Resuscitation Fluids

Acceptable Fluids (also known as):
- 0.9% Sodium Chloride
- Hartmann’s Solution (*Ringer-Lactate Solution, Compound Sodium Lactate*)
- 4.5% Albumin Solution (*PPS*)
- Gelofusine

Dose:

20ml/kg Bolus
Can be given in divided doses if appropriate
Fluids in Hypoglycaemia

Acceptable Fluids:
- 10% Glucose

Dose:
3-5ml/kg Bolus
**Maintenance Fluids**

**IV maintenance fluids are worked out on an hourly basis as follows:**

- For the first 10kg - 4mls/kg/hr
- For the second 10kg - 2mls/kg/hr
- For additional kg above 20kg - 1ml/kg/hr

**Worked example:**

Maintenance fluids for a 35kg child would be 75ml/hr:

| 0 – 10kg   | =   | 10 x 4 | =   | 40mls |
| 11 – 20kg  | =   | 10 x 2 | =   | 20mls |
| >20kg      | =   | 15 x 1 | =   | 15mls |
| TOTAL      | =   |        | =   | 75mls |

**NB:** For infants and children <10kg give 4mls/kg/hr (ie 96mls/kg/day)

**Acceptable fluids:**
- 0.45% Sodium Chloride / 5% Glucose pre-mixed bag

**Monitor blood glucose continually. Infants may require additional glucose, which may be added to the bag (refer to Non-Standard Glucose Solutions sheet).**
NON-STANDARD GLUCOSE INFUSIONS
(Edinburgh retrievals only)

**Burette:**
- Glucose 10%
  - 80ml Glucose 5% + 10ml Glucose 50%
  - Final volume = 90ml
- Glucose 15%
  - 70ml Glucose 5% + 20ml Glucose 50%
  - Final volume = 90ml

**Bags:**
- Sodium chloride 0.45% / Glucose 10%
  - Withdraw 55ml from 500ml bag of 0.45% Sodium Chloride / 5% Glucose
  - Add 55ml Glucose 50%
  - Mix well
- Sodium chloride 0.45% / Glucose 15%
  - Withdraw 110ml from a bag of 0.45% Sodium Chloride / 5% Glucose
  - Replace with 110ml Glucose 50%
  - Mix well
NON-STANDARD GLUCOSE INFUSIONS
(Glasgow retrievals only)

**Burette:**
- Glucose 10%
  - 80ml Glucose 5% + 10ml Glucose 50%
  - **Final volume = 90ml**

- Glucose 15%
  - 70ml Glucose 5% + 20ml Glucose 50%
  - **Final volume = 90ml**

**Bags:**
- Sodium chloride 0.45% / Glucose 10%
  - Take a bag of 500ml **Glucose 10%**
  - Add **7.5ml Sodium Chloride 30%**
  - Total in bag = 37.5mmol Sodium
    - = 0.45% Sodium Chloride / 10% Glucose
  - **Mix well**

- Sodium chloride 0.45% / Glucose 15%
  - **Withdraw 110ml** from a bag of 0.45%
    Sodium Chloride / 5% Glucose
  - Replace with **110ml Glucose 50%**
  - **Mix well**
**Approved Name:** Adenosine

**Application:** Termination of Paroxysmal SVT

**Contra-indications:** Second or third-degree AV block, sick sinus syndrome

**Precautions:** AF (atrial fibrillation) involving accessory pathways

**Drug Interactions:** Nil relevant

**Dose:**

<table>
<thead>
<tr>
<th>Age</th>
<th>Initial Dose</th>
<th>Increasing by</th>
<th>Maximum Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Ages</td>
<td>50 microgram/kg</td>
<td>50 microgram/kg every 2mins</td>
<td>300 microgram/kg (Max 3mg)</td>
</tr>
</tbody>
</table>

**Reconstitution:** Use neat in children >10kg
Children <10kg – dilute to 1mg/ml in 0.9% Sodium Chloride

**Flushes compatible:** 0.9% Sodium Chloride

**Administration:** Rapid bolus. Flush immediately.

**Stability:** Use dilute solution immediately

**Physical Compatibility with other Drugs:** Do not mix with other drugs

**Side Effects:** Bronchospasm in asthmatic patients
Painful if given peripherally

**Comments:** Half-life less than 2 seconds.
Immediate effect is total heart block.
Approved Name: Adrenaline (Epinephrine)

Application: Inotrope

Contra-indications: Nil relevant

Precautions: Pre-existing arrhythmias, diabetes, central administration preferred.

Drug Interactions: Inhalational anaesthetics – risk of arrhythmia; beta-blockers – hypertension

Dose: 0.01 – 2 microgram/kg/min

Reconstitution: 0.3mg/kg in 50ml diluent

Stability in IV Solutions:

<table>
<thead>
<tr>
<th>Sodium Chloride 0.9%</th>
<th>Glucose 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

Administration: 1ml/hr = 0.1microgram/kg/min
Contact PICU if requiring inotropes

Stability: Infusion stable for 24 hours

Physical Compatibility with other Drugs: See comments

Side Effects: Tremor, tachycardia, arrhythmia, cold extremities, headache, dizziness, nausea and vomiting

Comments: Inotropes should be administered through the same lumen of the same central line. Should be administered centrally, but may be given peripherally if necessary. Do not bolus drugs through the inotrope line. Monitor blood glucose.
Approved Name: Dobutamine

Application: Inotrope

Contra-indications: Nil relevant

Precautions: Hypotension – causes vasodilatation which could lead to severe hypotension in a hypovolaemic patient

Drug Interactions: Nil relevant

Dose: 5 – 20 microgram/kg/min

Reconstitution: 3mg/kg in 50ml diluent

Stability in IV Solutions:

<table>
<thead>
<tr>
<th>Sodium Chloride 0.9%</th>
<th>Glucose 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

Administration: 1ml/hr = 1microgram/kg/min. Contact PICU if requiring inotropes

Stability: Infusion stable for 24hrs

Physical Compatibility with other Drugs: See comments

Side Effects: Tachycardia, hypertension, phlebitis, rarely thrombocytopenia

Comments: Inotropes should be administered through the same lumen of the same central line
Should be administered centrally, but may be given peripherally if necessary.
Do not bolus drugs through the inotrope line.
Approved Name: Dopamine

Application: Inotrope

Contra-indications: Nil relevant

Precautions: Central administration preferred

Drug Interactions: Nil relevant

Dose: 5 – 20 microgram/kg/min

Reconstitution: 3mg/kg in 50ml diluent

Stability in IV Solutions:

<table>
<thead>
<tr>
<th>Sodium Chloride 0.9%</th>
<th>Glucose 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

Administration: 1ml/hr = 1microgram/kg/min. Contact PICU if requiring inotropes

Stability: Infusion stable for 24hrs

Physical Compatibility with other Drugs: See comments

Side Effects: Tachycardia, peripheral vasoconstriction (cold peripheries), hypertension

Comments: Inotropes should be administered through the same lumen of the same central line. Should be administered centrally, but may be given peripherally if necessary. Do not bolus drugs through the inotrope line.
Approved Name: Fentanyl

Application: Analgesic

Contra-indications: Nil relevant

Precautions: Renal impairment, hepatic impairment

Drug Interactions: Nil relevant

Dose: Infusion 2-5 microgram/kg/hr
Bolus 1-2 microgram/kg as required

Reconstitution: Neat solution of 50 microgram/ml
(use 10ml ampoules)

Stability: Infusion stable for 24 hours

Physical Compatibility with Other Drugs: See comments

Side Effects: Respiratory depression, nausea/vomiting, hypotension, bradycardia, constipation. Large doses may cause chest wall rigidity if given without muscle relaxants.

Comments: Opioids and benzodiazepines can be run together on the same lumen or line. Non-ventilated patients should be appropriately monitored with respiratory support available. Naloxone is the recognised antagonist of opioids. Fentanyl will obtund the hypertensive response to intubation and therefore attenuate the associated rise in intracranial pressure.
**Approved Name:** Lorazepam (Ativan ®)  

**Application:** Anti-convulsant  

**Contra-indications:** Nil relevant  

**Precautions:** Store in refrigerator  

**Drug Interactions:** Other benzodiazepines and sedative agents (reduced respiratory drive)  

**Dose:**

<table>
<thead>
<tr>
<th>Age</th>
<th>ALL AGES</th>
</tr>
</thead>
</table>
| Dose | 100 microgram/kg  
|      | Max 4mg/dose |

**Reconstitution:** Further dilution required  

**Flushes compatible:** 0.9% Sodium Chloride  

**Administration:** Slow bolus over 3-5 minutes diluted to 1mg/ml with Water for injections or Sodium Chloride 0.9%  

**Stability:** Use solution immediately  

**Physical Compatibility with other Drugs:** Do not mix with other drugs  

**Side Effects:** Respiratory Depression, delirium, drowsiness, hypotension  

**Comments:** IV solution can be given rectally or sublingually (same dose)
**Approved Name:** Magnesium Sulphate (use in asthma)

**Application:** Adjunct to bronchodilators in severe status asthmaticus

**Contra-indications:** Nil relevant

**Precautions:** Nil relevant

**Drug Interactions:** Nil relevant

**Dose:** 50mg/kg (=0.1ml/kg of 50% Magnesium Sulphate), Max 2g

**Reconstitution:** Further dilution is required

**Stability in IV Solutions:**

<table>
<thead>
<tr>
<th>Sodium Chloride 0.9%</th>
<th>Glucose 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

**Flushes compatible:** As above

**Administration:** Dilute dose 5 times before administration (eg dose = 1ml, dilute to 5ml). Administer over 20 minutes

**Stability:** Use dilute solution immediately.

**Physical Compatibility with other Drugs:** Do not mix with other drugs

**Side Effects:** High magnesium levels can cause dystonia, nausea, vomiting, flushing

**Comments:** 1g magnesium sulphate = 4mmol magnesium
Approved Name: Midazolam

Application: Sedative

Contra-indications: Myaesthenia gravis (unless already ventilated)

Precautions: Nil relevant

Drug Interactions: Nil relevant

Dose:

<table>
<thead>
<tr>
<th>Age</th>
<th>Dose</th>
<th>Bolus</th>
</tr>
</thead>
<tbody>
<tr>
<td>All ages</td>
<td>100 – 200 microgram/kg/hr</td>
<td>100 – 200 microgram/kg</td>
</tr>
</tbody>
</table>

Reconstitution: 50mg to 50ml diluent

Stability in IV Solutions:

<table>
<thead>
<tr>
<th></th>
<th>Sodium Chloride 0.9%</th>
<th>Glucose 5%</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

Administration: 0.1ml/kg/hr =100microgram/kg/hr

Stability: Infusion stable for 24hrs

Physical Compatibility with other Drugs: See Comments

Side Effects: Gastro-intestinal disturbance, hypotension, bradycardia, bronchospasm, respiratory depression

Comments: Opioids and benzodiazepines can be run together on the same lumen or line. Non-ventilated patients should be appropriately monitored with respiratory support available.
**Approved Name:** Morphine

**Application:** Analgesic / moderate sedative action

**Contra-indications:** Nil relevant

**Precautions:** Renal impairment, hepatic impairment,

**Drug Interactions:** Nil relevant

**Dose:**

<table>
<thead>
<tr>
<th>Loading Dose</th>
<th>Maintenance Dose</th>
<th>Bolus as required</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-100 microgram/kg</td>
<td>10-80 microgram/kg/hr</td>
<td>20-40 microgram/kg</td>
</tr>
</tbody>
</table>

**Reconstitution:** 1mg/kg Morphine in 50ml diluent
Max 50mg in 50ml

**Stability in IV Solutions:**

<table>
<thead>
<tr>
<th>Sodium Chloride 0.9%</th>
<th>Glucose 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

**Administration:** 1ml/hr = 20microgram/kg/hr (if patient <50kg)

**Stability:** Infusion stable for 24hrs

**Physical Compatibility with other Drugs:** See comments

**Side Effects:** Respiratory depression, nausea/vomiting, constipation, drowsiness, urticaria/pruritis

**Comments:** Opioids and benzodiazepines can be run together on the same lumen or line. Non-ventilated patients should be appropriately monitored with respiratory support available. Naloxone is the recognised antagonist of Morphine.
Approved Name: Noradrenaline (Norepinephrine)

Application: Inotrope

Contraindications: Nil relevant

Precautions: Central administration preferred.

Drug Interactions: Inhalational anaesthetics - risk of arrhythmia; beta-blockers - hypertension

Dose: 0.01 – 2 microgram/kg/min

Reconstitution: 0.3mg/kg in 50ml diluent

Stability in IV Solutions:

<table>
<thead>
<tr>
<th>Sodium Chloride 0.9%</th>
<th>Glucose 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

Administration: 1ml/hr = 0.1 microgram/kg/min

Stability: Infusion stable for 24hours

Physical Compatibility with other Drugs: See comments

Side Effects: Hypertension, bradycardia, peripheral ischaemia

Comments: Inotropes should be administered through the same lumen of the same central line. Should be administered centrally, but may be given peripherally if necessary. Do not bolus drugs through the inotrope line. Extravasation will cause local necrosis. If extravasated refer to local extravasation policy.
Approved Name: Phenobarbital (Phenobarbitone)

Application: Anti-convulsant (status epilepticus)

Contra-indications: Porphyria

Precautions: Hepatic impairment

Drug Interactions: Extensive – refer to British National Formulary

Dose:

<table>
<thead>
<tr>
<th>Loading Dose</th>
<th>Maintenance Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>20mg/kg</td>
<td>5mg/kg twice daily</td>
</tr>
</tbody>
</table>

Reconstitution: Dilute dose to 10 times volume with Water for injection

Stability in IV Solutions:

| Water | YES |

Flushes compatible: Sodium Chloride 0.9% pre and post dose

Administration: Administer as slow infusion over 20 minutes. Rate should not exceed 1mg/kg/min

Stability: Use solution immediately

Physical Compatibility with other Drugs: Do not mix with other drugs

Side Effects: Drowsiness, hyperkinesia, irritant to skin – caution when making up infusions.
Approved Name: Phenytoin

Application: Anti-convulsant (status epilepticus)

Contra-indications: Sinus bradycardia, sino-atrial block, second & third-degree heart block, porphyria

Precautions: Hypotension, heart failure

Drug Interactions: Extensive. Refer to British National Formulary

Dose:

<table>
<thead>
<tr>
<th>Age</th>
<th>Loading Dose</th>
<th>Maintenance Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neonate</td>
<td>20mg/kg</td>
<td>2-4 mg/kg twice daily</td>
</tr>
<tr>
<td>1 month – 18 yrs</td>
<td>18mg/kg</td>
<td>2.5-7.5mg/kg twice daily</td>
</tr>
</tbody>
</table>

Reconstitution: Epanutin® Ready Mixed does not require dilution. Other brands – dilute 50mg/ml to 10mg/ml with 0.9% Sodium Chloride.

Stability in IV Solutions: Sodium Chloride 0.9% YES

Flushes compatible: 0.9% Sodium Chloride

Administration: Administer as slow infusion over 20 minutes. Rate should not exceed 1mg/kg/min. Use an in-line filter where available.

Stability: Use reconstituted diluted infusion within one hour. Ready-mixed solution should only be drawn up at the moment of injection.

Physical Compatibility with other Drugs: Do not mix with other drugs

Side Effects: Arrhythmia, skin irritation if extravasated.
**Approved Name:** Dinoprostone (Prostaglandin E2); *also known as “Prostin”*

**Application:** Maintenance of PDA prior to surgical intervention

**Contra-indications:** Nil relevant

**Precautions:** Nil relevant

**Drug Interactions:** NSAIDs (e.g. Ibuprofen) will antagonise the effect

**Dose:** 10 – 50 **nanogram/kg/min**

**Reconstitution:** 75 **microgram/kg** in 50ml diluent

**Stability in IV Solutions:**

<table>
<thead>
<tr>
<th>Sodium Chloride 0.9%</th>
<th>Glucose 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>YES</strong></td>
<td><strong>YES</strong></td>
</tr>
</tbody>
</table>

**Flushes compatible:** As above

**Administration:** Continuous IV Infusion
0.4ml/hr = 10 **nanogram/kg/min.** Titrate to effect as instructed by PICU consultant

**Stability:** Infusion stable for 24hrs

**Physical Compatibility with other Drugs:** Do not mix with other drugs

**Side Effects:** Nausea, vomiting, diarrhoea, bronchospasm, pyrexia, respiratory depression, apnoea – consider intubation

**Comments:** Dinoprostone should be infused through a dedicated lumen or line. *Drugs with similar names are available. Check all drugs carefully before starting infusion.*
In some cases it may be appropriate to commence infusion at 100 nanograms/kg/min (4ml/hr) until duct open and then quickly wean to maintenance dose. **PICU will advise when this is necessary. Caution with history/increased risk of NEC Prostaglandin E2 has been implicated.**
**Approved Name:** Salbutamol  

**Application:** Bronchodilator  

**Contra-indications:** Nil relevant  

**Precautions:** Tachycardia, hypokalaemia, QT interval prolongation, hyperglycaemia, hyperthyroidism.  

**Drug Interactions:** Corticosteroids: increased risk of hypokalaemia  
Theophylline/Aminophylline: increased risk of hypokalaemia  

**Dose:**  
Loading Dose 15 microgram/kg over 15 mins  
Maintenance Dose 2-5 microgram/kg/min  
Maximum rate 10 microgram/kg/min in consultation with PICU  

**Stability in IV Solutions:**  

<table>
<thead>
<tr>
<th>Sodium Chloride 0.9%</th>
<th>Glucose 5%</th>
<th>Water for Injections</th>
<th>Sodium Chloride 0.45%/Glucose 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

**Reconstitution:**  
Remove 100ml from a 500ml bag  
Use 5mg/ml solution  
Replace with 20x5ml ampoules  
=100mg Salbutamol  
Concentration = 200 microgram/ml  

**Administration:**  
0.3ml/kg/hr= 1 microgram/kg/min  

**Stability:** Stable for 24 hours  

**Physical Compatibility with other Drugs:** Incompatible with Aminophylline  

**Side Effects:** Tachycardia, tremor, hypokalaemia  

**Comments:** Venous irritant, central access preferable  
Monitor blood glucose and serum potassium  
Monitor ECG  
This requires 20 ampoules of Salbutamol
Approved Name: Vasopressin/Arginine Vasopressin

Application: Pressor/Inotrope

Contra-indications: Hepatic Failure

Precautions: Cardiac Failure, hypertension

Drug Interactions: Nil relevant

Dose: 0.0003 – 0.002 units/kg/min

Reconstitution: 1 unit/kg in 50ml diluent

Stability in IV Solutions:

<table>
<thead>
<tr>
<th>Sodium Chloride 0.9%</th>
<th>Glucose 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

Administration: 1ml/hr = 0.0003 units/kg/min
6ml/hr = 0.002 units/kg/min (max dose)

Stability: Stable for 12hrs

Physical Compatibility with other Drugs: Do not mix with other drugs

Side Effects: Vasoconstriction - may cause peripheral and myocardial ischaemia, hypertension, fluid retention, nausea/vomiting, hypersensitivity reactions.

Comments: Inotropes should be administered through the same lumen of the same central line. Do not bolus drugs through the inotrope line. Extravasation will cause local necrosis. If extravasated refer to local extravasation policy.
Approved Name: Vecuronium

Application: Muscle relaxant (non-depolarising)

Contra-indications: Nil relevant

Precautions: Nil relevant

Drug Interactions: Nil relevant

Dose: Infusion 100-200 microgram/kg/hr
Bolus 100-200 microgram/kg

Reconstitution: Dissolve 10mg powder in 10ml of water

Stability in IV Solutions:

<table>
<thead>
<tr>
<th>Sodium Chloride 0.9%</th>
<th>Glucose 5%</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

Administration: 0.1 ml/kg/hr = 100 microgram/kg/hr

Stability: Infusion stable for 24 hours

Physical Compatibility with Other Drugs: See comments

Side Effects: Nil relevant

Comments: Opioids, benzodiazepines and vecuronium can be run together on the same lumen or line. Patients will require ventilation.