 mL</td>
</tr>
<tr>
<td>Peripherally Inserted Central (PICC)</td>
<td>Before and after each access or every 12 hours if not in use</td>
<td>0.9 % Sodium Chloride 10 ml (Flush with 20 ml after blood draw)</td>
<td>Heparin 10 units/ml</td>
<td>1.5 mL</td>
</tr>
<tr>
<td>Tunneled or Non-Tunneled Central (Broviac, Hickman)</td>
<td>Before and after each access or once daily if not in use</td>
<td>0.9 % Sodium Chloride 10 ml</td>
<td>Heparin 10 units/ml</td>
<td>2 mL</td>
</tr>
<tr>
<td>Central Venous Power Injectable Line</td>
<td>Before and immediately after each access or once daily if not in use</td>
<td>0.9 % Sodium Chloride 10 ml</td>
<td>Heparin 10 units/ml</td>
<td>&lt; 1 mL</td>
</tr>
<tr>
<td>Tunneled or Non-Tunneled Central (Groshong)</td>
<td>Before and after each access or every 8 hours if not in use</td>
<td>0.9 % Sodium Chloride 10 ml</td>
<td>0.9% Sodium Chloride 1.5 mL</td>
<td>1.5 mL</td>
</tr>
<tr>
<td>Implanted Central Venous Port (Intermittent Use)</td>
<td>Before and after each access or every 24 hours if not in use</td>
<td>0.9 % Sodium Chloride 10 ml (Flush with 20 ml after blood draw)</td>
<td>Heparin 10 units/ml</td>
<td>2 mL</td>
</tr>
<tr>
<td>Implanted Central Venous Port (Not in use and de-accessed)</td>
<td>Every 4 weeks to lock off port</td>
<td>0.9 % Sodium Chloride 10 ml (Flush with 20 ml after blood draw)</td>
<td>Heparin 100 units/ml</td>
<td>2 mL</td>
</tr>
<tr>
<td>Dialysis and Apheresis</td>
<td>Before and after each access or once weekly if not in use</td>
<td>0.9 % Sodium Chloride 10 ml</td>
<td>Heparin 1000 units/ml OR Citrate 4%</td>
<td>Fill volume of each lumen of the catheter + 0.2 ml If catheter size is unknown estimate: Non-tunneled 1.5 ml + 0.2 ml Tunneled 1.8 ml + 0.2 ml) If using a TEGO connector, lock with 8-9 ml sodium chloride flush 0.9%</td>
</tr>
</tbody>
</table>

While saline is the preferred flushing solution for all devices, open-ended devices should be flushed with heparin if recommended by the manufacturer.
Table 3. Summary of Flushing and Locking Recommendations for Adults Post Cardiac Surgery or with Heparin Induced Thrombocytopenia (HIT) *(UW Health Class I, Level of Evidence C)*

<table>
<thead>
<tr>
<th>Vascular Access Device</th>
<th>Flushing Frequency</th>
<th>Flushing Medication</th>
<th>Locking Medication</th>
<th>Catheter Capacity per Lumen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midline</td>
<td>Before and after each access or every 8 hours if not in use</td>
<td>Sodium Chloride Flush 0.9% 5-10 ml</td>
<td>Sodium Chloride Flush 0.9% 5-10 ml</td>
<td>1.5 mL</td>
</tr>
<tr>
<td>Central (Including PICC)</td>
<td>Before and after each access or every 8 hours if not in use</td>
<td>Sodium Chloride Flush 0.9% 10 ml</td>
<td>Sodium Chloride Flush 0.9% 10 ml</td>
<td>1.5 - 2 mL</td>
</tr>
</tbody>
</table>
Table 4. Summary of Flushing and Locking Recommendations for Pediatric Patients *(UW Health Class I, Level of Evidence C)*

<table>
<thead>
<tr>
<th>Vascular Access Device</th>
<th>Flush Solution*</th>
<th>Flushing Volume</th>
<th>Flushing Frequency</th>
<th>Should this CVAD be locked?</th>
<th>Lock Solution*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral Intravenous Catheter (PIV)</td>
<td>Sodium Chloride 0.9%</td>
<td>Minimum of 1 mL</td>
<td>Before and after each access or every 8 hour if not in use</td>
<td>Yes</td>
<td>Sodium Chloride 0.9%</td>
</tr>
</tbody>
</table>
| Peripherally Inserted Central Catheter (PICC) | Sodium Chloride 0.9% | Minimum of 2 mL | Before and after each access or every 12 hour if not in use | Yes | Heparin*: concentration is determined by patient location.  
  • NICU = 1 unit/mL  
  • Other patient locations = 10 units/mL |
|                       | Heparin 0.5 units/mL | Continuous infusion at minimum rate of 0.5-1 mL/hour | Not applicable | No | Not applicable |
| Peripherally Inserted Central Catheter (PICC) 2.6 French double lumen (21 gauge and 23 gauge) Both lumens are managed the same. Recommendation: Blood sampling should be done through the 21 gauge lumen. | Heparin* 0.5 units/mL; Other solutions or emulsion (lipids) | Continuous infusion in both ports.  
  Minimum rates:  
  • Heparin solution = 0.5 mL/hour  
  • Other solutions = 1 mL/hour | Not applicable | No | Not applicable |

* Patients with a history of HIT/HITT should never receive heparin
<table>
<thead>
<tr>
<th>Vascular Access Device</th>
<th>Flush Solution</th>
<th>Flushing Volume</th>
<th>Flushing Frequency</th>
<th>Should this CVAD be locked?</th>
<th>Lock Solution</th>
</tr>
</thead>
</table>
| Non-Tunneled Central Venous Catheters (Cook, Arrow) | Sodium Chloride 0.9% | Minimum of 2 mL | Before and after each access or every 12 hour if not in use | Yes | Heparin*: concentration is determined by patient location.  
  - NICU = 1 unit/mL  
  - Other patient location = 10 units/mL |
| Tunneled Central Venous Catheters (Broviac, Hickman) Includes power injectable lines | Sodium Chloride 0.9% | Minimum of 2 mL | Before and after each access or every 12 hour if not in use.  
  In ambulatory setting flush every 24 hours if not in use. | Yes | Heparin*: concentration is determined by patient location:  
  - NICU = 1 unit/mL  
  - Other patient locations = 10 units/mL |
| Implanted Venous Port Includes power injectable ports | Sodium Chloride 0.9% | Minimum of 3 mL | Before and after each access or every 12 hour if not in use.  
  In ambulatory setting flush every 24 hours when not in use. | Yes | When accessed:  
  Heparin* 10 units/mL  
  For monthly lock (every 30 days) and when de-accessed:  
  Heparin 100 units/mL |

* Patients with a history of HIT/HITT should never receive heparin
<table>
<thead>
<tr>
<th>Vascular Access Device</th>
<th>Flush Solution</th>
<th>Flushing Volume</th>
<th>Flushing Frequency</th>
<th>Should This CVAD Be Locked?</th>
<th>Lock Solution</th>
</tr>
</thead>
</table>
| Umbilical Venous Catheter (UVC) Single lumen | Heparin*: concentration is determined by patient location:  
- NICU = 0.5 units/mL  
- Other patient locations = 1 units/mL | Continuous infusion at minimum rate of 0.5 mL/hr | Not applicable | No | Not applicable |
| Umbilical Venous Catheter (UVC) Double – Proximal lumen | Heparin*: concentration is determined by patient location:  
- NICU = 0.5 unit/mL  
- Other patient locations = 1 units/mL | Continuous infusion at minimum of 0.5 mL/hr | Not applicable | No | Not applicable |
| Umbilical Venous Catheter (UVC) Double – Distal lumen | Sodium chloride 0.9% | Minimum of 1 mL | Before and after each access OR every 12 hours when not in use | Yes | Heparin*: concentration is determined by patient location:  
- NICU = 0.5 units/mL  
- Other patient locations = 1 units/mL |
| Umbilical Arterial Catheter (UAC) | Heparin*: concentration determined by patient location:  
- NICU = 0.5 unit/mL  
- Other patient locations = 1 units/mL | Continuous infusion at minimum of 0.5 mL/hour | Not applicable | No | Not applicable |

* Patients with a history of HIT/HITT should never receive heparin
Table 4. Continued: Summary of Flushing and Locking Recommendations for Pediatric Patients
(UW Health Class I, Level of Evidence C)

<table>
<thead>
<tr>
<th>Vascular Access Device</th>
<th>Flush Solution</th>
<th>Flushing Volume</th>
<th>Flushing Frequency</th>
<th>Should this CVAD be locked?</th>
<th>Lock Solution</th>
</tr>
</thead>
</table>
| Dialysis and Apheresis          | Sodium Chloride 0.9% | Minimum of 3-5 mLs      | Before and after each access or weekly if not in use | Yes                         | • First line: Citrate 4% solution  
                                  |                   |                         |                           |                             | • Second line: Heparin 1000 Unit/mL* |
| Atrial Catheters (left or right)| Heparin* 1 unit/mL | Continuous infusion at minimum of 1mL/hour | Not Applicable                         | No                          | Not applicable                    |

* Patients with a history of HIT/HITT should never receive heparin
**UW Health Implementation**

**Potential Benefits**
1. Decrease in the incidence of occlusion and bloodstream infection
2. Decrease in the incidence of combining incompatible fluids/medications
3. Increased patient comfort and satisfaction

**Potential Harms**
1. HIT
2. Systemic anticoagulation
3. Fluid overload
4. Infection

**Patient Resources**
None identified.

**Implementation Plan/Tools**
1. Health Link will be used to implement the clinical practice guideline
2. Information will be sent to nurses, pharmacists, radiologic technologists, and physicians regarding updated guideline

**Disclaimer**
Clinical practice guidelines assist clinicians by providing a framework for the evaluation and treatment of patients. This guideline outlines the preferred approach for most patients. It is not intended to replace a clinician’s judgment or to establish a protocol for all patients. It is understood that some patients will not fit the clinical condition contemplated by a guideline and that a guideline will rarely establish the only appropriate approach to a problem.
References

### Appendix A Modified Grading of Recommendations Assessment, Development, and Evaluation (GRADE)

<table>
<thead>
<tr>
<th>LEVEL A</th>
<th>Recommendation that procedure or treatment is useful/effective</th>
<th>Evidence from multiple randomized trials or meta-analyses</th>
<th>Recommendation in favor of treatment or procedure being useful/effective</th>
<th>Some conflicting evidence from multiple randomized trials or meta-analyses</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS I</td>
<td>Benefit &gt;&gt; Risk Procedure/Treatment SHOULD be performed/ administered</td>
<td>Data derived from multiple randomized clinical trials or meta-analyses</td>
<td>Recommendation in favor of treatment or procedure being useful/effective</td>
<td>Some conflicting evidence from multiple randomized trials or meta-analyses</td>
</tr>
<tr>
<td>CLASS Ia</td>
<td>Benefit &gt;&gt; Risk Additional studies with focused objectives needed</td>
<td>IT IS REASONABLE to perform procedure/administer treatment</td>
<td>Recommendation of usefulness/efficacy less well established</td>
<td>Greater conflicting evidence from multiple randomized trials or meta-analyses</td>
</tr>
<tr>
<td>CLASS Ib</td>
<td>Benefit &gt;&gt; Risk Additional studies with broad objectives needed; additional registry data would be helpful</td>
<td>Procedure/Treatment MAY BE CONSIDERED</td>
<td>Recommendation that procedure or treatment is not useful/effective and may be harmful</td>
<td>Sufficient evidence from multiple randomized trials or meta-analyses</td>
</tr>
<tr>
<td>LEVEL B</td>
<td>Limited populations evaluated* Only consensus opinion of experts, case studies, or standard of care</td>
<td>Data derived from single randomized trial or nonrandomized studies</td>
<td>Recommendation in favor of treatment or procedure being useful/effective</td>
<td>Some conflicting evidence from single randomized trial or nonrandomized studies</td>
</tr>
<tr>
<td>CLASS IIa</td>
<td>Benefit &gt;&gt; Risk Additional studies with focused objectives needed</td>
<td>Procedure/Treatment MAY BE CONSIDERED</td>
<td>Recommendation of usefulness/efficacy less well established</td>
<td>Greater conflicting evidence from single randomized trial or nonrandomized studies</td>
</tr>
<tr>
<td>LEVEL C</td>
<td>Very limited populations evaluated* Only consensus opinion of experts, case studies, or standard of care</td>
<td>Recommendation in favor of treatment or procedure being useful/effective</td>
<td>Only diverging expert opinion, case studies, or standard of care</td>
<td>Recommendation of usefulness/efficacy less well established</td>
</tr>
<tr>
<td>CLASS IIb</td>
<td>Benefit &gt;&gt; Risk Additional studies with broad objectives needed; additional registry data would be helpful</td>
<td>Procedure/Treatment MAY BE CONSIDERED</td>
<td>Only diverging expert opinion, case studies, or standard of care</td>
<td>Recommendation that procedure or treatment is not useful/effective and may be harmful</td>
</tr>
</tbody>
</table>

*Estimated of certainty of treatment effect

**Effective 5-17-2018. Contact CCKM@uwhealth.org for previous versions.**