This handbook is intended for use in pediatric critical care and may not be applicable in many situations encountered in general pediatric practice. Due to the specialized nature of the PICU environment and patient population some of the drugs, indications, doses and monitoring requirements may be different in individual situations. While this book is intended to reflect the practice in the PICU at our institution at the time of writing new information may become available. Every attempt has made to ensure accuracy but these recommendations should be used with caution and with good clinical judgment.

We would like to thank our colleagues in the PICU at McMaster University Medical Centre for their input and we hope that this handbook is a useful reference for them. Thanks also to Colleen Cameron, Christine Folia and Christine Wynne for their extensive contributions to this project.

July 2004
## PALS Medications for Cardiac Arrest and Symptomatic Arrhythmias

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dose</th>
<th>Supplied</th>
<th>Administration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adenosine</strong></td>
<td>IV/IO: <strong>0.1 mg/kg</strong></td>
<td>3 mg/mL: 0.03 mL/kg</td>
<td>Rapid bolus followed by rapid flush</td>
</tr>
<tr>
<td></td>
<td>(max 6 mg)</td>
<td>(max 2 mL)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Repeat dose: <strong>0.2 mg/kg</strong></td>
<td>Repeat dose: 0.07 mL/kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(max 12 mg)</td>
<td>(max 4 mL)</td>
<td></td>
</tr>
<tr>
<td><strong>Amiodarone</strong>*</td>
<td>IV/IO: <strong>5 mg/kg</strong></td>
<td>50 mg/mL: 0.1 mL/kg</td>
<td>Rapid bolus for VF/VT, over 20-60 minutes for perfusing tachycardias</td>
</tr>
<tr>
<td></td>
<td>(max 300 mg)</td>
<td>(max 6 mL)</td>
<td></td>
</tr>
<tr>
<td><strong>Atropine</strong></td>
<td>IV/IO: <strong>0.02 mg/kg</strong></td>
<td>0.1mg/mL: 0.2 mL/kg</td>
<td>Bolus</td>
</tr>
<tr>
<td></td>
<td>(min 0.1 mg, max 0.5 mg for child, 1 mg for adolescent)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ET: use 2-10 times the IV dose</td>
<td></td>
<td>Dilute with NS to 3-5 mL</td>
</tr>
<tr>
<td><strong>Calcium Chloride</strong></td>
<td>IV/IO: <strong>20 mg/kg</strong></td>
<td>10% solution: 0.2 mL/kg</td>
<td>Give slow push, central line preferred</td>
</tr>
<tr>
<td><strong>Dextrose</strong></td>
<td>IV/IO: <strong>0.5-1 g/kg</strong></td>
<td>D&lt;sub&gt;10&lt;/sub&gt;W: 5-10 mL/kg</td>
<td>Avoid hyperglycemia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D&lt;sub&gt;50&lt;/sub&gt;W: 1-2 mL/kg</td>
<td></td>
</tr>
<tr>
<td><strong>Epinephrine</strong></td>
<td>IV/IO: <strong>0.01 mg/kg</strong></td>
<td>1:10 000: 0.1 mL/kg</td>
<td>Bolus</td>
</tr>
<tr>
<td></td>
<td>ET: <strong>0.1 mg/kg</strong></td>
<td>1:1 000: 0.1 mL/kg</td>
<td>Dilute with NS to 3-5 mL</td>
</tr>
<tr>
<td>Medication</td>
<td>Dose</td>
<td>Supplied</td>
<td>Administration</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------</td>
<td>---------------------------</td>
<td>-----------------------------------------</td>
</tr>
<tr>
<td><strong>Lidocaine</strong></td>
<td><strong>IV/IO: 1 mg/kg</strong></td>
<td>20 mg/mL: 0.05 mL/kg</td>
<td>Bolus</td>
</tr>
<tr>
<td></td>
<td><strong>ET</strong>: use 2-10 times the IV dose</td>
<td></td>
<td>Dilute with NS to 3-5 mL</td>
</tr>
<tr>
<td></td>
<td><strong>IV/IO Infusion: 20-50 microgram/kg/min</strong></td>
<td>Add 100 mg to total of 100 mL</td>
<td>Run at 1.2 - 3 mL/kg/h</td>
</tr>
<tr>
<td><strong>Magnesium Sulfate</strong></td>
<td><strong>IV/IO: 25-50 mg/kg</strong> (max 2 g)</td>
<td>0.5 g/mL: 0.05-0.1 mL/kg (max 4 mL)</td>
<td>Rapid infusion for torsades or severe hypomagnesemia</td>
</tr>
<tr>
<td><strong>Naloxone</strong></td>
<td><strong>IV/IO/IM: 0.1 mg/kg</strong> (max 2 mg)</td>
<td>0.4 mg/mL: 0.25 mL/kg (max 5 mL)</td>
<td>Bolus</td>
</tr>
<tr>
<td></td>
<td><strong>ET</strong>: use 2-10 times the IV dose</td>
<td></td>
<td>Dilute with NS to 3-5 mL</td>
</tr>
<tr>
<td><strong>Procainamide</strong>*</td>
<td><strong>IV/IO: 15 mg/kg</strong></td>
<td>100 mg/mL: 0.15 mL/kg (max 10 mL)</td>
<td>Give over 30-60 minutes</td>
</tr>
<tr>
<td><strong>Sodium Bicarbonate</strong></td>
<td><strong>IV/IO: 1 mEq/kg</strong></td>
<td>4.2%: 2 mL/kg 8.4%: 1 mL/kg</td>
<td>Give slowly and if ventilation is adequate. Use 4.2% in neonates</td>
</tr>
<tr>
<td>Cardioversion</td>
<td>0.5 J/kg, double dose if arrhythmia continues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defibrillation</td>
<td>2 J/kg initially then 4 J/kg for each subsequent defibrillation attempt.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ETT size</td>
<td>age in years + 4</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

*Do not routinely use in combination with other drugs that prolong the QT interval.*
PALS Bradycardia Algorithm

No

•Observe
•Support ABCs
•Consider transfer to ALS facility

Yes

Is Bradycardia causing severe cardio respiratory compromise? (poor perfusion, hypotension, respiratory difficulty, altered consciousness)

During CPR
•Attempt/verify tracheal intubation and vascular access
•Check electrode/paddle/pacer position and contact
•Give epinephrine q3-5 min, consider dopamine or epinephrine infusions
•Identify and treat possible causes:
  •Hypoxemia
  •Hypothermia
  •Head injury
  •Heart block
  •Heart transplant (special situation)
  •Toxins/poisons/drugs

Chest compressions if despite oxygenation and ventilation: heart rate < 60 bpm in infant or child and poor systemic perfusion

Epinephrine*
May repeat q3-5 min

Atropine*
(May repeat once)

Consider cardiac pacing

If Pulseless arrest develops, see Pulseless arrest algorithm

*Give atropine first for bradycardia due to suspected increased vagal tone or primary AV block.
PALS Tachycardia With Adequate Perfusion Algorithm

- **BLS Algorithm; Assess and Support ABCs prn**
- **Provide oxygen**
- **Attach monitor/defibrillator**
- **12 lead ECG if practical**

Evaluate QRS duration

QRS duration normal for age, approximately \( \leq 0.08 \) s

- **Evaluate rhythm**
  - **Probable sinus tachycardia**
  - **Probable supraventricular tachycardia**

During evaluation
- **Provide oxygen/ventilation**
- **Support ABCs**
- **Confirm monitor/pacer**
- **Prepare for cardioversion**
- **Identify and treat possible causes**
  - **Hypoxemia**
  - **Hypovolemia**
  - **Hyerthermia**
  - **Hyper/Hypokalemia**
  - **Metabolic disorders**
  - **Tamponade**
  - **Tension Pneumothorax**
  - **Toxins/Poisons/Drugs**
  - **Tromboembolism**
  - **Pain**

Consider alternative medications:
- **Amiodarone** or
- **Procaainamide** or
- **Lidocaine** bolus
  (do not routinely give amiodarone and procainamide together)

QRS duration wide for age, approximately \( >0.08 \) s

Probable ventricular tachycardia

Consider vagal maneuvers

Adenosine, double and repeat if ineffective

- **Consult pediatric cardiologist**
- **12 lead ECG**
- **Attempt cardioversion with sedation**
PALS Tachycardia With Poor Perfusion Algorithm

**BLS algorithm: Assess, support ABCs**

- **Pulse Present?**
  - **Yes**
    - Provide oxygen and ventilation prn
    - Attach monitor/defibrillator
  - **No**
    - See pulseless arrest algorithm

**QRS duration normal for age, approximately ≤ 0.08 s**

- **Evaluate the tachycardia**
  - Probable sinus tachycardia
  - Probable supraventricular tachycardia

**During evaluation**
- Oxygen/ventilation prn
- Confirm monitor/pacer
- Prepare for cardioversion
- Identify and treat possible causes:
  - Hypoxemia
  - Hypovolemia
  - Hyperthermia
  - Hyper/Hypokalemia
  - Metabolic disorders
  - Tamponade
  - Tension Pneumothorax
  - Toxins/Poisons/Drugs
  - Tromboembolism
  - Pain

**QRS duration wide for age, approximately >0.08 s**

- **Evaluate the tachycardia**
  - Immediate cardioversion
    - Probable ventricular tachycardia
      - Immediate cardioversion (sedate if possible, but no delays)
      - Consider alternative medications:
        - Amiodarone or
        - Procainamide or
        - Lidocaine bolus (wide complex only)
        (Do not routinely give amiodarone and procainamide together)
        • Consult pediatric cardiologist
        • 12 lead ECG

- Immediate cardioversion (sedate if possible, but no delays) or Immediate adenosine
PALS Pulseless Arrest Algorithm

• BLS Algorithm: Assess and Support ABCs prn
  • Provide oxygen
  • Attach monitor/defibrillator

Assess rhythm (ECG)

VF/VT

- Attempt defibrillation up to 3 times

- Epinephrine q3-5 min

- Attempt defibrillation within 30-60 s after each medication

- Amiodarone
  - Or
  - Lidocaine bolus
  - Or
  - Magnesium (for torsades des pointes or hypomagnesemia)

Not VF/VT (includes PEA and asystole)

- During CPR
  • Attempt/verify tracheal intubation/vascular access
  • Check electrode/paddle position and contact
  • Give epinephrine q3-5 min (consider higher doses for subsequent doses)
  • Consider alternative medications: vasopressors, antiarrhythmics, buffers
  • Identify and treat possible causes:
    • Hypoxemia
    • Hypovolemia
    • Hypothermia
    • Hyper/Hypokalemia
    • Metabolic disorders
    • Tamponade
    • Tension Pneumothorax
    • Toxins/Poisons/Drugs
    • Thromboembolism

- Epinephrine q3-5 minutes

- Continue CPR for up to 30 minutes
**PICU Sedation Algorithm for Intubated Patients**

**Patient is . . .**

**In pain**
- Morphine 0.1 mg/kg IV then 10-100 mcg/kg/h and 0.1 mg/kg IV q1h prn (for neonates, see Notes)
  - Is pain controlled?
    - Yes: Is patient anxious or agitated?
      - Yes: Morphine bolus AND increase infusion 20% AND adjunctive therapies
      - No: Re-assess q4h and prn Once patient has been adequately sedated for ≥ 24 hrs consider decreasing dose of sedatives to avoid oversedation.
    - No: Morphine bolus AND increase infusion 20% AND adjunctive therapies

**Anxious/Agitated**
- Lorazepam 0.1 mg/kg IV q2h or q4h and q1h prn (for neonates, see Notes)
  - Effective?
    - Yes: Add Morphine 0.1 mg/kg IV then 10-20 mcg/kg/h (for neonates, see Notes)
      - Effective?
        - Yes: Increase Lorazepam to 0.2 mg/kg IV q4h and q1h prn AND increase morphine to 30-100 mcg/kg/h
          - Effective?
            - Yes: D/C scheduled Lorazepam • Midazolam 1-6 mcg/kg/min (start at 3-4 mcg/kg/min) • Consider adjunctive therapies
              - Effective?
                - Yes: Call staff physician Propofol bolus 1-2 mg/kg IV then 0.5-4 mg/kg/h (maximum 12 hrs)
        - No: Effective?
          - Yes: Increase Lorazepam to 0.2 mg/kg IV q4h and q1h prn AND increase morphine to 30-100 mcg/kg/h
            - Effective?
              - Yes: D/C scheduled Lorazepam • Midazolam 1-6 mcg/kg/min (start at 3-4 mcg/kg/min) • Consider adjunctive therapies
                - Effective?
                  - Yes: Call staff physician Propofol bolus 1-2 mg/kg IV then 0.5-4 mg/kg/h (maximum 12 hrs)
          - No: Effective?
            - Yes: Increase Lorazepam to 0.2 mg/kg IV q4h and q1h prn AND increase morphine to 30-100 mcg/kg/h
              - Effective?
                - Yes: D/C scheduled Lorazepam • Midazolam 1-6 mcg/kg/min (start at 3-4 mcg/kg/min) • Consider adjunctive therapies
                  - Effective?
                    - Yes: Call staff physician Propofol bolus 1-2 mg/kg IV then 0.5-4 mg/kg/h (maximum 12 hrs)
            - No: Effective?
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                        - Effective?
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                    - No: Effective?
                      - Yes: Increase Lorazepam to 0.2 mg/kg IV q4h and q1h prn AND increase morphine to 30-100 mcg/kg/h
                        - Effective?
                          - Yes: D/C scheduled Lorazepam • Midazolam 1-6 mcg/kg/min (start at 3-4 mcg/kg/min) • Consider adjunctive therapies
                            - Effective?
                              - Yes: Call staff physician Propofol bolus 1-2 mg/kg IV then 0.5-4 mg/kg/h (maximum 12 hrs)
                        - No: Effective?
                          - Yes: Increase Lorazepam to 0.2 mg/kg IV q4h and q1h prn AND increase morphine to 30-100 mcg/kg/h
                            - Effective?
                              - Yes: D/C scheduled Lorazepam • Midazolam 1-6 mcg/kg/min (start at 3-4 mcg/kg/min) • Consider adjunctive therapies
                                - Effective?
                                  - Yes: Call staff physician Propofol bolus 1-2 mg/kg IV then 0.5-4 mg/kg/h (maximum 12 hrs)
Notes
1. This algorithm is not intended for non-intubated or status epilepticus patients and modification of these drugs, doses and monitoring may be required to minimize adverse effects, especially respiratory depression.
2. In neonates morphine is the drug of choice for sedation and a usual maximum of 40 microgram/kg/h is recommended. Consider midazolam instead of lorazepam to reduce exposure to solvents and preservatives.
3. Adjuncts for analgesia:
   i. Acetaminophen
   ii. NSAIDs: ibuprofen, naproxen or ketorolac
4. Adjuncts for sedation:
   i. Chloral hydrate
   ii. Diphenhydramine or dimenhydrinate
5. Adjuncts for treatment of adverse effects:
   i. Diphenhydramine/Dimenhydrinate for pruritis/nausea
   ii. Senna and lactulose for constipation
6. Give bolus of morphine or midazolam prior to increasing infusions.
7. Morphine and midazolam may accumulate in renal insufficiency.
8. Patients may require larger doses of sedatives and analgesics in first 24-48 hours. Reassess doses of medications daily to reduce accumulation.
9. There is no true maximum dose of morphine but most patients will require less than 100 microgram/kg/h.
10. Monitor patients for drug withdrawal and treat promptly with opiates and/or benzodiazepines. For patients receiving opiates or benzodiazepines for >5-7 days, wean (start at approximately 20% per day) to decrease the occurrence of withdrawal symptoms.
11. Patients who appear comfortable may still need sedation and/or analgesia for procedures.
**Neuromuscular Blockade Algorithm**

**Does patient actually require paralysis?**
- (Jet ventilator/oscillator/high airway pressures, patient fighting ventilator on maximal sedation, head injury, critical airway)

- **Yes**
  - Morphine infusion AND Lorazepam 0.1-0.2 mg/kg IV q4h + q1h prn
  - Would a 10-20 BPM increase in heart rate be detrimental?
    - **Yes**
      - Vecuronium 0.1mg/kg IV q30 min prn
      - Put sign in patient’s window to indicate patient is paralyzed.
    - **No**
      - Pancuronium 0.1 mg/kg IV q1h prn

- **No**
  - Continue with maximum sedation

**Reassess q4h**
- Lacrilube q6h and prn
Notes

1. Neuromuscular blockade is avoided unless strongly indicated. Most patients can be managed with deep sedation and/or adjustment of mode of ventilation. Indications for paralysis include jet ventilation, oscillation, high airway pressures, patient fighting ventilator on maximum sedation, severe head injury or a critical airway.

2. Neuromuscular blockade increases atelectasis in dependent regions, retention of secretions, skin breakdown and increases the risk of ventilator associated pneumonia and deep vein thrombosis.

3. Neuromuscular blockade can lead to prolonged muscle weakness especially in combination with corticosteroids.

4. Reassess need for paralysis frequently (q12-24h).

5. Assume that the patient can hear and feel you, but is unable to respond to you.

6. Use intermittent dosing, administering next dose with first sign of spontaneous movement or twitch.

7. Continuous infusions of neuromuscular blockers are not routinely recommended. If it would be detrimental for patient to recover briefly between bolus doses, consider paralyzing completely for 6-8 hours, then let patient recover to ensure no drug accumulation.

8. Peripheral nerve stimulation (Train of Four) is not routinely used, but may be useful when evaluating residual paralysis during emergence or evaluating drug dosage with continuous infusions.

9. **Regular sedation, analgesia and ocular lubrication** are required. These agents provide no analgesia or sedation.

10. **Duration of action with normal renal function:**
    - vecuronium: 30-60 minutes
    - pancuronium: 45-90 minutes
Continuous Infusions

Medications given by continuous infusion in the PICU are often a source of errors. Non-standard infusions should only be used when absolutely necessary and it must be clearly indicated when a non-standard infusion is in use. For larger patients (>40-50 kg) consider using the standard adult solutions. All orders MUST include the patient’s weight, amount of drug, total volume of IV solution, dose and IV rate.

Example: \( Wt = 15 \text{ kg}, \) add 45 mg of dopamine to a total volume of 50 mL NS, run at 5 mL/h (5 microgram/kg/min).

Three commonly used methods for preparing continuous infusions:

1) The Rule of Sixes and Variations
   \[ 6 \times (\text{patient weight in kg}) = \text{___ mg of drug add to a TOTAL of 100 mL of fluid.} \]

   If this step is followed then 1 mL/h = 1 microgram/kg/min.

   This is the preferred method for inotropes, vasopressors, opiates, midazolam, nitroglycerin and nitroprusside in most patients. At higher doses and in smaller infants the fluid required to deliver the dose may be excessive and the solution must be further concentrated. If used for larger patients there may be excess drug wastage, which may be reduced by using 3 times the weight in 50 mL, 1.5 times the weight in 25 mL or another method of solution preparation.
2) **Fixed Solution Concentration**
   Using a fixed concentration, run the solution in mL/kg/h.
   Examples:
   - Propofol is 10 mg/mL: \(0.1 \text{ mL/kg/h} = 1 \text{ mg/kg/h}\)
   - Insulin 25 units/250 mL: \(1 \text{ mL/kg/h} = 0.1 \text{ units/kg/h}\)
   - Labetalol 1 mg/mL: \(1 \text{ mL/kg/h} = 1 \text{ mg/kg/h}\)

3) **Calculation**
   This method used is to deliver the required dose at a set rate of IV fluid. This works well in fluid restricted patients but requires multiple calculations and the solution and rates may need to be reassessed as the dose is changed and is therefore not often used.

   To calculate the amount of drug required:
   1. multiply the dose by the weight
   2. convert the time units (i.e. min to hours, if required)
   3. convert the dose units (i.e. micrograms to milligrams)
   4. divide by the desired rate (in mL/h)
   5. multiply by the total volume required (including enough to flush lines) to find the total amount of drug required.

   **Example:** To run dopamine at a dose of 10 microgram/kg/min at a rate of 2 mL/h in a 3 kg patient:
   1. 10 microgram/kg/min x 3 kg = 30 microgram/min
   2. 30 microgram/min = 1800 microgram/h
   3. 1800 microgram/h = 1.8 mg/h
   4. 1.8 mg/h ÷ 2 mL/h = 0.9 mg/mL
   5. 0.9 mg/mL x 50 mL (this volume is enough for 12 hours at 2 mL/h + extra for priming lines) = 45 mg

   The order should read: Add 45 mg of dopamine to a total of 50 mL of IV fluid and run at 2 mL/h (=10 microgram/kg/min).
Safer Order Writing

In both critical care and pediatrics there is a high potential for medication errors and due to both the nature of the patients and the medications involved the consequences of any errors may catastrophic.

Some rules intended to reduce the potential for medication errors:

- Write orders clearly and concisely.
- Use generic drug names only.
- Be careful with mg/kg/DAY vs mg/kg/DOSE.
- Include the intended dose per kilogram on each order.
- Write the patients weight on each order sheet.
- Never place a decimal and a zero after a whole number (4.0 mg should be 4 mg) and always place a zero in front of a decimal point (.2 mg should be 0.2 mg). The decimal point has been missed and tenfold overdoses have been given.
- Never abbreviate the word unit. The letter U has been misinterpreted as a 0, resulting in a 10 fold overdose.
- Always order medications as mg, not mL as different concentrations may exist of a given medication. There are a few exceptions such as co-trimoxazole (Septra®).
- QD is not an appropriate abbreviation for once daily, it has been misinterpreted as QID. It is best to write out “once daily” or “q24h.”
- Do not abbreviate drug names (levo, 6MP, MSO4, MgSO4, HCTZ).
- Do not abbreviate microgram to μg, use mcg, or even safer, write out microgram or use milligrams if possible (0.25 mg instead of 250 micrograms).
<table>
<thead>
<tr>
<th>Medications for Intubation</th>
<th>Drug</th>
<th>Dose</th>
<th>Onset of action</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sedatives</strong></td>
<td>midazolam</td>
<td>0.1-0.25 mg/kg</td>
<td>1-2 min</td>
<td>↓BP if hypovolemic, minimal effect on ICP</td>
</tr>
<tr>
<td></td>
<td>propofol</td>
<td>1-2 mg/kg</td>
<td>&lt; 1 minute</td>
<td>↓ICP, ↓BP</td>
</tr>
<tr>
<td></td>
<td>thiopental</td>
<td>2-5 mg/kg</td>
<td>&lt; 1 minute</td>
<td>↓ICP, ↓BP</td>
</tr>
<tr>
<td></td>
<td>etomidate</td>
<td>0.2-0.4 mg/kg</td>
<td>1 min</td>
<td>↓ICP, minimal effect on BP</td>
</tr>
<tr>
<td><strong>Analgesics</strong></td>
<td>morphine</td>
<td>0.2 mg/kg</td>
<td>2-5 min</td>
<td>Minimal effect on ICP, may ↓BP</td>
</tr>
<tr>
<td></td>
<td>fentanyl</td>
<td>2-5 mcg/kg</td>
<td>1 minute</td>
<td>Minimal effect on ICP and BP</td>
</tr>
<tr>
<td></td>
<td>remifentanil</td>
<td>2-4 mcg/kg</td>
<td>&lt; 1 minute</td>
<td>Duration of action 3-10 min</td>
</tr>
<tr>
<td><strong>Sedative/Analgesic</strong></td>
<td>ketamine</td>
<td>1-2 mg/kg</td>
<td>1-2 min</td>
<td>bronchodilation, ↑ICP, little effect on BP</td>
</tr>
<tr>
<td><strong>Paralytics</strong></td>
<td>rocuronium</td>
<td>1 mg/kg</td>
<td>45-90 s</td>
<td>Duration of action: 30-60 min</td>
</tr>
<tr>
<td></td>
<td>vecuronium</td>
<td>0.2 mg/kg</td>
<td>0.5-2 min</td>
<td>Duration of action: 30-60 min</td>
</tr>
<tr>
<td></td>
<td>succinylcholine</td>
<td>1-2 mg/kg</td>
<td>45-60 s</td>
<td>Duration of action: &lt;10 min</td>
</tr>
<tr>
<td><strong>Adjuvants</strong></td>
<td>atropine</td>
<td>0.02 mg/kg</td>
<td>1-2 minutes</td>
<td>minimum 0.1, maximum 1 mg</td>
</tr>
<tr>
<td></td>
<td>lidocaine</td>
<td>2 mg/kg</td>
<td>5 minutes</td>
<td></td>
</tr>
</tbody>
</table>
## Comparison of Inotropes and Vasopressors

<table>
<thead>
<tr>
<th>Receptor Specificity</th>
<th>SVR</th>
<th>Inotropic effects</th>
<th>Heart rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>α</td>
<td>β₁</td>
<td>β₂</td>
</tr>
<tr>
<td>Dopamine</td>
<td>high dose</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Dobutamine</td>
<td>+</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>Epinephrine</td>
<td>+++</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Milrinone**</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Norepinephrine</td>
<td>+++</td>
<td>++</td>
<td>-</td>
</tr>
<tr>
<td>Phenylephrine</td>
<td>+++</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Vasopressin</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*Vasopressin receptor type 1.
**Milrinone is a phosphodiesterase inhibitor.

### Approximate Equivalent Doses of Opioid Analgesics

<table>
<thead>
<tr>
<th></th>
<th>Oral Dose</th>
<th>Parenteral Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Codeine</td>
<td>200 mg</td>
<td>120 mg</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>N/A</td>
<td>100 micrograms</td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>4 mg</td>
<td>2 mg</td>
</tr>
<tr>
<td>Meperidine</td>
<td>300 mg</td>
<td>75 mg</td>
</tr>
<tr>
<td>Morphine</td>
<td>20 mg</td>
<td>10 mg</td>
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### Approximate Equivalent Doses of Corticosteroids

<table>
<thead>
<tr>
<th></th>
<th>Equivalent Dose (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dexamethasone</td>
<td>0.75</td>
</tr>
<tr>
<td>Hydrocortisone</td>
<td>20</td>
</tr>
<tr>
<td>Methylprednisolone</td>
<td>4</td>
</tr>
<tr>
<td>Prednisone</td>
<td>5</td>
</tr>
<tr>
<td>Prednisolone</td>
<td>5</td>
</tr>
</tbody>
</table>
## Comparison of IV Solutions

<table>
<thead>
<tr>
<th>IV Solution</th>
<th>Sodium (mEq/L)</th>
<th>Dextrose (g/L)</th>
<th>Osmolarity (mOsm/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium Chloride 0.45 %</td>
<td>77</td>
<td>0</td>
<td>154</td>
</tr>
<tr>
<td>Sodium Chloride 0.9 %</td>
<td>154</td>
<td>0</td>
<td>308</td>
</tr>
<tr>
<td>Sodium Chloride 3 %</td>
<td>513</td>
<td>0</td>
<td>1030</td>
</tr>
<tr>
<td>Dextrose 5 %</td>
<td>0</td>
<td>50</td>
<td>250</td>
</tr>
<tr>
<td>Dextrose 5 % Sodium Chloride 0.2 %*</td>
<td>39</td>
<td>50</td>
<td>320</td>
</tr>
<tr>
<td>Dextrose 5 % Sodium Chloride 0.45%</td>
<td>77</td>
<td>50</td>
<td>405</td>
</tr>
<tr>
<td>Dextrose 5 % Sodium Chloride 0.9 %</td>
<td>154</td>
<td>50</td>
<td>560</td>
</tr>
<tr>
<td>Dextrose 10 %</td>
<td>0</td>
<td>100</td>
<td>505</td>
</tr>
<tr>
<td>Dextrose 10 % Sodium Chloride 0.2 %*</td>
<td>39</td>
<td>100</td>
<td>575</td>
</tr>
<tr>
<td>Dextrose 10 % Sodium Chloride 0.45%*</td>
<td>77</td>
<td>100</td>
<td>660</td>
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<tr>
<td>Dextrose 10 % Sodium Chloride 0.9%*</td>
<td>154</td>
<td>100</td>
<td>813</td>
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<tr>
<td>Dextrose 3.3% Sodium Chloride 0.3%</td>
<td>51</td>
<td>33</td>
<td>273</td>
</tr>
<tr>
<td>Lactated Ringers†</td>
<td>130</td>
<td>0</td>
<td>273</td>
</tr>
</tbody>
</table>

†Also contains Calcium 1.5 mmol/L, Potassium 4 mEq/L and Lactate 28 mmol/L
*These solutions are not commercially available.
**Acetaminophen**
Analgesic and antipyretic.

PO/PR: 40-60 mg/kg/day ÷ q4-6h (maximum 60 mg/kg or 4 g/day). A single dose greater than 150 mg/kg is generally considered to be toxic, but toxicity has been reported at lower doses (90-120 mg/kg/day). Rectal absorption may be erratic, consider increasing dose by approximately 20%. 1 microgram/mL = 6.62 micromol/mL.

<table>
<thead>
<tr>
<th>Weight (kg)</th>
<th>Single Dose (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 - 3.9</td>
<td>40</td>
</tr>
<tr>
<td>4.0 - 5.4</td>
<td>60</td>
</tr>
<tr>
<td>5.5 - 7.9</td>
<td>80</td>
</tr>
<tr>
<td>8.0 - 10.9</td>
<td>120</td>
</tr>
<tr>
<td>11.0 - 15.9</td>
<td>160</td>
</tr>
<tr>
<td>16.0 - 21.9</td>
<td>240</td>
</tr>
<tr>
<td>22.0 - 26.9</td>
<td>320</td>
</tr>
<tr>
<td>27.0 - 31.9</td>
<td>400</td>
</tr>
<tr>
<td>32.0 - 43.9</td>
<td>480</td>
</tr>
<tr>
<td>44 – over</td>
<td>650</td>
</tr>
</tbody>
</table>

**Acetazolamide**
Carbonic anhydrase inhibitor diuretic.

Diuretic:
PO: 5-10 mg/kg/day ÷ q8-24h (maximum 1 g/day).
Increases urinary bicarbonate loss and alkalinizes urine.
Acetylcysteine

Antidote for acetaminophen overdose:
IV: Total dose 300 mg/kg IV over 21 hours:
   150 mg/kg over 1 hour then
   50 mg/kg over 4 hours then
   100 mg/kg over 16 hours

Longer courses of therapy may be indicated if delayed presentation or slow resolution of liver function abnormalities. If symptoms of histamine release and brochospasm occur, hold infusion, give anti-histamines +/- corticosteroids and bronchodilators, then restart infusion.

Acetylsalicylic Acid

Antiplatelet:
PO: 5 mg/kg/dose q24h.
   Minimum 20 mg, usual maximum 80 or 325 mg.

Kawasaki disease:
PO: 80-100 mg/kg/day ÷ q6h, reduce dose to 3-5 mg/kg q24h once fever resolves.
Supplied as 80 mg chewable tablets and 325 and 650 mg tablets.

Activated Charcoal

see Charcoal

Acyclovir

Antiviral.

Herpes simplex encephalitis:
IV: 45 mg/kg/day ÷ q8h (60 mg/kg/day has been used in infants).

Other herpes simplex infections:
IV: 15-30 mg/kg/day ÷ q8h.

Varicella (severe) or in immunocompromised hosts:
IV: 30-45 mg/kg/day ÷ q8h, switch to PO when lesions crusted.
PO: 80 mg/kg/day ÷ qid (maximum 800 mg/dose).
Ensure adequate urine output. Adjust dosing interval in renal impairment.
Adenosine
Antiarrhythmic.

Treatment of SVT:
IV: 0.1 mg/kg bolus (maximum 6 mg), if no response in 2 min: 0.2 mg/kg bolus (maximum 12 mg).
Not effective for atrial fibrillation/flutter or ventricular fibrillation. Adverse effects such as dyspnea, arrhythmias, bradycardia, flushing, sinus and AV block are very common but are usually transient due to short (10 seconds) half-life of drug. Give rapid IV bolus followed by rapid NS flush.

Albumin
Colloid plasma volume expander (human plasma protein).

IV: 0.5-1 g/kg/dose:
5% solution (50 mg/mL): 10-20 mL/kg/dose.
25% solution (250 mg/mL): 2-4 mL/kg/dose.
Use 5% solution for fluid resuscitation and volume expansion, 25% albumin is very viscous and hyperosmolar, use with caution.

Alprostadil
Prostoglandin E$_1$.

Maintenance of patent ductus arteriosus:
IV: Initially 0.05 microgram/kg/min, use lowest effective dose, 0.01-0.1 microgram/kg/min has been used.
May cause apnea, be prepared to intubate. Most effective in infants less than 96 hours of age.

Alteplase
Thrombolytic.

Unblocking of occluded catheters:
Intracatheter: Instill 1 mg/mL solution into occluded lumen. Maximum volume equal to the internal volume of catheter lumen, to maximum of 2 mL. Leave in place for 30 min-2h, then aspirate solution. Do not infuse. May repeat once if ineffective.
**Amikacin**  
Aminoglycoside antibiotic.  

**IV**: 15-20 mg/kg/day ÷ q12-24h.  
Adjust dosing interval in renal impairment. Ototoxicity and nephrotoxicity may occur, consider monitoring trough levels (<5-10 mg/L) in patients at risk for nephrotoxicity; septic shock, concurrent nephrotoxins, fluctuating renal function or extended treatment courses. May potentiate muscle weakness with neuromuscular blockers. Reserved for gram negative organisms with documented resistance to other aminoglycosides.

**Aminocaproic Acid**  
Fibrinolysis inhibitor.  

**Treatment of excessive bleeding due to hyperfibrinolysis:**  
**IV**: 50-100 mg/kg then 30-50 mg/kg/h until bleeding stops (maximum 1 g/h).  
Rapid IV injection may cause hypotension, bradycardia, arrhythmias. Give loading dose over 1 hour.

**Aminophylline**  
Xanthine derivative used to treat reversible airway obstruction.  

**Acute bronchospasm:**  
**IV**: 6 mg/kg then infusion (based on ideal body weight):  
2-6 months: 0.4-0.5 mg/kg/h  
6-11 months: 0.6-0.7 mg/kg/h  
1-12 years: 0.8-1 mg/kg/h  
>12 years: 0.7 mg/kg/h  
No longer first line for treatment of asthma, high dose inhaled/IV β₂ agonists and corticosteroids are preferred. Dose adjustments are required in CHF, liver dysfunction. multisystem organ failure, shock and in smokers. Drug interactions are common, including ciprofloxacin, clarithromycin, erythromycin. Draw level 30 minutes after end of bolus infusion and 12-24 hours after initiation of continuous infusion. Target serum level is 10-15 mg/L (55-83 micromol/mL).
**Amiodarone**

Antiarrhythmic.

IV: 5 mg/kg loading dose then 5-15 microgram/kg/min. Give loading dose over 20-60 minutes for perfusing rhythms or rapid bolus for VF. Rapid IV boluses are limited to the treatment of VF because of the associated hypotension, which may respond to reducing the infusion rate. Heart block requiring pacing has occurred. Do not use in cardiogenic shock, severe sinus node dysfunction, sinus bradycardia, 2nd and 3rd degree AV block. Central line required for concentrations >2 mg/mL.

**Amlodipine**

Calcium channel blocker antihypertensive.

PO: 0.1-0.3 mg/kg q24h (usual maximum 10 mg/day).

**Amoxicillin**

Penicillin derivative oral antibiotic.

PO: 25-50 mg/kg/day ÷ q8h (maximum 1 g/dose). For severe infections and for suspected penicillin resistant S. pneumoniae doses of up to 100 mg/kg/day have been tolerated (maximum 1 g/dose). Use ampicillin if IV therapy is required.

**Amoxicillin/Clavulanic Acid**

Penicillin derivative antibiotic and beta-lactamase inhibitor.

PO: 25-40 mg/kg/day of amoxicillin component ÷ q8h (maximum 500 mg/dose). Active against gram positive, gram negative and anaerobic organisms.
**Amphotericin B (Amphotericin B Deoxycholate)**

Antifungal.

IV: 0.6-1 mg/kg/dose q24h (maximum 70 mg/dose). For Candida use 0.6-0.8 mg/kg/day and 1 mg/kg/day for Aspergillus. Traditionally give ½ dose on first day and increase to full dose over 1-2 days, but may give full dose on first day. Consider hydration (10 mL/kg of normal saline) pre-amphotericin to reduce the risk of nephrotoxicity. Commonly causes nephrotoxicity, hypokalemia and hypomagnesemia. Not compatible with any saline solutions, dilute to 0.1 mg/mL or less in dextrose solutions and infuse over 2-6 hours.

**Amphotericin B Lipid Complex (Abelcet®) and Liposomal Amphotericin B (AmBisome®)**

Antifungal (lipid formulations of amphotericin B).

IV: 3-5 mg/kg q24h.

Consider using these in renal insufficiency, if nephrotoxicity develops while on standard Amphotericin B or with clinical failure with alternate agents. These lipid formulations are better tolerated but are very costly.

**Ampicillin**

Penicillin derivative antibiotic.

- **Meningitis:**
  
  IV: 200 mg/kg/day ÷ q6h (maximum 2 g/dose).

- **Other infections:**
  
  IV: 100-200 mg/kg/day ÷ q6h (maximum 2 g/dose).

Doses of 400 mg/kg/day have been used for meningitis. Adjust dosing interval in renal impairment. Use amoxicillin if oral therapy is required.
Arginine
Treatment of urea cycle disorders.

**OTC or CPS deficiency:**
IV: 0.2 g/kg as a loading dose, then 0.2 g/kg/day as a continuous infusion.

**ASL or ASS deficiency:**
IV: 0.6 g/kg as a loading dose, then 0.6 g/kg/day as a continuous infusion.

ASA/Aspirin
See acetylsalicylic acid.

Atracurium
Non-depolarizing neuromuscular blocking agent.

IV: 0.4 mg/kg q30min prn
or
0.4 mg/kg then 2-15 microgram/kg/min.

Bolus dosing preferred. Does not require dosage modification in renal or hepatic impairment. Regular sedation, analgesia and ocular lubrication required. Monitor depth of paralysis using peripheral nerve stimulation when using infusions (target 1-2 twitches out of 4). Onset of action is within 2 minutes, duration of action is 30-40 minutes. Prolonged weakness may occur, especially when corticosteroids are used concurrently with non-depolarizing neuromuscular blocking agents.

Atropine
Vagolytic.

**Bradycardia:**
IV: 0.02 mg/kg/dose, minimum dose: 0.1 mg, maximum dose: 0.5 mg for child, 1 mg for adolescent.

If giving via ETT, increase IV dose 2-10 fold and dilute to 3-5 mL with NS. Follow with several positive pressure breaths.
**Azithromycin**
Azolide antibiotic (related to the macrolides).

PO/IV: 10 mg/kg (maximum 500 mg) once, then
5 mg/kg (maximum 250 mg) q24h x 4.
For serious infections may give 10 mg/kg q24h.

Chlamydial infection (non-gonococcal urethritis or cervicitis):
PO: 1 g once (minimum weight 45 kg).

**Budesonide**
Inhaled corticosteroid.
NEB: 0.25-1 mg bid via nebulizer.

**Calcium**
Electrolyte.
Treatment of hypocalcemia, hyperkalemia, hypermagnesemia and
calcium channel antagonist overdose. These doses are suggested
starting doses, increase and repeat as required.

**Calcium Gluconate:**
IV: 50-100 mg of calcium gluconate/kg/dose (0.5-1 mL/kg/dose)
or
IV: Add 1 g of calcium gluconate to a total of 50 mL NS
(0.046 mmol/mL) and give 0.05-0.1 mmol/kg/h
(1-2 mL/kg/h), adjust rate q4h.

**Calcium Chloride:**
IV: 10-20 mg of calcium chloride/kg/dose (0.1-0.2 mL/kg/dose).

<table>
<thead>
<tr>
<th></th>
<th>Elemental Calcium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium gluconate 10% (100 mg/mL)</td>
<td>9 mg/mL</td>
</tr>
<tr>
<td>Calcium chloride 10% (100 mg/mL)</td>
<td>27.2 mg/mL</td>
</tr>
</tbody>
</table>

If treating asymptomatic hypocalcemia infuse dose over at least 1 hour.
Captopril
Angiotensin converting enzyme inhibitor.
   PO: 0.1-0.3 mg/kg/dose q8h initially
       (usual maximum 6 mg/kg/day or 200 mg/day).
Monitor blood pressure closely after first dose, may cause profound hypotension.

Carbamazepine
Anticonvulsant.
   PO: 10-20 mg/kg/day initially, usual maintenance dose is
       20-30 mg/kg/day. Divide daily dose q8-12h.
Serum trough concentration target is 17-51 micromol/L (4-12 microgram/mL).

Cefaclor
Oral second generation cephalosporin.
   PO: 20-40 mg/kg/day ÷ q8h (maximum 1.5 g/day).
Adjust dosing interval in renal impairment. Do not give with food.
Non-formulary at Hamilton Health Sciences.

Cefazolin
First generation cephalosporin.
   IV: 75-150 mg/kg/day ÷ q8h (maximum 6 g/day).
Adjust dosing interval in renal impairment.

Cefixime
Oral third generation cephalosporin.
   PO: 8 mg/kg/day ÷ q12-24h (maximum 400 mg/day).
   Uncomplicated cervical/urethral gonorrhea:
       PO: 400 mg once (minimum weight 45 kg).
Adjust dose in renal impairment. Not active against Pseudomonas aeruginosa
or Staphlococcus aureus. Restricted at Hamilton Health Sciences to the
treatment of STDs.
**Cefotaxime**  
Third generation cephalosporin.  

**Meningitis:**  
IV: 200 mg/kg/day ÷ q6h (maximum 8 g/day).  

**Other infections:**  
IV: 100-200 mg/kg/day ÷ q8h (maximum 6 g/day).  
Adjust dosing interval in renal impairment. Not active against Pseudomonas aeruginosa.

**Cefotetan**  
Second generation cephalosporin.  

IV: 60 mg/kg/day ÷ q12h (maximum 6 g/day).  
Adjust dosing interval in renal impairment. Active against anaerobic organisms. Non-formulary at Hamilton Health Sciences.

**Cefoxitin**  
Second generation cephalosporin.  

IV: 80-160 mg/kg/day ÷ q8h (maximum 8 g/day).  
Adjust dosing interval in renal impairment. Active against anaerobic organisms. Non-formulary at Hamilton Health Sciences.

**Cefprozil**  
Oral second generation cephalosporin.  

PO: 30 mg/kg/day ÷ q12h (maximum 1 g/day).  
Adjust dose in severe renal impairment.

**Ceftazidime**  
Third generation cephalosporin.  

IV: 75-150 mg/kg/day ÷ q8h (maximum 6 g/day).  
Adjust dosing interval in renal impairment. Active against Pseudomonas aeruginosa.
Ceftriaxone
Third generation cephalosporin.

Meningitis:
IV/IM: 80 mg/kg/dose q12 hours × 3 doses then q24h (maximum 2 g/dose).

Other infections:
IV/IM: 50-75 mg/kg q24h (maximum 2 g/day).

No dosage adjustment required in renal impairment. Not active against Pseudomonas aeruginosa. Restricted at Hamilton Health Sciences to patients without IV access, otherwise use cefotaxime.

Cefuroxime/Cefuroxime Axetil
Second generation cephalosporin.

Epiglottitis/facial cellulitis:
IV: 150 mg/kg/day ÷ q8h (maximum 1.5 g/dose)

Other infections:
IV: 75-150 mg/kg/day ÷ q8h (usual maximum dose is 750 mg/dose)
PO: 20-30 mg/kg/day ÷ bid (maximum 1 g/day)

Adjust dosing interval in renal impairment. Oral formulation is non-formulary at Hamilton Health Sciences.

Cephalexin
First generation cephalosporin.

PO: 25-50 mg/kg/day ÷ qid, for severe infections can give 100 mg/kg/day (maximum 4 g/day).

Adjust dosing interval in renal impairment.

Charcoal
Adsorbent used in toxic ingestions.

PO: 1-2 g/kg once.
PO: Multiple dose therapy 0.5 g/kg q4-6h.

Give via NG if necessary, consider antiemetics.
Chloral Hydrate
Sedative and hypnotic.

**Procedural Sedation:**
PO/PR: 80 mg/kg, may repeat half dose if no effect in 30 minutes (maximum 2 g/dose).

**Sedation:**
PO/PR: 25-50 mg/kg/dose (maximum 500 mg q6h or 1 g hs).

Avoid in liver dysfunction. Tolerance develops and withdrawal may occur after long-term use. For PR use dilute syrup with water.

Ciprofloxacin
Quinolone antibiotic.

**IV/PO:** 20-30 mg/kg/day ÷ q12h
(maximum 400 mg/dose IV or 750 mg/dose PO).

Excellent oral absorption, use IV only if PO contraindicated. Feeds, formula, calcium, magnesium, iron, antacids and sulcralfate reduce absorption, hold feeds for 1 hour before and 2 hours after dose. Adjust dosing interval in renal impairment. Ciprofloxacin has been used in pediatrics but the association between ciprofloxacin and the development of arthropathy in humans is still controversial. Active against Pseudomonas aeruginosa.
**Cisatracurium**
Non-depolarizing neuromuscular blocking agent.

IV: 0.1 mg/kg then 0.03 mg/kg prn

or

0.1 mg/kg then 1-3 microgram/kg/min

(range 0.5-10 microgram/kg/min).

Bolus dosing preferred. Does not require dosage modification in renal or hepatic impairment. Regular sedation, analgesia and ocular lubrication required. Monitor depth of paralysis using peripheral nerve stimulation when using infusions (target 1-2 twitches out of 4). Onset of action within 2-3 minutes, duration of action is 30-40 minutes. Prolonged weakness may occur, especially when corticosteroids are used concurrently with non-depolarizing neuromuscular blocking agents

**Clarithromycin**
Macrolide antibiotic.

PO: 15 mg/kg/day ÷ q12h (maximum 1 g/day).

Drug interactions include theophylline, carbamazepine, cisapride, digoxin, cyclosporine, tacrolimus. Adjust dose in severe renal impairment.

**Clindamycin**
Antibiotic.

IV: 30-40 mg/kg/day ÷ q8h (maximum 900 mg/dose).

PO: 10-20 mg/kg/day ÷ q6-8h (maximum 450 mg/dose).

May potentate muscle weakness with neuromuscular blockers. Oral suspension is very poorly tolerated, avoid if possible, use 150 mg capsules or an alternative antibiotic. Active against gram positive and anaerobic organisms.
**Cloxacillin**
Beta-lactamase-resistant penicillin.

- **IV:** 100-200 mg/kg/day ÷ q6h (maximum 8 g/day).
- **PO:** 25-50 mg/kg/day ÷ q6h (maximum 500 mg/dose).

Higher oral doses are poorly tolerated, usually use cephalexin instead. Primarily used in Staphylococcal infections.

**Codeine**
Opiate analgesic used to treat mild-moderate pain.

- **PO/IM/SC:** 0.5-1 mg/kg q4h prn (maximum 60 mg/dose).

Not for IV use due to significant histamine release and possible cardiovascular side effects. Not commonly used in ICU setting.

**Co-trimoxazole (Trimethoprim/Sulfamethoxazole)**
Sulfa derivative antibiotic.

- **Bacterial infections:**
  - **PO/IV:** 8 mg/kg/day (of trimethoprim component) ÷ q12h.

- **Pneumocystis carinii pneumonia (PCP):**
  - **PO/IV:** 20 mg/kg/day (of trimethoprim component) ÷ q6h.

Excellent oral absorption, use IV only if PO contraindicated. Maintain good fluid intake and urine output. Adjust dosing interval in renal impairment. Monitor CBC and LFTs. Do not use in patients with G-6-PD deficiency. If PCP is severe (i.e. hypoxia), consider adding methylprednisolone 1 mg/kg q24h.

Order in mL of suspension or injection or number of tablets:
- **Suspension:** 8 mg trimethoprim and 40 mg sulfamethoxazole/mL.
- **Injection:** 16 mg trimethoprim and 80 mg sulfamethoxazole/mL.
- **Tablet:** 80 mg trimethoprim and 400 mg sulfamethoxazole.
- **DS tablet:** 160 mg trimethoprim and 800 mg sulfamethoxazole.
Cyclosporine
Immunosuppressant.
IV dose is approximately 50% of oral dose. Dose and serum levels vary widely with indication and the individual protocol, but usually:
   IV:  3-6 mg/kg/day ÷ q12h.
   PO: 5-10 mg/kg/day ÷ q12h.
Requires dose reduction in liver or renal dysfunction. Cyclosporine interacts with many medications, including fluconazole, erythromycin, tacrolimus, diltiazem, methylprednisolone, grapefruit juice, phenytoin, phenobarbital, carbamazepine, trimethoprim. Trough levels usually 100-300 microgram/L but varies with the indication.

Desmopressin (DDAVP)
Analogue of vasopressin.
   Diabetes Insipidus:
      Nasal: 2.5-10 microgram/dose q12-24h.
      IV/IM/SC: 0.25-1 microgram/dose q12-24h
      (maximum 4 microgram/dose).
   Coagulopathy:
      IV/SC: 0.3 microgram/kg/dose
      (maximum 20 microgram/dose).
Used as replacement therapy in diabetes insipidus, treatment of prolonged bleeding times and mild bleeding associated with some types of hemophilia. Parenteral dose is approximately 10% of intranasal dose and 1% of the oral dose. In the treatment of diabetes insipidus check urine output, volume status, serum and urine electrolytes prior to each dose.
Nasal spray=10 microgram/puff, nasal solution = 100 microgram/mL.
Dexamethasone
Corticosteroid.

Croup:
IV/IM/PO: 0.6 mg/kg once.

Meningitis:
IV: 0.15 mg/kg/dose q6h for 4 days.
   Begin with first antibiotic dose.

Prevention of post-extubation stridor:
IV: 0.25-0.5 mg/kg/dose (maximum 10 mg/dose) q6h x 6 doses.
   Begin 24 hours pre-extubation if possible.

Increased ICP due to space occupying lesion:
IV/PO: 0.2-0.4 mg/kg initially followed by
   0.3 mg/kg/day ÷ q6h.

Discontinuation of therapy >14 days requires gradual tapering. Consider supplemental steroids at times of stress if patient has received long-term or frequent bursts of steroid therapy. Prolonged weakness may occur when corticosteroids are used concurrently with non-depolarizing neuromuscular blocking agents.

Dextrose

Treatment of hypoglycemia:
IV: 0.5-1 g/kg/dose:
   1-2 mL/kg of 50% dextrose
   5-10 mL/kg of 10% dextrose

1 mmol of dextrose (0.2 g of dextrose) provides 2.8 kJ (0.67 kcal).
### Diazepam

Benzodiazepine sedative, anxiolytic and amnestic.

**Status epilepticus:**
- IV: 0.25 mg/kg/dose (maximum 5 mg, 10 mg for older children).
- PR: 0.5 mg/kg/dose (maximum 20 mg/dose).

**ICU sedation:**
- IV: 0.1-0.3 mg/kg q1h prn.

Fast onset and short duration of action with single doses, duration of action prolonged with continued use. Not first line drug for ICU sedation due to short duration of action and the potential for accumulation. Withdrawal may occur if discontinued abruptly after prolonged use. Not recommended for continuous infusion due to poor solubility. Can give parenteral preparation rectally, diluted with water.

### Digoxin

<table>
<thead>
<tr>
<th>Total Digitalization Dose (maximum 1 mg)</th>
<th>Maintenance Dose (usual maximum 250 mcg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Divide dose q6h x 3 doses.</td>
<td>Begin 12 h after last loading dose.</td>
</tr>
<tr>
<td>PO</td>
<td>IV</td>
</tr>
<tr>
<td>37 weeks-2 y</td>
<td>50 mcg/kg</td>
</tr>
<tr>
<td>&gt; 2 years</td>
<td>40 mcg/kg</td>
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<tr>
<td></td>
<td>35 mcg/kg</td>
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<tr>
<td></td>
<td>30 mcg/kg</td>
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<tr>
<td></td>
<td>10 mcg/kg/day</td>
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<tr>
<td></td>
<td>8 mcg/kg/day</td>
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<tr>
<td></td>
<td>8 mcg/kg/day</td>
</tr>
<tr>
<td></td>
<td>6 mcg/kg/day</td>
</tr>
</tbody>
</table>

Usually divide daily maintenance dose q12h if less than 10 years of age, otherwise give dose once daily. Doses based on ideal body weight, decrease dose for patients with renal impairment. Digoxin has many drug interactions including nifedipine, verapamil, amiodarone, erythromycin, cisapride and sucralfate. IV dose is approximately 80% of PO dose. Monitor trough levels (0.5-2 microgram/L or 1-2.6 micromol/L).

### Dimenhydrinate

Antihistamine used to treat nausea and vomiting.

- IV/IM/PO: 1 mg/kg/dose q4-6h (maximum 50 mg/dose).
**Diphenhydramine**  
Anti-histamine used primarily to treat urticaria.  
IV/IM/PO: 0.5-1 mg/kg/dose q6h (maximum 50 mg/dose).

**Divalproex**  
See valproic acid.

**Dobutamine**  
Inotrope.  
IV: 2-20 microgram/kg/min.  
Correct hypovolemia first to prevent hypotension. Give via central line if possible.

**Domperidone**  
Prokinetic agent.  
PO: 1.2-2.4 mg/kg/day ÷ q6h (maximum 80 mg/day).

**Dopamine**  
Vasopressor and inotrope.  
*Hypotension and shock:*  
IV: 2-20 microgram/kg/min.  
Correct hypovolemia first. Consider changing to, or adding another drug at 15-20 microgram/kg/min or if tachycardia occurs. Give via central line if possible.

**Drotecogin Alfa (Activated)**  
Recombinant human activated protein C.  
*Severe sepsis:*  
IV: 24 microgram/kg/h for 96h.  
Anticoagulant and anti-inflammatory. There is limited experience with the use of drotecogin in pediatrics.
**Enalapril or Enalaprilat**
Angiotensin converting enzyme inhibitor.

**Hypertension, CHF:**
- **PO:** 0.1 mg/kg/day ÷ q12-24h, increase as required
  (maximum 0.5 mg/kg/day or 40 mg/day).
- **IV:** 5-10 microgram/kg/dose q6-12h, titrated to clinical effect (usual maximum 30 microgram/kg/dose or 5 mg/dose).

Monitor blood pressure closely. There is limited experience with the use of IV enalaprilat in pediatrics. Enalaprilat is the IV formulation of enalpril.

**Enoxaparin**
Anticoagulant, low-molecular weight heparin.

**Treatment:**
- **SC:** <2 months of age: 1.5 mg/kg/dose q12h.
  >2 months of age: 1 mg/kg/dose q12h.

**Prophylaxis:**
- **SC:** <2 months of age: 0.75 mg/kg/dose q12h.
  >2 months of age: 0.5 mg/kg/dose q12h.

Monitor platelets and hemoglobin. Avoid in severe renal dysfunction. Anti-factor Xa level drawn 4 hours post SC injection should be 0.5-1 unit/mL for treatment and 0.2-0.4 unit/mL for prophylaxis.

**Epinephrine**
Vasopressor and inotrope.

**Symptomatic bradycardia or pulseless arrest:**
- **IV:** 0.01 mg/kg/dose (0.1 mL/kg of 1:10 000 solution).
- **ETT:** 0.1 mg/kg/dose (0.1 mL/kg of 1:1000 solution).

**Refractory hypotension/shock:**
- **IV:** 0.1-1 microgram/kg/min
  (doses of 0.01-1 microgram/kg/min have been used).

**Post-extubation stridor/croup:**
- **NEB:** 2.5-5 mg/dose (2.5-5 mL of 1:1000 solution) prn.

1:10 000 solution = 0.1 mg/mL and 1:1 000 solution = 1 mg/mL.
Epinephrine (Racemic)

Post-extubation stridor/croup:
NEB: 0.25-0.5 mL of 2.25% solution via nebulizer prn

Erythromycin
Macrolide antibiotic.

IV: 25-50 mg/kg/day ÷ q6h  (maximum 4 g/day).
PO: 20-40 mg/kg/day ÷ q6h  (maximum 2 g/day).

Has many drug interactions, may increase levels of midazolam, carbamazepine, theophylline, cyclosporine, phenytoin. GI adverse effects common, even with IV use. Thrombophlebitis common.

Esmolol
Short acting β blocking agent.

Atrial fibrillation/atrial flutter/VT/hypertension:
IV: 100-500 microgram/kg then 50-300 microgram/kg/min.  
Titrate by 50-100 microgram/kg/min q5-10min.
High doses of 500-1000 micrograms/kg/min have been rarely required.

Short-term use only, consider bolus dose with each increase in infusion. Change to longer acting agent once desired effect achieved. Duration of action is approximately 10 minutes.

Ethacrynic Acid
Loop diuretic.

IV: 0.5-1 mg/kg/dose.

Use only if poor response to appropriate doses of furosemide. Repeat doses are not usually recommended but has been given q8-12h.
**Ethanol**

**Treatment of methanol or ethylene glycol overdose:**

**IV:** Give ethanol 10% in D5W:

<table>
<thead>
<tr>
<th>Dose</th>
<th>Volume of 10% Ethanol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loading Dose:</td>
<td>600 mg/kg</td>
</tr>
<tr>
<td>Maintenance Dose:</td>
<td>66 mg/kg/h</td>
</tr>
<tr>
<td>Hemodialysis:</td>
<td>118 mg/kg/h</td>
</tr>
</tbody>
</table>

These doses are suggested starting doses for non-drinkers, higher rates will be required for drinkers. Titrate to keep ethanol level >22 mmol/L. Expect intoxication and CNS depression and hypoglycemia in children.

**Etomidate**

Sedative.

**Endotracheal intubation:**

**IV:** 0.2-0.4 mg/kg.

Onset of action is within 1 minutes, minimal hemodynamic effect. Etomidate is not marketed in Canada and may not be available in all situations.

**Fentanyl**

Short-acting narcotic analgesic.

**Procedural sedation, non-ventilated patients:**

**IV:** 0.5-1 microgram/kg/dose, repeated prn.

**Sedation/analgesia of ventilated ICU patients:**

**IV:** 1-2 microgram/kg then

1-5 (usual maximum 10) microgram/kg/h and/or

1-2 microgram/kg/dose q1-2h prn.

Reduce dose if used in combination with benzodiazepines. Use with caution in non-ventilated patients due to potential for respiratory depression. Rapid IV administration may cause chest wall rigidity with subsequent difficulty with ventilation (give naloxone or paralysis). Withdrawal may occur if discontinued abruptly after prolonged use.
Ferrous Sulfate
See iron.

Fluconazole
Antifungal.

Oropharyngeal candidiasis:
IV/PO: 3 mg/kg q24h.

Esophageal candidiasis:
IV/PO: 6 mg/kg q24h (maximum 400 mg/day).

Candidemia:
IV/PO: 12 mg/kg once (maximum 800 mg) then 6 mg/kg/day (usual maximum 400 mg/day, but higher doses have been used).

Excellent oral absorption, use IV only if PO contraindicated. Adjust dosing interval in renal impairment. May increase serum levels of cyclosporine, midazolam, cisapride, phenytoin. Aspergillus species and Candida krusei are intrinsically resistant, Candida glabrata may respond to higher doses.

Flumazenil
Benzodiazepine antagonist.

IV: 0.01 mg/kg/dose (maximum 0.2 mg/dose), q1-3 min prn (maximum total dose is 0.05 mg/kg or 1 mg).

Reverses sedation but may not reliably reverse respiratory depression. Monitor for recurring sedation, as repeat doses may be required. May precipitate seizures and/or benzodiazepine withdrawal. Not recommended for routine use in the PICU or in suspected overdoses.

Fluticasone
Inhaled corticosteroid.

INH: 125-500 microgram q12h.

Higher doses may be required if administered through a ventilator due to loss of drug in the circuit.
**Furosemide**
Loop diuretic.
PO: 1-2 mg/kg/dose, adjust dose/frequency prn, usually q6-24h.
IV: 0.5-2 mg/kg/dose, adjust dose/frequency prn, usually q6-24h
or
begin at 0.1 mg/kg/hour and titrate to clinical effect (maximum 0.5 mg/kg/h).

**Gentamicin**
Aminoglycoside antibiotic.
IV: 5-6 mg/kg/dose q24h
or
2.5 mg/kg/dose q8h.
Once daily dosing should be used for all patients > 1 month of age, except in the treatment of endocarditis and in patients with extensive burns. Adjust dosing interval in renal impairment. Ototoxicity and nephrotoxicity may occur, consider monitoring trough levels (target <2 mg/L) in patients at risk for nephrotoxicity; septic shock, concurrent nephrotoxins, fluctuating renal function or extended treatment courses. May potentiate muscle weakness with neuromuscular blockers.

**Glucagon**
Treatment of hypoglycemia:
IV/IM/SC: 0.025-0.1 mg/kg/dose (maximum 1 mg/dose)
or
<20 kg give 0.5 mg, >20 kg give 1 mg
May need to repeat dose and/or give glucose due to short duration of action.

Hypotension and bradycardia caused by β blocker overdose:
IV: 0.05-0.15 mg/kg then 1-5 mg/h (maximum 15 mg/h),
titrater to heart rate and blood pressure
**Heparin**
Anticoagulant.

IV: 75 units/kg bolus then:
- < 1 year of age: 28 units/kg/hour.
- > 1 year of age: 20 units/kg/hour.

Measure APTT 4 hours after loading dose and adjust heparin to maintain APTT at 60-85 s. Monitor platelets and hemoglobin.

<table>
<thead>
<tr>
<th>APTT (s)</th>
<th>Bolus units/kg</th>
<th>Hold minutes</th>
<th>Rate Change units/kg/h</th>
<th>Repeat APTT h</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50</td>
<td>50</td>
<td>0</td>
<td>↑20%</td>
<td>4</td>
</tr>
<tr>
<td>50-59</td>
<td>0</td>
<td>0</td>
<td>↑10%</td>
<td>4</td>
</tr>
<tr>
<td>60-85</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>86-95</td>
<td>0</td>
<td>0</td>
<td>↓10%</td>
<td>4</td>
</tr>
<tr>
<td>96-120</td>
<td>0</td>
<td>30</td>
<td>↓10%</td>
<td>4</td>
</tr>
<tr>
<td>&gt;120</td>
<td>0</td>
<td>60</td>
<td>↓15%</td>
<td>4</td>
</tr>
</tbody>
</table>

**Hydralazine**
Antihypertensive, vasodilator.

IV: 0.1-0.5 mg/kg/dose q4-6h (usual maximum 20 mg/dose).
PO: 0.75 mg/kg/day ÷ q6h, increase as required and tolerated (maximum of 5 mg/kg/day).

May cause reflex tachycardia. Onset of action within 15 minutes after IV administration.

**Hydrochlorothiazide**
Thiazide diuretic.

PO: 2-4 mg/kg/day ÷ q12h.
Hydrocortisone
Corticosteroid.

**Acute asthma:**
IV: 5 mg/kg/dose q6h for 24-48 hours then reassess.

**Anaphylaxis:**
IV: 5-10 mg/kg/dose.

**Anti-inflammatory:**
IV: 2.5-10 mg/kg/day ÷ q6-8h.

**Acute adrenal crisis:**
IV: 1-2 mg/kg then:
- Infants: 25-150 mg/day ÷ q6h.
- Older children: 150-300 mg/day ÷ q6h.

Discontinuation of therapy >14 days requires gradual tapering. Consider supplemental steroids at times of stress if patient has received long-term or frequent bursts of steroid therapy. Prolonged weakness may occur when corticosteroids are used concurrently with non-depolarizing neuromuscular blocking agents.

Ibuprofen
Analgesic and anti-inflammatory (NSAID).

PO: 5-10 mg/kg/dose q6-8h (maximum 2 400 mg/day).

Adverse effects include renal dysfunction, GI irritation and ulceration.

<table>
<thead>
<tr>
<th>Weight (kg)</th>
<th>Single Dose (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 - 3.9</td>
<td>20</td>
</tr>
<tr>
<td>4.0 - 5.4</td>
<td>30</td>
</tr>
<tr>
<td>5.5 - 7.9</td>
<td>40</td>
</tr>
<tr>
<td>8.0 - 10.9</td>
<td>60</td>
</tr>
<tr>
<td>11.0 - 15.9</td>
<td>100</td>
</tr>
<tr>
<td>16.0 - 21.9</td>
<td>150</td>
</tr>
<tr>
<td>22.0 - 26.9</td>
<td>200</td>
</tr>
<tr>
<td>27.0 - 31.9</td>
<td>250</td>
</tr>
<tr>
<td>32.0 - 43.9</td>
<td>300</td>
</tr>
<tr>
<td>44 – over</td>
<td>400</td>
</tr>
</tbody>
</table>
Imipenem
Broad spectrum antibiotic.

IV: \[ 60-100 \text{ mg/kg/day} \div \text{q6h (maximum 4 g/day)} \].

Increase dosing interval for patients with renal impairment. Allergic reactions may occur in patients with penicillin hypersensitivities. Reserved for documented resistance. Non-formulary at Hamilton Health Sciences, use meropenem instead.

Immune Globulin, Intravenous (IgG, IVIg)
Pooled human immune globulins.

ITP:
IV: \[ 0.8-1 \text{ g/kg q24h for 1-2 doses} \].

Kawasaki disease:
IV: \[ 2 \text{ g/kg once} \].

Guillian-Barre syndrome:
IV: \[ 1 \text{ g/kg q24h for 2 days or 0.4 g/kg q24h for 4 days} \].

Streptococcal Toxic Shock:
IV: \[ 1 \text{ g/kg q24h for 1-2 doses} \].

Hypogammaglobulinemia
IV: \[ 0.4 \text{ g/kg q3-4 weeks} \].

Most adverse reactions, fever and hypotension are related to the rate of infusion. Anaphylaxis can occur. For most products begin at \[ 0.5 \text{ mL/kg/h} \] and increase q15min if tolerated to maximum of \[ 4 \text{ mL/kg/hr or 250 mL/h} \].
**Insulin**
Recombinant human insulin.

**Diabetic ketoacidosis:**
IV: 0.05-0.1 units/kg/h initially.

**For IV administration MUST use regular insulin.**

**Hyperkalemia:**
IV: 0.1 units/kg AND dextrose 0.5 g/kg.

**Diabetes mellitus:**
SC: 0.3-0.5 unit/kg/day in divided doses (as a combination of short and long acting insulins). Adjust as required based on blood glucose measurements, usually 0.5-1 unit/kg/day.

With continuous infusions measure blood glucose q1h initially, adjust dose as required based on blood glucose measurements.

**Ipratropium**
Inhaled anticholinergic bronchodilator.

**Severe asthma:**
NEB: 125-250 microgram (0.5-1 mL) q4-6h.
INH: 2-4 puffs q4-6h.

Higher doses may be required if administered through a ventilator due to loss of drug in the circuit.

**Iron**

**Treatment of iron deficiency anemia:**
PO: 4-6 mg/kg/day (of elemental iron) ÷ q8-24h.

**Prevention of iron deficiency anemia:**
PO: 2-3 mg/kg/day (of elemental iron) q24h.

Give with food if GI upset occurs.
Isoproterenol
β adrenergic agonist.
Temporary management of bradycardia:
IV: 0.025-1 microgram/kg/min (maximum 2 microgram/kg/min).
Used for the treatment of atropine resistant bradyarhythmias, ventricular arrhythmias due to A-V block. Increases risk of arrhythmias.

Kayexalate®
See sodium polystyrene sulfonate.

Ketamine
Dissociative anaesthetic and analgesic.
Procedural sedation/intubation:
IV: 0.5-2 mg/kg/dose.
IM: 3-5 mg/kg/dose.
Sedation in intubated patients (rarely used):
IV: 5-20 microgram/kg/min.
Ketamine has little respiratory or cardiovascular depressant effects. Useful for short painful procedures. Avoid in the presence of increased ICP or intraocular pressure. Emergence reactions such as vivid dreams or hallucinations may be treated with benzodiazepines.

Ketorolac
Analgesic and anti-inflammatory (NSAID).
IV/IM: 1-2 mg/kg/day (maximum 120 mg/day) ÷ q6h.
PO: 10 mg q6h (minimum weight 45 kg).
For oral use give ibuprofen or naproxen for younger children. There is limited experience with multiple dose ketorolac in pediatric patients. Adverse effects include renal dysfunction, GI irritation and ulceration.
**Labetalol**

Antihypertensive, α and β receptor blocker.

**Hypertensive urgencies/emergencies:**

IV: 0.2-0.5 mg/kg/dose (maximum 20 mg) q15-20 minutes until desired response is obtained

or

0.5-3 mg/kg/h. Start low and titrate based on response.

**Lactulose**

Osmotic laxative.

PO: infants: 2.5-5 mL q8-24h.
    children: 5-10 mL q8-24h.
    adolescents: 15-30 mL q8-24h.

**Levofloxacin**

Quinolone antibiotic.

IV/PO: There is limited experience with levofloxain in pediatrics.

Some centres use 10 mg/kg/dose q24h
(maximum 500 mg/dose).

Excellent oral absorption, use IV only if PO contraindicated. Feeds, formula, calcium, magnesium, iron, antacids and sulcralfate reduce absorption, hold feeds for 1 hour before and 2 hours after dose. Adjust dosing interval in renal impairment. Quinolones have been used in pediatrics but the association between quinilones and the development of arthropathy in humans is still controversial. NOT active against Pseudomonas aeruginosa.
Lidocaine

**Antiarrhythmic:**

IV:  1 mg/kg/dose, repeat prn to a maximum of 3 mg/kg then 20-50 microgram/kg/min.

**Prevention of increased ICP with intubation or suctioning:**

IV:  1-2 mg/kg/dose.

Use the lower end of the dosing range for patients in shock or with CHF due to reduced lidocaine clearance. Initial dose may be given via ETT, increase IV dose 2-10 fold and dilute to 3-5 mL with NS. Follow with several positive pressure breaths.

Lorazepam

Benzodiazepine sedative, anxiolytic and amnestic.

**Status epilepticus:**

IV:  0.1 mg/kg/dose, (usual maximum 4 mg/dose).

PR:  0.2 mg/kg/dose.

**ICU Sedation:**

IV/PO:  0.05-0.1 mg/kg/dose q1h prn +/- scheduled doses (may increase to 0.2 mg/kg/dose).

Intermediate duration of action and no active metabolites. Withdrawal may occur if discontinued abruptly after prolonged use. Not recommended for continuous infusion due to poor solubility. May give parenteral preparation rectally, diluted with water.
Magnesium Sulfate
Electrolyte.

Hypomagnesemia:
IV: 25-100 mg/kg of magnesium sulfate (maximum 5 g).
Usual maximum rate is 20 mg/kg of magnesium sulfate/h.

Severe asthma:
IV: 25-40 mg/kg of magnesium sulfate once over 20 minutes.

Torsades des pointes:
IV: 25-50 mg/kg of magnesium sulfate (maximum 2 g) rapid infusion.
Watch for hypotension with faster infusion rates. Usual dilution for infusion is 10 mg of magnesium sulfate/mL. Order in mg or g of magnesium sulfate to reduce the potential for error. 1 g of magnesium sulfate = 4 mmol of magnesium = 8 mEq of magnesium = 100 mg of elemental magnesium.

Mannitol
Osmotic diuretic.

Reduction of intracranial pressure:
IV: 0.25-1 g/kg (1.25-5 mL/kg of 20% solution) over 15-30 minutes q4-6h prn.
Contraindicated in anuric patients. Monitor serum osmolality if frequent doses are required.

Meperidine
Narcotic analgesic.
IV: 1-2 mg/kg/dose q3-4h.
Not recommended for routine use in the ICU. Avoid in renal impairment due to the accumulation of metabolites, which may cause seizures. Oral use not usually recommended due to poor absorption and lack of pediatric formulations.
**Meropenem**
Broad spectrum antibiotic.

**Meningitis:**
IV: 120 mg/kg/day ÷ q8h (maximum 6 g/day).

**Other infections:**
IV: 60 mg/kg/day ÷ q6-8h
(usual maximum 500 mg IV q6h, or 1 g IV q8h).

**Cystic fibrosis:**
IV: 75 mg/kg/day ÷ q8h (usual maximum 6 g/day).

Spectrum of activity similar to that of imipenem. Increase dosing interval for patients with renal impairment. Allergic reactions may occur in patients with penicillin hypersensitivities. Reserved for documented resistance.

**Methylene Blue**
Treatment of drug induced methemoglobinemia:
IV: 1-2 mg/kg/dose, may repeat in 1 hour prn.

**Methylprednisolone**
Corticosteroid.

**Acute asthma:**
IV: 1-2 mg/kg/dose q6h until improvement seen
(usually 24-48 hours) then q24h or switch or oral prednisone.

**Anti-inflammatory:**
IV: 1-2 mg/kg q24h.

**High dose/pulse therapy:**
IV: 10-30 mg/kg q24h x 1-3 doses.

**Spinal cord injury:**
IV: 30 mg/kg IV over 15 minutes then 5.4 mg/kg/h beginning 45 minutes later and continuing for 23 or 48 h.

Discontinuation of therapy >14 days requires gradual tapering. Consider supplemental steroids at times of stress if patient has received long-term or frequent bursts of steroid therapy. Prolonged weakness may occur when corticosteroids are used concurrently with non-depolarizing neuromuscular blocking agents.
Metoclopramide
Antiemetic, gastrointestinal prokinetic agent.
IV/PO: 0.4-0.8 mg/kg/day ÷ q6h (usual maximum 40 mg/day). Extrapyramidal reactions occur more commonly in children and may be treated with diphenhydramine.

Metronidazole
Anti anaerobic antibiotic.
Anerobic infections:
IV/PO: 20-30 mg/kg/day ÷ q12h (maximum 1 g/day).
C. difficile:
IV/PO: 30 mg/kg/day ÷ q6-8h (maximum 1.5 g/day).
Excellent oral absorption, use IV only if PO contraindicated or not tolerated. Enteral administration preferred for colitis caused by C. difficile, but IV can be used.

Midazolam
Benzodiazepine sedative, anxiolytic and amnestic.
Procedural sedation:
IV: 0.05-0.1 mg/kg/dose, repeat prn to desired level of sedation.
Refractory status epilepticus:
IV: 0.2 mg/kg then 1 microgram/kg/min, increased q15 min prn, most cases require less than 5 microgram/kg/min.
ICU sedation:
IV: 0.05-0.1 mg/kg/dose q1-2h prn
or
1-3 microgram/kg/min and 0.05-0.1 mg/kg q1h prn (usual maximum 6 microgram/kg/min).
Midazolam has a short duration of action after single doses, but may have an extended duration of action after repeated dosing due to accumulation. Continuous infusions of benzodiazepines for ICU sedation are recommended only if intermittent boluses are ineffective. Always order a breakthrough dose to treat acute agitation if using a continuous infusion. Withdrawal may occur if discontinued abruptly after prolonged use.
**Milrinone**  
Inotrope and vasodilator.  
IV: 50 microgram/kg over 15 min then 0.25-0.75 microgram/kg/min.  
Used for short-term treatment of refractory CHF. Hemodynamic effects are similar to dobutamine, watch for hypotension and thrombocytopenia.

**Morphine**  
Narcotic analgesic.  
**Sedation/analgesia:**  
IV: 0.05-0.1 mg/kg/dose q2-4h and increase as required  
or  
0.1 mg/kg then 10-40 (usual maximum 100) microgram/kg/h.  
For breakthrough, use 1-1.5 times the hourly dose +/- increase the infusion.  
Reduced doses may be required if used in combination with benzodiazepines. Use with caution in non-ventilated patients due to potential for respiratory depression. There is no upper dose limit if increased gradually. To prevent withdrawal, avoid abrupt cessation following high doses or long duration of therapy (> 5 days). Common adverse effects are pruritis, nausea and constipation, which may be overlooked in PICU patients.

**Naloxone**  
Narcotic antagonist used to reverse opioid induced respiratory depression.  
**Opiate overdose/respiratory arrest:**  
IV/IM/SC: 0.1 mg/kg q1-2 minutes prn (maximum of 2 mg/dose).  
**Partial reversal of opiate induced respiratory depression:**  
IV/IM/SC: 0.01 mg/kg q1-2 minutes prn until desired effect.  
May precipitate withdrawal in narcotic dependent patients. Will also reverse analgesia. If giving via ETT, increase IV dose 2-10 fold and dilute to 3-5 mL with NS. Follow with several positive pressure breaths.
**Naproxen**
Analgesic and anti-inflammatory (NSAID).
- **PO:** 10-20 mg/kg/day ÷ q8-12h (maximum 1 g/day).
Adverse effects include renal dysfunction, GI irritation and ulceration.

**Neostigmine**
Reversal of non-depolarizing neuromuscular blocking agents:
- **IV:** 0.025-0.1 mg/kg/dose (usual maximum dose 0.5-2 mg/dose, to a total dose of 5 mg).
Will not reverse the effects of succinylcholine. Give with atropine to prevent bradycardia and other cholinergic effects. Complete reversal may take several minutes and repeat doses may be required.

**Nifedipine**
Antihypertensive, calcium channel blocker.
- **Hypertensive urgencies:**
  - **PO:** 0.25-0.5 mg/kg/dose, usual maximum 10 mg/dose.
    - Try to use 5 or 10 mg/dose.
- **Hypertension:**
  - **PO:** 0.5-1 mg/kg/day.
May cause rapid and profound hypotension. Bite and swallow capsule for rapid (<5 minutes) effect. Available as 5 and 10 mg short acting capsules (dose q6-8h) and 10 and 20 mg long acting tablets (dose q12h) and 20, 30 and 60 mg extended release tablets (dose q24h).

**Nitroglycerin**
Antihypertensive, vasodilator.
- **IV:** 0.5-5 (maximum 10) microgram/kg/min.
Titrate to effect, tolerance may develop, requiring dosage adjustment.
**Nitroprusside**
Antihypertensive, vasodilator.

IV: 0.5-3 (maximum 5) microgram/kg/min
Titrate to response, doses greater than 4 microgram/kg/min are rarely required. Monitor for cyanide toxicity (check cyanide and thiocyanate levels) in patients with renal insufficiency, with high doses or prolonged infusions.

**Norepinephrine**
Vasopressor with $\alpha$ and $\beta$ activity.

IV: 0.05-1 microgram/kg/min.
Give via central line.

**Nystatin**
Topical antifungal.

Oral candidiasis:
- PO: infants: 100 000 units swish and swallow q6h.
- children: 250 000 units swish and swallow q6h.
- adolescents: 500 000 units swish and swallow q6h.

**Omeprazole**
Inhibitor of gastric acid secretion (proton pump inhibitor).

PO: 0.7-1.4 mg/kg/day ÷q12-24h (maximum 40 mg/day).
Do not give crushed tablets without sodium bicarbonate solution. An oral solution is available for doses other than 10 and 20 mg but is very unpalatable and should be given via feeding tube.

**Ondansetron**
Antiemetic.

IV/PO: 0.15 mg/kg/dose q8h (maximum 8 mg/dose).
**Pancuronium**
Non-depolarizing neuromuscular blocking agent.

IV: 0.1 mg/kg/dose q1h prn.
Regular analgesia, sedation and ocular lubrication required. Duration of action may be prolonged for patients with renal impairment. May cause tachycardia. Duration of action prolonged in renal dysfunction. Prolonged weakness may occur, especially when corticosteroids are used concurrently with non-depolarizing neuromuscular blocking agents.

**Pantoprazole**
Inhibitor of gastric acid secretion (proton pump inhibitor).

There is limited experience with pantoprazole in pediatric patients.

PO/IV: Adult dose: 40 mg q24h (maximum q12h),
1 mg/kg q24h has been used in pediatric patients.

**Major gastrointestinal hemorrhage:**
IV: Adult dose: 80 mg loading dose then 8 mg/h.

There is more data with the use of oral omeprazole in pediatric patients. Intravenous and oral pantoprazole provide equivalent acid suppression. Do not crush tablets.

**Paraldehyde**
Anticonvulsant.

IV: 100-200 mg/kg over 20 min to 2 h, may follow with
20-50 mg/kg/h, titrated to response.

PR: 200-400 mg/kg/dose.
Give rectally diluted with an equal amount of saline or oil (mineral or olive). Solutions must be mixed in glass and protected from light. Paraldehyde has largely been supplanted by other less toxic and easier to administer agents.
**Penicillin G**

Antibiotic.

**Moderate to severe infections:**

- **IV:** 100 000-400 000 units/kg/day ÷ q4-6h (max 20 million units/day).

**Meningitis:**

- **IV:** 400 000 units/kg/day ÷ q4h (max 20 million units/day)

Increase dosing interval for patients with renal impairment.

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**Pentobarbital**

Barbiturate sedative and anticonvulsant.

**Procedural sedation:**

- **IV:** 1-3 mg/kg, repeat doses of 1-2 mg/kg may be given q5-10 minutes until adequate sedation (usual maximum 6 mg/kg or 200 mg total dose).

**Refractory status epilepticus/uncontrolled intracranial hypertension:**

- **IV:** 3-5 mg/kg over 20 min then 1-3 mg/kg/hour, higher doses may be required.

Hypotension is common, especially with rapid infusion, treat promptly with fluids and vasopressors. Avoid extravasation, central line preferred. Respiratory depression is common. Coma usually occurs at 20-40 mg/L (88-177 micromol/L), but higher levels may be required. Has no analgesic properties.

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**Phenobarbital**

Barbiturate anticonvulsant.

**Status epilepticus:**

- **IV:** 15-20 mg/kg over 20-30 minutes.

**Maintenance:**

- **IV/PO:** 3-5 mg/kg/day ÷ q12-24h.

Usual serum level for seizure control: 65-172 micromol/L (15-40 mg/L).
**Phentolamine**

α receptor blocker.

Treatment of α agonist drug extravasation:

SC: Infiltrate area of extravasation, dilute 5 mg in 10 mL of NS and do not exceed 0.1-0.2 mg/kg or 5 mg total dose. Use within 12 hours of extravasation. Effective in extravasations of dopamine, epinephrine, norepinephrine and phenylephrine

**Phenylephrine**

Vasopressor, α receptor agonist.

Refractory hypotension and shock:

IV: 0.1-2 microgram/kg/min (usual maximum 4 microgram/kg/min).

For tetralogy of Fallot/hypercyanotic spells may give bolus of 5-10 microgram/kg before beginning infusion. Give via central line.

**Phenytoin**

Anticonvulsant, antiarrhythmic.

Status epilepticus:

IV: 15-20 mg/kg over 20 minutes.

Maintenance:

IV/PO: 5 mg/kg/day (range 3-10 mg/kg/day) ÷ q8-12h.

Anti-arrhythmic:

IV: 1.25 mg/kg q5min until arrhythmia suppressed (maximum of 15 mg/kg total dose),

or

15 mg/kg over 20 min.

May require higher doses for patients with head injuries. Must be diluted in saline only and requires in-line filter (0.22 micron). Hold feeds before and after enteral administration as continuous feeds and formula may decrease bioavailability of oral products. Significantly increased free fraction in patients with hypoalbuminemia may result in underestimation of effective drug concentration and difficulty in interpretation of drug levels and toxicity may occur at “therapeutic” serum levels. Therapeutic level: 40-80 micromol/L (10-20 microgram/mL).
Phosphate (Sodium or Potassium Phosphate)
Electrolyte.
    IV:  0.15-0.6 mmol/kg of phosphate/dose as either potassium or sodium phosphate.
Correct deficit slowly and check serum phosphate and potassium after each dose. Maximum rate of administration is 0.3 mmol of phosphate/kg/h (to maximum of 15 mmol/h). Potassium phosphate supplies approximately 1.5 mEq of potassium for each mmol of phosphorus and carries the risk of arrhythmias and cardiac arrest with rapid IV administration.

Phytonadione
    See vitamin K.

Piperacillin
Broad spectrum penicillin.
    IV:  200-300 mg/kg/day ÷ q6h (maximum 16 g/day).
Adjust dose interval in severe renal impairment. Active against Pseudomonas aeruginosa.

Piperacillin/Tazobactam
Broad spectrum penicillin with beta-lactamase inhibitor.
    IV:  200-300 mg/kg/day (of piperacillin component) ÷ q6-8h.
    Max dose is 4.5 g (4 g piperacillin + 0.5 g tazobactam) q8h
Order in mg or g of piperacillin, for example, give piperacillin/tazobactam (as x mg of piperacillin component) IV q8h. Adjust dosage interval for patients with severe renal impairment. Active against gram positive, (including S. aureus), gram negative and anerobic organisms.
Potassium Chloride
Electrolyte.

**Treatment of hypokalemia:**
- **PO:** 1-2 mEq/kg/day ÷ q6-12h.
- **IV:** 0.25-1 mEq/kg/dose.

**Risk of arrhythmias and cardiac arrest with rapid IV administration.**
Dose recommendations assume normal renal function. Maximum rate of administration in PICU is 0.5 mEq/kg/h (maximum 20 mEq/h). Use 0.1 mEq/mL for peripheral use, 0.2 mEq/mL for central lines. For maintenance fluids the usual maximum concentration for a peripheral IV is 40 mEq/L.

Potassium Phosphate
See phosphate.

Prednisone or Prednisolone
Corticosteroid.

**Acute asthma:**
- **PO:** 1-2 mg/kg q24h.

**Anti-inflammatory or immunosuppressive:**
- **PO:** 0.5-2 mg/kg 24h, dose may be tapered as tolerated.

1 mg Prednisone = 1 mg Prednisolone. Discontinuation of therapy >14 days requires gradual tapering. Consider supplemental steroids at times of stress if patient has received long-term or frequent bursts of steroid therapy. Prolonged weakness may occur when corticosteroids are used concurrently with non-depolarizing neuromuscular blocking agents.
**Procainamide**

Antiarrhythmic.

**IV:** Loading dose: 15 mg/kg over 30-60 min
or
3-5 mg/kg over 5 min q5-10 min until arrhythmia
is suppressed (maximum 1 g total dose).

**Infusion:** 20-80 microgram/kg/min (usual max 2 g/day).

Discontinue if QRS increases to >50 of baseline or hypotension develops.

Do not use with other drugs that prolong the QT interval such as amiodarone.

**Prochlorperazine**

Antiemetic.

**IV/PO:** 0.1-0.15 mg/kg/dose q6-8h (maximum 10 mg/dose).

Not usually used in children due to increased risk of extrapyramidal
reactions, but may be used in older children and adolescents. Extrapyramidal
reactions can be treated with diphenhydramine.

**Propofol**

General anaesthetic.

**Procedural sedation and intubation:**

**IV:** 1-3mg/kg.

**ICU sedation:**

**IV:** 0.5-4 mg/kg/h.

Limit use to <12h and <4 mg/kg/h, prolonged use in children is not
recommended because of a suggested risk of fatal metabolic acidosis. May
cause hypotension, local pain with infusion and infection (lipid vehicle is an
excellent medium for microbial growth).
**Propranolol**

Non-selective β receptor blocker.

**Arrhythmias:**

IV: 0.01-0.15 mg/kg/dose (maximum 3 mg/dose).

May repeat q6-8h prn.

PO: 0.5-4 mg/kg/day ÷ q6-8h (usual maximum 320 mg/day).

**Tetralogy Spells:**

IV: 0.05-0.1 mg/kg/dose over 10 minutes

(usual maximum 0.25 mg/kg/dose or 3 mg/dose).

PO: 1-6 mg/kg/day ÷ q6-8h (usual maximum 320 mg/day).

Note difference between IV and PO doses. Use is contraindicated in bradycardia, heart block and asthma.

**Protamine**

Heparin antidote.

IV: Dose of protamine is based on the amount of heparin received and the time since last heparin dose. In general, 1 mg will bind 100 units of heparin (usual maximum 50 mg/dose):

<table>
<thead>
<tr>
<th>Time since last heparin dose</th>
<th>Protamine Dose (maximum 50 mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;30 minutes</td>
<td>1 mg per 100 units heparin</td>
</tr>
<tr>
<td>30-60 minutes</td>
<td>0.5-0.75 mg per 100 units heparin</td>
</tr>
<tr>
<td>60-120 minutes</td>
<td>0.375-0.5 mg per 100 units heparin</td>
</tr>
<tr>
<td>&gt;120 minutes</td>
<td>0.25-0.375 mg per 100 units heparin</td>
</tr>
</tbody>
</table>

Give over at least 10 minutes. Use with caution in patients with known reactions to fish. Check APTT 15 minutes after administration of protamine. May need repeat dose of heparin was given by SC injection due to slower absorption. Protamine will not reliably neutralize low molecular weight heparins, but with life threatening bleeding can try 1 mg protamine for every 1 mg or 100 Units of low molecular weight heparin if given within 3-4 hours of low-molecular weight heparin.

**Protein C (Activated)**

See drotrecogin alfa.
Racemic Epinephrine
See epinephrine.

Ranitidine
H₂ receptor antagonist.
Reduction of gastric acid secretion:
IV: 2-6 mg/kg/day ÷ q6-12h (usual maximum 50 mg q6-8h).
PO: 4-10 mg/kg/day ÷ q8-12h (usual maximum 300 mg/day).
IV dose is approximately 50% of oral dose. Modify dosage interval for patients with renal impairment. May add daily dose to TPN.

Remifentanil
Opioid anesthetic and analgesic.
Rapid sequence induction:
IV: 2-4 microgram/kg.
Rapid onset of action, very short duration of action (3-10 min).

Rocuronium
Non-depolarizing neuromuscular blocking agent.
Endotracheal intubation:
IV: 0.6-1.2 mg/kg/dose (usual maximum 50 mg/dose).
Rapid onset of action (<1 min), duration of action is approximately 30-60 minutes. Other agents are usually preferred for continuing paralysis.
**Salbutamol**

Bronchodilator, $\beta_2$ agonist.

**Acute asthma:**

**MDI:** start at 2-4 puffs q20-60min prn. Higher doses may be required if administered through a ventilator due to loss of drug in the circuit.

**NEB:** 0.01-0.03 mL/kg/dose (5 mg/mL solution, maximum 1 mL) in 2-3 mL NS q½-4h, may give continuously if required.

**IV:** 1 microgram/kg/min, increase q15min prn to maximum of 10 microgram/kg/min.

**Maintenance therapy:**

**MDI:** 1-2 puffs q4h prn.

**Acute treatment of hyperkalemia:**

**IV:** 4 microgram/kg over 20 min.

Titrate dose to effect and/or adverse effects (tachycardia, tremor and hypokalemia). For most patients metered dose inhalers with a spacer device are the preferred method of drug delivery. Wet nebulization is less efficient and more costly. Monitor serum potassium, especially with IV. Cardiac monitoring required for IV use.

**Senna**

Stimulant laxative.

**PO:** infants: 1 or 2.5 mL (1.7 or 4.25 mg) q24h.

children: 2.5 or 5 mL (4.25 or 8.5 mg) q24h.

adolescents: 5 or 10 mL (8.5 or 17 mg) q24h.

Some patients, particularly those receiving opiates may require higher doses and/or more frequent administration. Also supplied as 8.6 mg tablets.

**Septra®**

See co-trimoxazole.
**Sodium Bicarbonate**
Alkalinizing agent.

- **Cardiopulmonary resuscitation/metabolic acidosis:**
  - IV: 1 mEq/kg/dose.
- **Urinary alkalization:**
  - IV: 0.6 mEq/kg q4h.

Avoid extravasation, tissue necrosis can occur. Incompatible with many drugs including calcium, atropine and epinephrine.

Use 4.2% (0.5 mEq/mL) in neonates.

**Sodium Benzoate**
Treatment of urea cycle disorders:

- IV: 250-500 mg/kg/day as a continuous infusion or divided q6h (250 mg/kg loading dose may be given).
  - For adolescents may use 5 g/m²/day.

**Sodium Benzoate/Sodium Phenylacacetate**
Treatment of urea cycle disorders:

- IV: 250-500 mg/kg/day of each component as a continuous infusion or divided q6h (250 mg/kg loading dose may be given).
  - For adolescents may use 5 g/m²/day.

Solution contains 100 mg/mL of each component.
**Sodium Chloride 3% (513 mml/L)**

Electrolyte.

**Reduction of raised intracranial pressure:**
IV: 2-5 mL/kg/dose.

**Correction of hyponatremia:**
(Correct long-standing hyponatremia slowly, serum sodium should rise no faster than 0.5 mmol/L/h unless symptomatic or if seizures occur)
IV: usual maximum rate of administration:
- 1 mmol/kg/h (2 mL/kg/h of NaCl 3%)
  or
- replace estimated sodium deficit, mEq of sodium = 0.6 x wt (kg) x (target plasma sodium – present plasma sodium).

Give solutions >0.9% via central line. Rapid correction of long-standing hyponatremia has been associated with central pontine myelinolysis. Follow serum sodium and osmolality frequently.

**Sodium Phosphate**

See phosphate.

**Sodium Polystrene Sulfonate (Kayexelate®)**

Cation exchange resin.

**Treatment of hyperkalemia:**
PO/PR: 1 g/kg/dose may be repeated prn (usual maximum 30-60 g/dose).

Give in water or juice, do mix with fruit juices with high potassium content such as orange juice.

**Sotalol**

Antiarrhythmic.

PO: 2-5 mg/kg/ day ÷ q12h (usual maximum 320-480 mg/day).

Infants tend to require lower doses than older children. Monitor heart rate, QTc interval.
**Spironolactone**
Potassium sparing diuretic.
- **PO:** 1-3 mg/kg/day ÷ q8-24h.

**Succinylcholine**
Depolarizing neuromuscular blocking agent.
- **IV:** 1-2 mg/kg/dose (maximum 150 mg).
- **IM:** 2.5-4 mg/kg/dose.
Onset of action within 30-60 seconds, duration of action less than 5-10 minutes. Contraindicated in hyperkalemia, increased intraocular pressure, extensive burns, crush injuries and rhabdomyolysis. Bradycardia may be reduced by pre-treatment with atropine and should be routinely given in children less than 5-8 years of age. Repeat doses of succinylcholine increase risk of bradycardia and asystole and should generally be avoided.

**THAM**
See tromethamine.

**Theophylline**
See aminophylline.
Thiopental
Barbiturate anticonvulsant and anesthetic.

Induction:
IV: 3-5 mg/kg/dose, may repeat prn.
Status epilepticus/refractory increased intracranial pressure:
IV: 3-5 mg/kg over 2-5 min, may repeat if required then
1.5-5 mg/kg/h initially, higher doses have been required.

Hypotension is common, especially with rapid IV injection, treat promptly
with fluids and vasopressors. Avoid extravasation, central line preferred.
Respiratory depression is common. Coma usually occurs at 30-130 mg/L
(124-536 micromol/L) but very high levels may be required. Has no analgesic
properties.

Tobramycin
Aminoglycoside antibiotic.
IV: 5-6 mg/kg/dose q24h
or
2.5 mg/kg/dose q8h.

Once daily dosing should be used for all patients > 1 month of age, except in
the treatment of endocarditis and in patients with extensive burns. Adjust
dosing interval in renal impairment. Ototoxicity and nephrotoxicity may
occur, consider monitoring trough levels (target <2 mg/L) in patients at risk
for nephrotoxicity; septic shock, concurrent nephrotoxins, fluctuating renal
function or extended treatment courses. May potentiate muscle weakness
with neuromuscular blockers. Reserved for documented or suspected
resistance to gentamicin.

Tranexamic Acid
Fibrinolysis inhibitor.

Treatment of excessive bleeding due to hyperfibrinolysis:
PO: 25 mg/kg q6-12h (usual maximum 1.5 g/dose).
IV: 10 mg/kg/dose q6-8h (usual maximum 1 g/dose).
There is limited experience with using tranexamic acid in children.
**Tromethamine (THAM)**
Alkalinizing agent.

IV: Dose depends on severity of acidosis. Usual dose is 1-2 mEq/kg. Give each dose over at least 1 hour via central line. Sodium bicarbonate is preferred unless patient is hypernatremic. Lower doses may be required in renal dysfunction. 1 mEq of tromethamine = 3.3 mL of solution

**Valproic Acid and Derivatives**
Anticonvulsant.

PO: 15-20 mg/kg/day increased to a maximum of 30-60 mg/kg/day ÷ q6-12h.

IV: Divide total daily maintenance q6h.

Desired therapeutic range: 350-690 micromol/L (50-100 microgram/mL). Dosing is equivalent for valproic acid, divalproex and sodium valproate.

**Vancomycin**
Antibiotic.

**Meningitis:**
IV: 60 mg/kg/day ÷ q6h (maximum 4 g/day).

**Other infections:**
IV: 40 mg/kg/day ÷ q6-12h (maximum 2 g/day).

Pseudomembranous colitis refractory to metronidazole:
PO: 50 mg/kg/day ÷ q6h (maximum 500 mg/day).

Reserved for the treatment of infections caused MRSA or coagulase negative Staphylococci. Infuse over at least one hour to avoid red man syndrome, increase infusion duration if reaction occurs. Adjust dosage interval for patients with renal impairment. Consider monitoring trough levels in patients with septic shock, concurrent nephrotoxins, fluctuating renal function or extended treatment courses. Trough levels should be 5-12 mg/L.
**Vasopressin**

Antidiuretic hormone, vasoconstrictor.

**Diabetes Insipidus:**

IV: 0.0005-0.01 unit/kg/h (0.5-10 milliunits/kg/h), requirements are highly variable, desmopressin is usually preferred.

**Refractory septic shock:**

IV: There is little experience with using vasopressin in pediatric septic shock. One small case series used 0.02-0.1 unit/kg/h.

Usual adult dose is 2 unit/h.

In refractory septic shock, add vasopressin to allow dosage reduction of conventional vasopressors, keep titration of vasopressin to a minimum and use the lowest effective dose. In the treatment of diabetes insipidus follow urine output, volume status, serum and urine electrolytes frequently.

**Vecuronium**

Non-depolarizing neuromuscular blocking agent.

IV: 0.1 mg/kg q30min prn or 1-2 microgram/kg/min.

Avoid continuous infusions, prn boluses preferred. Monitor depth of paralysis using peripheral nerve stimulation with infusions (target 1-2 twitches out of 4). Onset of action is within 1-2 minutes, duration of action is approximately 30-60 minutes and may be prolonged in patients with renal and hepatic dysfunction. Prolonged weakness may occur, especially when corticosteroids are used concurrently with non-depolarizing neuromuscular blocking agents.
**Verapamil**
Calcium channel antagonist antiarrhythmic.

- **Supraventricular Tachydysrhythmias (≥1 year of age):**
  - IV: 0.1 mg/kg/dose (maximum 5 mg/dose),
  - may repeat once in 30 minutes if needed.

Do not use for SVT in patients less than 1 year due to reports of refractory hypotension and cardiac arrest. Give IV under ECG monitoring. Have IV calcium chloride available. Adverse effects include severe hypotension and AV block. Can precipitate congestive heart failure and/or heart block if given with β-blockers.

**Vitamin K**
Reversal of prolonged clotting times or warfarin induced anticoagulation.

- IV/PO: 0.5-10 mg/dose.

Use lower doses if there is no significant bleeding and patient will require warfarin in the future. May repeat in 6-8 hours. Injection may be given by mouth, undiluted or in juice or water.