Guidelines for the management of children requiring advanced respiratory support: Central Manchester and Manchester Childrens NHS Foundation Trust

Introduction

These guidelines are aimed at supporting the adult intensive care unit in managing children that require ventilatory support whilst awaiting transfer to a paediatric intensive care unit, or in the event of a bed not being available, managing the child to recovery or withdrawal of support.

It is assumed that these guidelines will support staff with experience of critical care medicine and/or anaesthesia. As such these guidelines will focus on the differences of care and physiological and pharmacological variation.

These guidelines intend to supplement advice from the regional paediatric intensive care centres, and do not replace such advice, the duty consultant for the PICU at the Royal Manchester Children’s Hospital can be contacted through the hospital switchboard (0161 276 1234) or directly through PICU (0161 701 8000), or internally on 18024/18000.

Part 1: Intubation and care of the airway

Indications:

Please discuss with consultant paediatric Intensivist if there are any doubts concerning indications.

Key considerations

Anatomical differences

Relatively large head – tends to produce flexion of the neck with increased obstruction of the airway, as well as compromise view on laryngoscopy. This is particularly so in infants, placing a towel under the shoulders often achieves a neutral position, and improves the view. In older children, ‘sniffing the morning air’ position as in adults will produce the best view.

The larynx is anterior and cephalad (C1 in infants, C3 at 6 months, C5-6 in adults). This makes it easy to insert the laryngoscope too deep, as well as insertion of the endotracheal tube in to the right main bronchus, or at the carina.

The cricoid ring is the narrowest point in the airway in prepubescent children, a cuffed tube is generally avoided in this age group – however there are paediatric high volume, low pressure cuffed tubes that can be used in younger age groups, and above the age of 8, it probably does not matter if a cuffed tube is used. It is desirable to have a leak at 20cm pressure (unless the cuff is inflated).

The short airway results in even small movements of the endotracheal tube resulting in either inadvertent extubation or migration into the bronchi or abutting the carina. A nasotracheal tube is preferred for this reason as well as to protect against it being bitten on. It is recommended that an oral

www.crashcall.net for infusion and dose information
endotracheal tube is always placed initially, and if the child is stable and technical placement is easy, then the tube be changed to nasal.

The anterior placement of the larynx may need the use of a stylet or gum elastic bougie to facilitate placement.

**Physiological differences**

Children have a higher metabolic rate and a lower functional residual capacity, this results in rapid desaturation, consequently if intubation is not achieved within a minute, or the child has a significant desaturation, attempts at intubation should be stopped and bag and valve mask support started to restore oxygenation.

Infants have a high resting vagal tone and as cardiac output is rate dependent at this age, tolerate bradycardia poorly – atropine may help to reduce this.

Bradycardia is much more likely to occur as a result of hypoxia and atropine in not routinely required in older children requiring intubation.

**Drugs for intubation**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ketamine</td>
<td>1-2mg/kg</td>
<td>Iv / io</td>
</tr>
<tr>
<td>Thiopentone</td>
<td>2-5mg/kg</td>
<td>Iv / io</td>
</tr>
<tr>
<td>Propofol</td>
<td>2-4mg/kg</td>
<td>Iv / io</td>
</tr>
<tr>
<td>Suxamethonium</td>
<td>Adult 1mg/kg, child 2mg/kg, neonates 3mg/kg</td>
<td>Iv / io</td>
</tr>
<tr>
<td>Rocuronium</td>
<td>1mg/kg</td>
<td>Iv / io</td>
</tr>
</tbody>
</table>

**Selection of appropriate endotracheal tube:**

<1 year: length in cm; Weight (kg)/2 + 8 (oral), Weight (kg)/2 + 9 (nasal)

>1 year: Internal diameter: age/4 + 4 length in cms(oral): 12 + age/2 nasal: 15 + age/2  (useful to have a size smaller and one larger available). Avoid pre-cut tubes – it is easier to shorten the tube following a CXR as repositioning may be required.

[www.crashcall.net](http://www.crashcall.net) for infusion and dose information
It is essential to confirm endotracheal tube position radiographically post intubation, and it is recommended that the nasogastric tube position is confirmed at this time.

<table>
<thead>
<tr>
<th>Age</th>
<th>Weight</th>
<th>Internal Diameter</th>
<th>Length at teeth</th>
<th>Length at nose</th>
<th>Suction catheter FG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term infant</td>
<td>3.5kg</td>
<td>3.5mm</td>
<td>9cm</td>
<td>11cm</td>
<td>7</td>
</tr>
<tr>
<td>3 months</td>
<td>6kg</td>
<td>3.5mm</td>
<td>10cm</td>
<td>12cm</td>
<td>7</td>
</tr>
<tr>
<td>1 year</td>
<td>10kg</td>
<td>4.0mm</td>
<td>11cm</td>
<td>14cm</td>
<td>8</td>
</tr>
<tr>
<td>2 years</td>
<td>12kg</td>
<td>4.5mm</td>
<td>12cm</td>
<td>15cm</td>
<td>8</td>
</tr>
<tr>
<td>3 years</td>
<td>14kg</td>
<td>4.5</td>
<td>13cm</td>
<td>16cm</td>
<td>8</td>
</tr>
<tr>
<td>4 years</td>
<td>16kg</td>
<td>5mm</td>
<td>14cm</td>
<td>17cm</td>
<td>10</td>
</tr>
<tr>
<td>6 years</td>
<td>20kg</td>
<td>5.5mm</td>
<td>15cm</td>
<td>19cm</td>
<td>10</td>
</tr>
<tr>
<td>8 years</td>
<td>24kg</td>
<td>6.0mm</td>
<td>16cm</td>
<td>20cm</td>
<td>10</td>
</tr>
<tr>
<td>10 years</td>
<td>30kg</td>
<td>6.5mm</td>
<td>17cm</td>
<td>21cm</td>
<td>12</td>
</tr>
<tr>
<td>12 years</td>
<td>38kg</td>
<td>7.0mm</td>
<td>18cm</td>
<td>22cm</td>
<td>12</td>
</tr>
<tr>
<td>14 years</td>
<td>50kg</td>
<td>7.5mm</td>
<td>19cm</td>
<td>23cm</td>
<td>12</td>
</tr>
</tbody>
</table>

Fixation of the endotracheal tube:

Prepare 2 pieces of duoderm on the face as a preparatory surface for the application of tape.

Cut 2 ‘trouser legs’ as shown above.

www.crashcall.net for infusion and dose information
Secure the endotracheal tube with ‘trouser legs’ as shown below. The initial tape approaches from the opposite side of the face in order to have a larger bite of the nares as it wraps around the tube, the second tape approaches from the side the endotracheal tube is on, to provide a balanced counter-traction. The ‘leg’ of the tape that wraps around the endotracheal tube is initially the leg crossing the nose, whereas from the second tape, it is the one that crosses the upper lip, i.e alternate legs. Make a note of the tube length either at the teeth, or that nares prior to taping, as this makes alterations and restrapping more secure.

**Ventilation**

The usual mode of ventilation is a time cycled pressure controlled mode, although volume controlled ventilation with decelerating flow is used in children requiring neuroprotection. It may be necessary to use a paediatric circuit with lower dead space in smaller children – please check your ventilator specifications for this. (With the Evita Excel this is under 20kg)

The goals of ventilation and strategies are similar to the care of the adult patient, aiming for tidal volumes 6-8ml/kg.

In a child without pre-existing cyanotic cardiac disease or neurological injury, saturations above 92% with permissive hypercarbia are acceptable. In cyanotic heart disease, lower saturation limits are often acceptable, whilst in raised intracranial pressure or pulmonary hypertension, hypercarbia should be avoided.

High PEEP strategies are the same as for an adult, with PEEP up to 15 if needed, PIP however is limited to 35 (and preferably less than 30) to avoid air leaks.

Generally, when pressures exceed PIP of 30, or oxygenation remains poor in spite of high PEEP, high frequency oscillation ventilation (HFOV) is indicated.

**Ventilator settings**

[www.crashcall.net](http://www.crashcall.net) for infusion and dose information
These will depend on the underlying condition. In general, the rate set as well as the inspiratory time changes with age and mimic physiological values as a start point.

<table>
<thead>
<tr>
<th>age</th>
<th>Respiratory rate</th>
<th>Suggested inspiratory times</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>30-40/min</td>
<td>0.4 to 0.8 sec</td>
</tr>
<tr>
<td>1-2</td>
<td>25-35/min</td>
<td>0.8 to 1 sec</td>
</tr>
<tr>
<td>2-5</td>
<td>25-30/min</td>
<td>0.8 to 1.2 sec</td>
</tr>
<tr>
<td>5-12</td>
<td>20-25/min</td>
<td>0.8 to 1.2</td>
</tr>
<tr>
<td>&gt;12</td>
<td>15-20/min</td>
<td>1 to 1.4 sec</td>
</tr>
</tbody>
</table>

I/E ratios of 1:1 are acceptable – older children cope on a 1:2 or 1:3 ratio. Inverse ratios are avoided.

PEEP is usually started at 4-6cmH2O and increased as necessary.

PIP is set dependent on the tidal volumes achieved (though this will also depend on the inspiratory time set).

It is useful to check a blood gas within 30 minutes of a ventilator change especially if end tidal CO₂ monitoring is not available. (0.5ml blood is sufficient for this)

Prone positioning and rotation (to supine) often improves VQ mismatch and recruitment, and is recommended unless there is a specific contra-indication (eg spinal injury).

Regular physiotherapy and endotracheal suction is useful in clearing secretions, the period of derecruitment that occurs during this can often be corrected with a transient increase in PEEP.

Smaller children are more prone to needing frequent suctioning to keep their airways patent, and the use of saline helps to loosen secretions.

**Pulmonary hypertension**

If pulmonary hypertension is suspected, a trial of inhaled nitric oxide (iNO) can be started – usually at 20 or 30 ppm for an hour. If there is no significant improvement in oxygenation, then this should be stopped before suppression of endogenous nitric oxide occurs.

Weaning of iNO is facilitated by increasing the FiO2 as the nitric oxide is turned off. Alternatively, oral sildenafil may be started to facilitate weaning.

**General approach to weaning ventilation**

Wean FiO₂ < 0.3  Wean pressures to PEEP of 4-5, with dP(delta P) of 6-10 on CPAP with pressure support, if not tachypnoeic, and awake with cough and gag, consider extubation. Non-invasive ventilation may be helpful in avoiding re-intubation.

**Preparation for extubation:**

Fast for 4-6 hours prior to a planned extubation. Consider dexamethasone 0.25mg/kg load followed by

[www.crashcall.net](http://www.crashcall.net) for infusion and dose information
0.15mg/kg 6 hourly for 24 hours covering the period of extubation to minimise post-extubation stridor. Tracheostomies are not usually considered for the first 4 weeks on ventilation.

**Cardiovascular support**

Normal physiological values are age dependent

<table>
<thead>
<tr>
<th>Age</th>
<th>Weight kg</th>
<th>Pulse 95% range (/min)</th>
<th>Mean BP range (95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>term</td>
<td>3.5</td>
<td>95-145</td>
<td>40-60</td>
</tr>
<tr>
<td>6 months</td>
<td>7.5</td>
<td>110-175</td>
<td>50-90</td>
</tr>
<tr>
<td>1 year</td>
<td>10</td>
<td>105-170</td>
<td>50-100</td>
</tr>
<tr>
<td>3 years</td>
<td>14</td>
<td>80-140</td>
<td>50-100</td>
</tr>
<tr>
<td>7 years</td>
<td>22</td>
<td>70-120</td>
<td>60-90</td>
</tr>
<tr>
<td>10 years</td>
<td>30</td>
<td>60-110</td>
<td>60-90</td>
</tr>
<tr>
<td>12 years</td>
<td>38</td>
<td>60-100</td>
<td>65-95</td>
</tr>
<tr>
<td>14 years</td>
<td>50</td>
<td>60-100</td>
<td>65-95</td>
</tr>
<tr>
<td>&gt;14</td>
<td></td>
<td>65-115</td>
<td>65-110</td>
</tr>
</tbody>
</table>

**Cardiovascular monitoring**

Arterial line sites: A 24 g (yellow) cannula for infants, older children can take a 22G (blue cannula), adolescents can take a 20G. Leaderflex catheters are available in 22 G (4 and 6 cm lengths) and these can be used in infants (femorals) or older children in peripheral arteries. Heparin is added to normal saline to make up 1 unit/ml and run at 1 ml/hour.

CVP lines: usually inserted with ultrasound guidance – femorals are safest approach, although internal jugulars are generally larger and easy to hit. Subclavians are usually avoided in smaller children – technically difficult, and in the presence of a coagulopathy or high ventilation pressures may be associated with significant complications. Infants and younger children will take a 5 F triple lumen, older children will take a 7 FG. (In small neonates, it may be necessary to use a 4FG double lumen).

All internal jugular lines are x-rayed after placement, the tip should not be in the right atrium. It is not routine practice to image femoral lines unless the lumens do not aspirate on insertion, in which case contrast studies may be required.

Central lines are not routinely changed, and are removed only if there is evidence of infection or malfunction.

**Principles of support are similar to adults.**

Correct hypovolemia – in shock 20ml/kg aliquots of normal saline or gelofusin. Once adequate filling is achieved – consider inotropes.

The following chart summarises the recommendations from the American College of Critical Care Medicine:

[www.crashcall.net](http://www.crashcall.net) for infusion and dose information
**Guidelines for adult ITU**

0 min

- Recognize decreased mental status and perfusion. Begin high flow $O_2$. Establish IV/IO access.

**Initial resuscitation:** Push boluses of 20 cc/kg isotonic saline or colloid up to & over 60 cc/kg until perfusion improves or unless rales or hepatomegaly develop.
- Correct hypoglycemia & hypocalcemia. Begin antibiotics.

**In shock not reversed?**

5 min

- Fluid refractory shock: Begin inotrope IV/IO.
- Use atropine/ketamine IV/IO/IM to obtain central access & airway if needed.

**Reverse cold shock** by titrating central dopamine
- or, if resistant, titrate central epinephrine

**Reverse warm shock** by titrating central norepinephrine.

**In shock not reversed?**

15 min

- Catecholamine resistant shock: Begin hydrocortisone if at risk for absolute adrenal insufficiency

60 min

- Monitor CVP in PICU, attain normal MAP-CVP & $ScvO_2 > 70\%$

**Cold shock with normal blood pressure:**
- 1. Titrate fluid & epinephrine, $ScvO_2 > 70\%$, Hgb $> 10$ g/dL
- 2. If $ScvO_2$ still $< 70\%$

Add vasodilator with volume loading (nitrovasodilators, milrinione, imrinnone, & others)
- Consider levosimendan

**Cold shock with low blood pressure:**
- 1. Titrate fluid & epinephrine, $ScvO_2 > 70\%$, Hgb $> 10$ g/dL
- 2. If still hypotensive consider norepinephrine
- 3. If $ScvO_2$ still $< 70\%$ consider dobutamine, milrinone, enoximione or levosimendan

**Warm shock with low blood pressure:**
- 1. Titrate fluid & norepinephrine, $ScvO_2 > 70\%$
- 2. If still hypotensive consider vasopressin, terlipressin or angiotensin
- 3. If $ScvO_2$ still $< 70\%$ consider low dose epinephrine

**Persistent catecholamine resistant shock:** Rule out and correct pericardial effusion, pneumothorax, & intra-abdominal pressure $> 12$ mm/Hg. Consider pulmonary artery, PICCO, or FATD catheter, &/or doppler ultrasound to guide fluid, inotrope, vasopressor, vasodilator and hormonal therapies.
- Goal C.I. $> 3.3$ & $< 6.0$ L/min/m$^2$

**In shock not reversed?**

**Refractory shock:** ECMO

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[www.crashcall.net](http://www.crashcall.net) for infusion and dose information
Common inotrope infusions:

Please refer to www.crashcall.net.uk

<table>
<thead>
<tr>
<th>Infusion Drug</th>
<th>Dose Range</th>
<th>Dilute</th>
<th>Dilute Unit</th>
<th>Dilution</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrenaline/Noradrenaline</td>
<td>0.05-2 microg/kg/min</td>
<td>0.3 x bodyweight</td>
<td>in mg</td>
<td>in 50ml dextrose or saline</td>
<td>1ml/h = 0.1microg/kg/min</td>
</tr>
<tr>
<td>Dopamine/Dobutamine</td>
<td>3-20 microg/kg/min</td>
<td>15x bodyweight</td>
<td>in mg</td>
<td>in 50ml dextrose</td>
<td>1ml/h = 5 microg/kg/min</td>
</tr>
</tbody>
</table>

For example

A 20 kg child requiring dopamine would have an infusion made up of 15x20 =300 mg in 50 ml of saline
This run at 2 ml/hour would give 10 microg/kg/min

Likewise, this child needing adrenaline would have 0.3 x 20 = 6 mg in 50ml saline
This run at 1 ml / hour would give 0.1mcg/kg/min

Fluid management, nutrition and renal support.

Normal maintenance fluids are given at

100ml/kg/day for first 10 kg
50ml/kg/day for each additional kg above 10
20ml/kg/day for each additional kg above 20

Thus a 30 kg child would require

(10x 100) + (10x 50) + (10 x 20) = 1700ml/day

Up to a maximum of 2500ml/day in males and 2000ml/day in females

In ventilated children on full intravenous fluids, the maintenance is reduced to 70% because of insensible water losses. There is also evidence to suggest the running children relatively dry would be advisable in ARDS as well as H1N1 pneumonias.

The normal maintenance solutions are 0.45% saline in 5% dextrose (with 10mmol KCL added to 500ml if normal potassium and renal function), or 0.9% saline in 5% dextrose.

0.18% saline solutions (with dextrose) should not be used because of the risk of severe hyponatremia and risk of cerebral oedema and death,

Aim for 1ml/kg/h urine in infants and children and 0.5ml/kg/h in adolescents

www.crashcall.net for infusion and dose information
Feeding

Children can be fed nasogastrically once stable, and enteral feeds should be commenced as soon as possible. NG tube position must be confirmed radiologically, and aspirates should be checked regularly with a low reading pH indicator. If bolus feeds are not tolerated, continuous feeds should be tried. All children will benefit from trophic feeds unless there are specific contraindications (high dose vasoconstrictors, or obstruction etc).

Ranitidine or omeprazole should be started if feeds have not been commenced.

Sedation

Most mechanically ventilated children will require sedation. Any correctable environmental and physical factors causing discomfort should be addressed alongside the introduction of pharmacological agents. Midazolam is the recommended agent for the majority of critically ill children requiring intravenous sedation; it should be given by continuous infusion. Propofol should not be used to provide continuous sedation in critically ill children. Early use of enteral sedative agents is recommended.

<table>
<thead>
<tr>
<th>Intravenous agents</th>
<th>Enteral agents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midazolam</td>
<td>Chlora hydrate</td>
</tr>
<tr>
<td>Morphine</td>
<td>Alimemazine (Vallergan®)</td>
</tr>
<tr>
<td>Clonidine</td>
<td></td>
</tr>
<tr>
<td>Ketamine</td>
<td></td>
</tr>
<tr>
<td>Fentanyl</td>
<td></td>
</tr>
</tbody>
</table>

Midazolam

- Intravenous infusion; 2-8 micrograms/kg/min
- Intravenous bolus; 100-200 micrograms/kg/min

Consider reduced dose in renal and hepatic impairment

Enteral agents:

- Alimemazine (Vallergan®)
  - NG; 2-4mg/kg/dose 6 hourly
  - Maximum 60mg per dose
  - Avoid in renal and hepatic failure

- Chloral hydrate
  - NG; 25-50mg/kg/dose 4-6 hourly
  - Maximum 2g per dose
  - Can cause gastric irritation
  - Avoid in severe renal and hepatic failure

www.crashcall.net for infusion and dose information
Morphine

- Intravenous infusion; 10-60 micrograms/kg/hr
- Intravenous bolus; 100-200 micrograms/kg/dose

Consider reduced dose in renal and hepatic impairment, use with caution in asthmatic patients.

Clonidine

- Intravenous infusion; 0.1-2 micrograms/kg/hr
- NG; 1-5 micrograms/kg/dose 6 hourly

Start infusions at 1 microgram/kg/hr

Ketamine

- Intravenous infusion; 5-20 micrograms/kg/min
- Intravenous bolus; 1-2mg/kg/dose

May be useful in status asthmaticus

Avoid in raised intracranial pressure

Concentrations exceeding 10mg/ml should be infused centrally

Neuromuscular blockade

- A small proportion of critically ill children will require neuromuscular blocking agents in order to tolerate mechanical ventilation.
- Ensure adequate analgesia and sedation before commencing neuromuscular blocking agents.
- Atracurium or vecuronium given by continuous infusion are the recommended agents for the majority of critically ill children requiring neuromuscular blockade. Intermittent doses of pancuronium may be considered.
- Where continuous infusions are employed the degree of neuromuscular blockade being provided should be assessed at least once every 24 hours with train-of-four monitoring. Administered doses of neuromuscular blocking agents should be titrated to provide the minimum level of neuromuscular blockade required.
- Where continuous infusions are employed the degree of neuromuscular blockade being provided should be assessed at least once every 24 hours with train-of-four monitoring. Administered doses of neuromuscular blocking agents should be titrated to provide the optimum level of neuromuscular blockade.
- Whenever it is safe to do so, continuous infusions of neuromuscular blocking agents should be discontinued at least once every 24 hours until spontaneous movement returns and the levels of analgesia and sedation can be assessed.

www.crashcall.net for infusion and dose information
• The need for neuromuscular blocking agents should be regularly reviewed and they should be discontinued as soon as possible.

<table>
<thead>
<tr>
<th>drug</th>
<th>bolus</th>
<th>infusion</th>
<th>comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atracurium</td>
<td>0.5mg/kg</td>
<td>0.3-0.6mg/kg/hr</td>
<td>Histamine release and associated cardiac effects</td>
</tr>
<tr>
<td>Vecuronium</td>
<td>0.1mg/kg</td>
<td>0.5 – 2 microg/kg/min</td>
<td>Less histamine release</td>
</tr>
</tbody>
</table>

**Renal support**

Children in multi-organ failure may require continuous renal replacement therapy (CRRT) to facilitate continuous solute removal and/or fluid removal. The most commonly used modality is Continuous Veno-Venous Haemofiltration (CVVH) with pre-dilution.

Older children can be haemofiltered in the same way as adult patients. Advice regarding younger children is available from the duty consultant on PICU at the Royal Manchester Children’s Hospital.

Access to paediatric CRRT clinical guidelines is as available online at PICU server on the intranet.

**Continuous Veno-Venous Haemofiltration (CVVH) with pre-dilution**

![Continuous Veno-Venous Haemofiltration (CVVH) with pre-dilution chart](chart.png)

*www.crashcall.net* for infusion and dose information
Family issues

Generally the presence of the immediate family is of significant importance to the child and often improves compliance as well as comfort for the child. We tend to limit family to 2 members at a time for practical purposes, and often allow family to participate in the care of their child. Discussions regarding the child are best carried out away from the bed space as they may well be aware of some conversations. All child deaths need to be reported to the coroner regardless of the cause. There are family counsellors attached to the PICU who may be able to help with situations as they arise.

End-note:

This document has been written as a an aide to looking after children in the intensive care unit, it is far from comprehensive, and the PICU is always available to provide advice and support as required.

Please check all drug doses prior to prescribing.

There will be revisions to this document with increasing resource material in the appendix.

Please feed back any comments or queries you may have to: mahil.samuel@cmft.nhs.uk

www.crashcall.net for infusion and dose information
Appendix 1 – useful checklist for shift changes as well as ward rounds

<table>
<thead>
<tr>
<th>RMCH PICU Ward Round Check</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DNAR</strong> - status</td>
</tr>
<tr>
<td><strong>ETT</strong> - correct length and secure</td>
</tr>
<tr>
<td>Fluids and feeding – plan agreed</td>
</tr>
<tr>
<td>Analgesia and sedation – reviewed and appropriate</td>
</tr>
<tr>
<td>Ulcer prophylaxis (skin and gut) – reviewed</td>
</tr>
<tr>
<td>Lines - adequacy and excess</td>
</tr>
<tr>
<td>Tidal volumes - &lt;8ml/kg</td>
</tr>
<tr>
<td>Sepsis – clinical markers, micro results &amp; antibiotics reviewed</td>
</tr>
</tbody>
</table>

Appendix 2: antibiotic policies (available on the CMFT intranet)

Community acquired pneumonia:

<table>
<thead>
<tr>
<th>Age</th>
<th>Antibiotics</th>
<th>Dose</th>
<th>Frequency</th>
<th>Duration</th>
<th>Likely causative organism</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3 months</td>
<td>Cefotaxime iv</td>
<td>50mg/kg</td>
<td>2-3 (max 4 times a day)</td>
<td>Review after 24-48 hours.</td>
<td>Haemophilus influenzae type b in unvaccinated individuals (usually as part of a generalized septicaemic illness), now rare. Other very rare causes are Streptococcus pneumoniae and Staph aureus. In young children add clarithromycin if mycoplasma infection suspected.</td>
</tr>
<tr>
<td>3 months - 12 years (&lt;50kg)</td>
<td>Ceftriaxone iv + / - Clarithromycin po</td>
<td>50-80mg/kg</td>
<td>As per BNFC</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>12-18 years (&gt;50 kg)</td>
<td>Ceftriaxone iv + Clarithromycin po</td>
<td>1-4g</td>
<td>As per BNFC</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Add Flucloxacillin iv if Staph aureus is suspected. This can occur after a viral pneumonitis e.g. post-influenza.

[www.crashcall.net](http://www.crashcall.net) for infusion and dose information
Hospital acquired pneumonia

<table>
<thead>
<tr>
<th>Age</th>
<th>Antibiotics</th>
<th>Dose</th>
<th>Frequency</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3 months</td>
<td>Cefotaxime iv + / - Gentamicin iv</td>
<td>50mg/kg</td>
<td>2-3 (max 4 times a day)</td>
<td>According to response, usually 7-10 days</td>
</tr>
<tr>
<td>3 months - 12 years</td>
<td>Ceftriaxone iv + / - Gentamicin iv</td>
<td>50-80mg/kg</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(&gt;50 kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-18 years</td>
<td>Ceftriaxone iv + / - Gentamicin iv</td>
<td>1-4g</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(&gt;50 kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sepsis

<table>
<thead>
<tr>
<th>Age</th>
<th>Antibiotics</th>
<th>Dose</th>
<th>Frequency</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 months - 12 years</td>
<td>Ceftriaxone iv</td>
<td>50-80mg/kg</td>
<td>1</td>
<td>At least 5 days (usually 10) for N. meningitidis 10-14 days for Strep pneumoniae and other pathogens.</td>
</tr>
<tr>
<td>(&gt;50 kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-18 years</td>
<td></td>
<td>1-4g</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(&gt;50 kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Toxic shock syndrome

<table>
<thead>
<tr>
<th>Age</th>
<th>Antibiotics</th>
<th>Dose</th>
<th>Frequency</th>
<th>Duration</th>
<th>Likely causative organism</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 month - 18 years</td>
<td>Flucloxacillin iv + / - Benzylpenicillin iv + / - Clindamycin</td>
<td>12.5-25mg/kg (max 1g) Double if severe 25-50mg/kg (max 2.4g) 15-40mg/kg in 3-4 divided doses</td>
<td>4</td>
<td>According to response. Review clindamycin after 48 hours</td>
<td>Staphylococcus aureus or streptococcus.</td>
</tr>
<tr>
<td>Infants &lt; 3 months</td>
<td>Cefotaxime iv + Amoxicillin iv + / - Gentamicin</td>
<td>Refer to BNFC</td>
<td></td>
<td>At least 5 days (usually 10) for N. meningitidis 10-14 days for Strep pneumoniae and other pathogens</td>
<td><img src="image" alt="" /></td>
</tr>
</tbody>
</table>

Consider immunoglobulins in toxic shock syndrome

In severe sepsis consider adding gentamicin to ceftriaxone in older children.

[www.crashcall.net](http://www.crashcall.net) for infusion and dose information
References and useful resources:

Drug doses 14th Edition by Frank Shann – information on dosing, tube sizes, resuscitation, physiological parameters.

www.crashcall.net: resource for emergency drug calculator as well as tube sizes and fluid requirements


bnfc.org: British National formulary for children – information on drugs and interactions


www.crashcall.net for infusion and dose information