Clinical Guideline
Peripheral IV Extravasation/Infiltration (PIVIE) Treatment
Inpatient and Outpatient Pediatrics

NONCYTOTOXIC INFILTRATIONS & EXTRAVASATIONS: GUIDELINE FOR PEDIATRIC PATIENTS

Purpose:
To describe the management of intravenous (IV) infiltrations and extravasations in pediatric patients.

Applicability:
Prescribers, Pharmacists, Nurses

Procedure:
1. Definitions
   a. Infiltration: the inadvertent administration or leakage of a non-vesicant (e.g., irritant) medication or solution into the surrounding tissue instead of into the intended vascular space. This occurs when the catheter becomes dislodged or the vein ruptures, causing fluid to leak into the surrounding tissue.
   b. Extravasation: the inadvertent administration or leakage of a vesicant medication or solution into the surrounding tissue instead of into the intended vascular space. A vesicant is a solution or medication that causes the formation of blisters with subsequent sloughing of tissues occurring from tissue necrosis.

Note: Phlebitis is an inflammation of the intima of the vein, and is a commonly reported complication of infusion therapy. It is completely different from, but is often confused with infiltration and extravasation. It usually occurs when the vein is irritated from solutions.

2. Signs and Symptoms of IV Infiltrations/Extravasations
   a. Swelling
   b. Redness
   c. Stinging, burning, or pain at the administration site
   d. Loss of blood return from the IV
   e. IV flow rate that slows or stops
   f. Leaking around the IV catheter or implanted port needle
   g. Skin tightness at the venipuncture site
   h. Blotching of the skin
   i. Change in temperature of the skin, cool or warm

3. Measurement Based Assessment Tool
   a. The Cincinnati Pediatric Intravenous Extravasation Assessment System standardizes the identification and assessment in the early stage of infiltration and extravasation, thus reducing the need for treatment and serious complications.
   b. Three steps in the coding system:
      i. Volume measurement: measure max dimension of swelling of affected area (X), measure the ARM length (Y), calculate (X/Y) x 100= %.
         See Figure 1.
      ii. Medication Identification: Red (high risk), Yellow (intermediate risk), Green (low risk). See Figure 2.
      iii. Documentation: Document immediately in Cerner.

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Figure 1. Cincinnati Children's Hospital Medical Center IV Extravasation System
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Figure 2. Venous Infusion Extravasation Risk Chart

Venous Infusion Extravasation Risk
This is an estimate of risk for phlebitis or local tissue injury due to extravasation from any intravenous infusion device. Risk derived from available evidence, CCHMC data and CCHMC expert opinion, subject to review and change as further evidence becomes available.
For Treatment of Extravasation, Refer to CCHMC Policy P&T N-112
This does not apply to situations of emergency medical treatment.
If a medication is not on this list, please refer to the CCHMC formulary or contact pharmacy (6-4291) for information.

Red
Higher Risk
- Acyclovir
- Amiodarone
- Caffeine Citrate
- Calcium (all sub forms)
- Dextrose > 12.5%
- Doxycline
- Esmolol
- Mannitol 30% & 35%
- Promethazine
- Potassium >60 mEq/L
- Sodium bicarbonate ≥ 3%
- Sodium chloride ≥ 3%
- TPN > 500 mL/hour/L
- Vasopressors such as Dopamine

Yellow
Intermediate Risk
- Acetazolamide
- Allopurinol
- Amikacin
- Amphotericin B (conventional)
- Arginine
- Ciprofloxacin
- Dextrose 10% to ≤12.5%
- Diazepam
- Erythromycin
- Ganciclovir
- Lorazepam
- Midazolam
- Morphine
- Ondansetron
- NaCl
- Iodide based (CT) Radiology Contrast
- Phenobarbital
- Phenylethanol
- Potassium ≤ 60 mEq/L
- TPN ≤950 mL/hour/L
- Vancomycin

Green
Lower Risk
- Aminophylline
- Amphotericin B Liposomal
- Ampicillin
- Ampicillin/Sulbactam
- Cefazolin
- Cefotaxime
- Ceftriaxone
- Cefuroxime
- Clindamycin
- D5L.R.
- Dextrose < 10%
- Fentanyl
- Fosphenytoin
- Furazolidone
- Gaddelinium Based (MRI) Contrast
- Gentamicin
- Hydrocortisone
- Imipenem
- IVIG
- Lactated Ringers
- Lidocaine
- Magnesium sulfate (bolus)
- Metoprolol
- Methylprednisolone
- Normal saline
- Pantoprazole
- Piperacillin
- Tobramycin

NOTE:
- No intravenous infusion is "safe"
- Gross extravasation, even of normal saline, may result in serious harm including compartment syndrome causing ischemia and loss of muscle or permanent loss of limb function

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4. Management of Noncytotoxic Infiltrations/Extravasations (See Figure 3).
   a. Stop the infusion
   b. Assess the affected site for pain, erythema, and size of the infiltration
   c. Elevate the affected extremity to reduce swelling
   d. Notify provider of suspected infiltrate
      i. A provider must evaluate an extravasation.
      ii. A provider must write orders for compresses and antidotes as appropriate. (Refer to Tables I and II)
      iii. All treatments, including warm and cool compresses, require a provider order
      iv. All orders for compresses must include the frequency and duration of application
   e. Estimate total volume of fluid that escaped into the tissue
   f. Obtain orders for treatment interventions as needed
   g. Attempt to aspirate residual drug from the IV needle/catheter using a small (1-3 mL) syringe. If administering antidote, the first dose (see Table I) may be administered into the subcutaneous tissue via this cannula
   h. If not administering an antidote, remove IV catheter
      i. Apply cold or warm compresses as ordered (see Table II)
         i. Do not apply pressure to the site
         ii. Compresses should never be warmed in the microwave
         iii. For extravasation in the neonate, defer to the provider for use of compress
   i. Assess skin surface every hour x 24 hours for induration, discoloration, and feeling of numbness in the affected extremity
   j. Educate patients/families on worsening symptoms and to notify a provider:
      i. Increased swelling
      ii. Increased pain
      iii. Blistering, ulceration, induration or other skin changes
      iv. Altered tissue perfusion
      v. Changes in sensation
   k. Consider a plastic surgery consult for any of the following:
      i. Increased swelling
      ii. Increased pain
      iii. Blistering, ulceration, induration or other abnormal skin changes
      iv. Large infiltrate (greater than 25-50 mLs)
   m. Consider a vascular surgery consult for any of the following:
      i. Altered tissue perfusion
      ii. Change in sensation
   n. Elevate the affected extremity for 48 hours to reduce swelling. After 48 hours, encourage the patient to use the extremity normally to promote full range of motion
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This guideline should not replace clinical judgment.

Figure 3. Treatment Plan

<table>
<thead>
<tr>
<th>% Swelling and Infusate Component</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extravasation &gt;/= 30% AND Red list infusate</td>
<td>Treat with Hyaluronidase or appropriate antidote per provider order</td>
</tr>
<tr>
<td>Extravasation &gt;/= 30% AND Red list infusate</td>
<td>Clinical evaluation of the extravasation site by bedside RN, provider, and RRT RN to determine if hyaluronidase or appropriate antidote is clinically indicated. Decision criteria include imminent skin loss, and/or peripheral circulation impairment (compartment syndrome)</td>
</tr>
<tr>
<td>Extravasation &gt;/= 30% AND Yellow or Green list infusate</td>
<td>Clinical evaluation of the extravasation site by bedside RN, provider, and RRT RN to determine if hyaluronidase or appropriate antidote is clinically indicated, but hyaluronidase treatment usually NOT indicated.</td>
</tr>
<tr>
<td>Extravasation &lt; 30% AND Yellow or Green list infusate</td>
<td>No treatment indicated</td>
</tr>
<tr>
<td>Extravasation of any % of a Red list Vasoactive medication (dopamine, epinephrine, and related medications)</td>
<td>IMMEDIATE consult to provider and RRT RN, if necessary, to determine treatment plan and use of phentolamine or appropriate antidote.</td>
</tr>
</tbody>
</table>

5. Outpatient Instructions Related to IV Infiltrations/Extravasations
   a. These instructions pertain to infiltrations/extravasations that occur in the outpatient infusion center or if the patient is discharged within 72 hours of an inpatient infiltration/extravasation event
   b. Provide the following instructions to the patient and/or the patient’s family:
      i. Continue to apply cold or warm compresses as ordered (refer to Table 1). Do not apply pressure to the site.
      ii. Continue to elevate the affected extremity for 48 hours after the event to reduce swelling. After 48 hours, use the extremity normally to promote full range of motion
      iii. Monitor the infiltration/extravasation site closely for at least 72 hours after the event. Some sequelae may not manifest for 2-3 weeks after the event. Notify your physician and go to the emergency room to seek immediate medical attention if there is:
         1. Increased swelling
         2. Increased pain
         3. Blistering, ulceration, induration or other skin changes
         4. Altered tissue perfusion
         5. Changes in sensation
   c. The provider’s office and/or nurse should contact the patient the day after an outpatient infiltration/extravasation event to follow-up on the patient’s status

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6. Documentation of IV Infiltrations/Extravasations
   a. All infiltrations and extravasations must be verbally reported to the treating provider and the charge nurse on the inpatient unit.
   b. All infiltrations and extravasations must be electronically reported in the Safety Intelligence Reporting System.
   c. All infiltrations/extravasations must be documented in the medical record and include the following information:
      i. Date and time of infiltration/extravasation
      ii. Infiltrating/extravasating agent (including concentration and diluent)
      iii. Estimated volume of infiltration/extravasation
      iv. IV catheter type
      v. Location of IV insertion site
      vi. Description of infiltration/extravasation (including but not limited to the following):
         1. Size of the affected area
         2. Presence of swelling or redness
         3. Report of stinging, burning, or pain at the administration site
         4. Presence/absence of blood return
         5. Decreased IV flow rate
         6. Leaking around IV needle/catheter
      vii. Name of the provider that was notified and time notified
      viii. Any interventions (including compresses and antidotes)
      ix. Any response to interventions
      x. Patient education
   d. All site checks performed must be documented.

Table I. Treatment of Extravasation

<table>
<thead>
<tr>
<th>Overview of Treatment Modalities for Non-cytotoxic Medications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Pharmacologic</td>
</tr>
<tr>
<td>Elevation</td>
</tr>
<tr>
<td>Thermal</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Topicals</td>
</tr>
<tr>
<td>Pharmacologic</td>
</tr>
<tr>
<td>Hyaluronidase Injection</td>
</tr>
<tr>
<td><strong>Dilution:</strong> Withdraw 0.1 ml hyaluronidase 150 unit/ml &amp; place in 0.9 ml NS for concentration 15 units/ml.</td>
</tr>
<tr>
<td><strong>Administer:</strong> 15 units by Injection of 0.2 ml at 5 points around periphery of extravasation site. May repeat in 30-60 mins if no resolution. DO NOT use near active infection or purulence.</td>
</tr>
<tr>
<td>NICU</td>
</tr>
<tr>
<td>Dilute 0.1 mL hyaluronidase 150 unit/mL with 0.9 mL NS for a final concentration of 15 units/mL. Administer as five 0.2 mL injections around the periphery of the extravasation site</td>
</tr>
<tr>
<td>May repeat in 30-60 minutes if no resolution</td>
</tr>
<tr>
<td>Do NOT use near active infection or purulence</td>
</tr>
</tbody>
</table>

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### Inpatient and Outpatient Pediatrics

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<table>
<thead>
<tr>
<th>Treatment</th>
<th>Instructions</th>
</tr>
</thead>
</table>
| **Phentolamine Injection**     | **WEIGHTS < 1 kg:** use 0.1 mg/ml concentration  
Inject Total dose 0.05 mg by using 0.1 ml SQ at five points on edge of swelling/blanching can repeat in 60 mins but watch for low BP  
**WEIGHTS > 1-2.5 kg:** USE 0.1 mg/ml concentration  
Inject total dose 0.1 mg, by Using 0.2 ml SQ at five points on edge of swelling/blanching can repeat in 60 mins but watch for low BP  
**Weights 2.5-5 kg:** USE 0.5 mg/ml concentration  
Inject Total dose 0.25mg, by using 0.1 ml SQ at five points on edge of swelling/blanching can repeat in 60 mins but watch for low BP.  
**Weight < 5 kg:** see NICU recommendations  
**Weight > 5 kg:** USE 0.5mg/ml concentration  
Inject Total Dose 0.5mg, by Using 0.2 mL SubQ at five points at the leading edge of swelling/ blanching. Can repeat in 60 minutes. Monitor for low BP. | **WEIGHTS < 1 kg:** use 0.1 mg/ml concentration  
Inject Total dose 0.05 mg by using 0.1 ml SQ at five points on edge of swelling/blanching can repeat in 60 mins but watch for low BP  
**WEIGHTS > 1-2.5 kg:** USE 0.1 mg/ml concentration  
Inject total dose 0.1 mg, by Using 0.2 ml SQ at five points on edge of swelling/blanching can repeat in 60 mins but watch for low BP  
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Inject Total dose 0.25mg, by using 0.1 ml SQ at five points on edge of swelling/blanching can repeat in 60 mins but watch for low BP.  
**Weight < 5 kg:** see NICU recommendations  
**Weight > 5 kg:** USE 0.5mg/ml concentration  
Inject Total Dose 0.5mg, by Using 0.2 mL SubQ at five points at the leading edge of swelling/ blanching. Can repeat in 60 minutes. Monitor for low BP. |
| **Topical Nitroglycerin ointment** | Some say use on Postnatal age >/= 21 days  
Do not use on broken skin  
**DOSE:** 4 mm/kg of ointment MAX of 25 mm (1 inch)  
Use Gramfield tape:  
Order sentences:  
Nitroglycerin 2% ointment, 4 mm, (weight 1 kg)  
Apply ONCE  
MONITOR BP every 5 min x 15 mins  
Nitroglycerin 2% ointment , 8 mm, (weight 2 kg),  
Apply ONCE  
Monitor BP every 5 mins x 15 mins  
Nitroglycerin 2% ointment 12 mm, (weight 3kg),  
Apply once Monitor BP every 5 mins x 15 mins  
Nitroglycerin 2% ointment 16mm, (weight 4kg),  
Apply once Monitor BP every 5 mins x 15 mins  
Nitroglycerin 2% ointment 20 mm, (weight 5kg),  
Apply once Monitor BP every 5 mins x 15 mins | Weight < 5 kg: 4 mm/kg (max 25 mm) of ointment apply to affected area. Use Gramfield tape to measure.  
Weight > 5 kg: 1 inch apply to affected area  
Monitor BP every 5 minutes x 15 minutes |
| **Terbutaline (pediatrics)**    | Half-life too long in neonates                                                                                                                                             | Do not use in patients < 2 years of age  
Patient’s ≥ 2 years: Dilute 1 mg of terbutaline in 9 mL of NS to make a final concentration of 0.1 mg/mL. Inject 0.1-0.2 mL SubQ doses at the leading edge of the extravasated site |

*Phenolamine: extracted from NeoFax and Lexicomp & dose adjusted from pediatric cardiovascular surgery & dental literature.*
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**Table II. Medications Specific Treatment Modalities**

* For THERMAL Treatment in the neonate, defer to the provider for use of compress

<table>
<thead>
<tr>
<th>Drug</th>
<th>Mechanism of injury</th>
<th>Antidote</th>
<th>Primary Thermal Compress*</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acyclovir</td>
<td>pH</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>Ampicillin</td>
<td>Osmolarity</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>Amiodarone</td>
<td>pH</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>Amphotericin B</td>
<td>unknown</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>Aminophylline</td>
<td>osmolality/osmolarity</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>Arginine</td>
<td>pH/osmolarity</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>Calcium salts</td>
<td>osmolarity</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>Dantrolene</td>
<td>pH</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>Dextrose 10% W,12.5%</td>
<td>osmolarity</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>Diazepam</td>
<td>osmolarity</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>Digoxin</td>
<td>osmolarity</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>DoBUTamine</td>
<td>vasoconstriction</td>
<td>Phentolamine</td>
<td>warm</td>
<td>nitroglycerin ont/terbutaline-ped</td>
</tr>
<tr>
<td>DOPAmine</td>
<td>vasoconstriction</td>
<td>Phentolamine</td>
<td>warm</td>
<td>nitroglycerin ont/terbutaline-ped</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>pH</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>EPinephrine</td>
<td>vasoconstriction</td>
<td>Phentolamine</td>
<td>warm</td>
<td>nitroglycerin ont/terbutaline-ped</td>
</tr>
<tr>
<td>Esmolol</td>
<td>pH</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
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<tr>
<td>Etomidate</td>
<td>osmolarity</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>Fat Emulsion w/out TPN</td>
<td>Flush Out with Normal Saline</td>
<td>warm</td>
<td>FLUSH OUT procedure by Martin PH British J of Anaesthesia 1994;72:702.</td>
<td></td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Drug</th>
<th>Parameter</th>
<th>Solution</th>
<th>Temperature</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gentamicin</td>
<td>pH</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>Immune globulin</td>
<td>osmolarity</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>IV Contrast</td>
<td></td>
<td>No antidote</td>
<td>cool</td>
<td>Symptomatic treatment, defer to radiology IV Contrast policy</td>
</tr>
<tr>
<td>Lorazepam</td>
<td>osmolarity</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>Mannitol&gt;20%</td>
<td>osmolarity</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
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<tr>
<td>Metronidazole</td>
<td>unknown</td>
<td>Hyaluronidase</td>
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<td></td>
</tr>
<tr>
<td>Nafcillin</td>
<td>osmolarity</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>NOEpinephrine</td>
<td>vasoconstriction</td>
<td>Phentolamine</td>
<td>nitroglycerin/terbutaline-ped</td>
<td></td>
</tr>
<tr>
<td>Parenteral Nutrition</td>
<td>osmolarity</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>Pentamidine</td>
<td>pH</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>Phenobarbital</td>
<td>pH/osmolarity</td>
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<td>warm</td>
<td></td>
</tr>
<tr>
<td>Phenobarbital</td>
<td>pH/osmolarity</td>
<td>Hyaluronidase</td>
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<td></td>
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<tr>
<td>Phenytoin</td>
<td>pH/osmolarity</td>
<td>Hyaluronidase</td>
<td>warm</td>
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<tr>
<td>PHENYLephrine</td>
<td>vasoconstriction</td>
<td>Phentolamine</td>
<td>nitroglycerin/terbutaline-ped</td>
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</tr>
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<td>Potassium Phosphate</td>
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<td>Propofol</td>
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<td>warm</td>
<td>Flush out</td>
</tr>
<tr>
<td>Promethazine</td>
<td>pH</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>Sodium Bicarbonate</td>
<td>osmolarity</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td>Flush out/lidocaine</td>
</tr>
<tr>
<td>Sodium Chloride &gt;=3%</td>
<td>osmolarity</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
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<tr>
<td>Sodium Phosphate</td>
<td></td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
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<tr>
<td>Valproic acid</td>
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<td>cold</td>
<td></td>
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<tr>
<td>Vancomycin</td>
<td>pH</td>
<td>Hyaluronidase</td>
<td>warm</td>
<td></td>
</tr>
<tr>
<td>Vasopressin</td>
<td>vasoconstriction</td>
<td>Nitroglycerin ont</td>
<td>warm</td>
<td>Phentolamine/terbutaline-ped</td>
</tr>
</tbody>
</table>

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Ong JJ J Infus Nurs 2020;43(6)
Reynolds PM Pharmacotherapy 2014;34(6):67-632

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Executive Summary

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Approved (November 2021)

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References


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chrichmond.org

First approved: November 2021
Next expected update: November 2024
Peripheral IV Extravasation/Infiltration (PIVIE) Treatment Guideline

Executive Summary

Nitroglycerin


Phentolamine


Compartment Syndrome


Flush out Procedure


Citation

Title: PIVIE Guideline

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Date: November 2021

Retrieval website: http://www.chrichmond.org/clinicalguideline-PIVIE

Example:
Children's Hospital of Richmond at VCU, Saunders S, Pedigo S, Higgins K, McGehee J, Shaver L, Walczak D, Schefft M. PIVIE Guideline.
Available from: http://www.chrichmond.org/clinicalguideline-PIVIE