For every problem:

• **Verbalise** the problem. Say out loud….

  ‘We have a **problem**, I am **concerned**’

• Call for **HELP** early

• **Set oxygen to 100%** (except where stated otherwise)

• Identify a ‘**hands off**’ Team Coordinator

• **Delegate duties** to **specific** team members

• Use **closed loop**, quiet & efficient **communication**

• Use the **indexed pages & coloured boxes** in this manual to **assist you**

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**DIAGNOSING Problems**

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**EMERGENCIES**

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**www.AnaestheticCrisisHandbook.com**

(Created by Adam Hollingworth with help from many people along the way)

Adapted from various sources including:

• Guidelines: ANZAAG, AAGBI, NZRC, Starship Protocols
• vortexapproach.org, Dr Chrimes & Dr Fritz
• Hutt Valley & CCDHB: Clinical protocols
• ESA Emergency Quick Reference Guide
• CCDHB Crisis Checklists. Dr A McKenzie
• Emergencies in Anaesthesia. Oxford Handbook
• Wellington ICU Drug Manual. Dr A Psirides & Dr P Young
• Various published peer reviewed papers
Instructions for Use

• Use the **index** and **coloured tabs** to find quick reference pages to assist in a crisis.

• The **handbook is in 2 parts:**
  ‣ The front book: How to treat known **Emergencies**
  ‣ The back book: How to **Diagnose** Problems

• **Routine/obvious tasks** (eg call for help, turn oxygen to 100%) are assumed & thus **not** repeated on every sheet for clarity

• For simplicity & to avoid calculation errors in an emergency, **drug doses** are given for a **70kg adult**. Paeds doses are clearly marked with 📚 (where appropriate).

• There is an adult & paediatric drug formulary at the back

• Cards are arranged into coloured boxes:
  • Emergency/Doing tasks
  • Thinking tasks, diagnostic or further information
  • Doses, equipment or calculation information

• Work through emergency/doing boxes in a linear fashion. Decision making steps are highlighted for clarity.

Using an aid such as this efficiently, in a crisis, is a **learned** skill. You must take time to become **familiar** with this manual and **practise** using it.

It is recommended that a ‘**reader**’, with no other tasks, **read these cards out loud** to the team leader during the crisis.
25d. High Airway Pressure
26d. Desaturation
27d. High EtCO₂
28d. Low EtCO₂
29d. Tachycardia
30d. Bradycardia
31d. Hypertension
32d. Hypotension
33d. Failure to wake
34r. TELEPHONE DIRECTORY
35r. ADULT DRUG FORMULARY
36r. PAEDS DRUG FORMULARY
25d. HIGH AIRWAY PRESSURE

- Listen to chest. Watch for bilateral chest rise & fall
- Switch to bag - manually ventilate to confirm high pressure
- Examine EtCO₂ waveform - ?bronchospasm ?kinked ETT
- Exclude light anaesthesia & inadequate muscle relaxation
- Perform a systematic visual check:
  - airway device (inside & outside mouth) → filter → circuit → valves → ventilator
- Check airway - the position & patency - suction full length of ETT
  (Consider performing bronchoscopic exam)
- If suspect autoPEEP watch for persistent expiratory flow at end expiration. Try disconnecting circuit.
- If problem not identified need to exclude circuit > filter > airway > patient source:
  - Exclude circuit: replace circuit with Ambu-bag (if required convert to TIVA)
  - Exclude filter: replace or remove
  - Exclude airway: replace ETT. If using LMA convert to ETT
  - Not resolved = patient problem

- Consider timing of event eg CVL insertion, position change, surgical event
- Possible causes (most common in bold):
  - **Circuit:**
    - ventilator settings
    - kinked tube
    - valve failures
    - obstructed filter
    - O₂ flush failure
  - **Airway:**
    - laryngospasm
    - tube position
    - tube size
    - blocked or kinked tube
  - **Patient:**
    - chest wall rigidity
    - bronchospasm
    - anaphylaxis
    - pneumothorax
    - pneumoperitoneum
    - obesity
    - alveolar problems/pathology:
      - oedema
      - infections
      - ARDS
      - contusion
    - tracheal problems/pathology:
      - FB
      - secretions
      - tumour
26d. DESATURATION

- Check FiO₂ & turn to 100% O₂
- Check patient colour, peripheral temperature & probe position
- Switch to bag to test circuit integrity & lung compliance
- Check the SpO₂ & EtCO₂ waveforms to aid systematic diagnosis:
  - **If EtCO₂ waveform abnormal or absent:**
    - Exclude: disconnected circuit, cardiac arrest, ↓ cardiac output
    - Consider laryngospasm or bronchospasm (if LMA convert to ETT)
    - **Check airway** position & patency:
      - Visualise cords = r/o oesophageal ETT
      - Suction full length of ETT (consider performing bronchoscopic exam)
      - Look inside mouth for kinks/gastric contents
    - Check ventilator mode & setting
    - Ventilate via Ambu-bag to exclude ventilator/circuit/probe problem
  - **If EtCO₂ waveform normal:** (: intact circuit integrity):
    - Check fresh gas flow / FiO₂
    - Exclude endobronchial ETT
    - Inspect neck veins, chest rise & auscultate. Use ultrasound (if skilled)
    - Consider airway, lung/breathing, circulation causes (see yellow box)

- Work through diagnostic checklist below to exclude all other causes

- Consider timing of event eg position change, surgical event
- **Possible causes** (most common in bold):
  - **Airway:**
    - airway obstruction
    - laryngospasm
    - bronchospasm
    - endobronchial intubation
    - 1 lung ventilation
    - aspiration
  - **Lungs/Breathing:**
    - apnoea/hypoventilation
    - atelectasis
    - pneumothorax
    - sepsis/ARDS
    - pulmonary oedema
    - contusion
    - pneumonia
    - interstitial lung disease
  - **Circulation:**
    - cardiac arrest
    - cardiac failure
    - anaphylaxis
    - embolism: pulmonary, air, CO₂, cement
    - hypothermia/poor periph circulation
    - methaemoglobinemia e.g. prilocaine
27d. HIGH EtCO₂

- Quick check patient monitors: ?oxygenated & anaesthetised patient:
  - Anaesthetist’s A Airway EtCO₂, B SpO₂, Vent Settings, C HR, MAP, D Depth of anaesthesia, E Temp

- This is generally not a crisis. Use the time to consider the causes

- Frequency gamble:
  - Check monitors & ventilator:
    - EtCO₂ waveform
    - Fresh Gas Flow - correct for circuit type, size of patient
    - Ventilator settings & mode - Resp rate, Tidal volume
  - Check soda lime ?exhausted
  - Review:
    - Anaesthetic depth
    - Recent drug doses for errors

- Systematically work through all causes (see below)

- Consider timing of event eg drug administration, surgical event

- Possible causes (most common in bold):

  **↑Production**
  - Endogenous:
    - sepsis/↑temp
    - MH
    - thyroid storm
    - malignant neuroleptic syndrome
    - reperfusion
  - Exogenous:
    - CO₂ insufflation
    - bicarb administration

  **↓Elimination**
  - Lungs:
    - hypoventilation
    - bronchospasm/asthma
    - COPD
  - Circuit/machine:
    - ↓Fresh Gas Flow/re-breathing
    - incorrect vent settings
    - soda lime exhaustion
    - airway obstruction
    - ↑dead space
    - valve malfunction
Quick check patient monitors: oxygenated & anaesthetised patient:
- Anaesthetist's A Airway EtCO\(_2\), B SpO\(_2\), Vent Settings, C HR, D MAP, E Depth of anaesthesia, Temp

If no EtCO\(_2\) waveform diagnose immediately:
- Cardiac arrest - see tab 6e or tab 7e
- Incorrect ETT placement - if in doubt replace
- Severe bronchospasm - confirm airway & see tab 4e
- Check circuit & CO\(_2\) sample line connections

If low EtCO\(_2\) then first frequency gamble:
- Check sampling line - securely connected & patent
- Check MAP
- Examine patient:
  - Airway position & patency
  - Auscultate & ensure bilateral chest rise - (r/o laryngospasm/bronchospasm)
- Check ventilator:
  - Switched on & functioning
  - Correct settings: tidal volume, RR

If problem not identified work through causes systematically (see yellow box)

Consider timing of event e.g. post intubation, drug administration, surgical event

Possible causes (most common in bold):

- **NO EtCO\(_2\)**:
  - oesophageal intubation
  - no ventilation, no airway
  - cardiac arrest
  - circuit/sampling line disconnection
  - ventilator failure or not on
  - apnoea

- **↓Production**:
  - hypothermia
  - deep anaesthesia
  - ↓thyroid

- **Sampling dilution**:
  - high FGF
  - sampler placed incorrectly
  - dilution of sampling gas with air
  - circuit disconnected

- **↑Elimination**:
  - hyperventilation

- **↓Transport of CO\(_2\) in blood**:
  - severe hypotension
  - anaphylaxis
  - cardiac arrest
  - embolism - air or pulmonary
  - tamponade/tension pneumothorax

- **↓CO\(_2\) diffusion in lung**:
  - low tidal volumes/dead space
  - laryngospasm
  - severe bronchospasm
  - ETT obstruction
  - endobronchial intubation
**29d. TACHYCARDIA**

☐ Check patient monitors: is the patient oxygenated & anaesthetised?:
  - Anaesthetist's A Airway, ECO₂, B SpO₂, C Vent Settings, D HR, MAP, E Depth of anaesthesia, F Temp

☐ If there is diagnostic uncertainty & MAP <65 with HR >150 then give **synchronised DC shock** (see yellow box for joules)

☐ Differentiate sinus tachycardia & complex tachy-arrhythmia:
  - current surgical/pain stimulation
  - sinus rhythm?
  - QRS regularity?
  - QRS width?

☐ If sinus tachycardia consider causes (see yellow box below)

☐ If complex tachy-arrhythmia treat based on MAP:
  - MAP <65mmHg = **synchronised DC shock** (see yellow box for joules)
  - MAP >65mmHg = manage by regularity & QRS width:

  - Regular:
    - **Narrow**: [SVT] vagal manoeuvres, adenosine, β blocker
    - **Wide**: [VT] amiodarone
    - [SVT with aberrancy] see narrow
    - [WPW] amiodarone
  - Irregular:
    - **Narrow**: [AF] β blocker or amiodarone
    - **Wide**: [torsades] magnesium
    - [AF with pre-excitation] amiodarone
    - [AF with aberrancy] see narrow

☐ Send urgent ABG. Ensure high normal K⁺ & Mg²⁺

- Consider timing of event eg drug administration, surgical event etc.
- **Possible causes of sinus tachycardia** (most common in bold):
  - **Primary causes**:
    - IHD
    - cardiomyopathy
    - sick sinus syndrome
    - accessory conduction pathways
    - myocarditis
    - pericarditis
    - valvular disease
    - congenital heart disease
  - **Secondary causes**:
    - hypovolaemia
    - anaesthesia depth
    - drugs - incl drug error
    - pain
    - electrolyte abnormalities
    - cardiac tamponade
    - sepsis
    - thyroid storm
    - MH

- Synchronised shock guides:
  - AF/monomorphic VT: 100J ⇒ 150J ⇒ 200J (0.5J/kg ⇒ 1J/kg ⇒ 2J/kg)
  - SVT or flutter: 50J ⇒ 100J ⇒ 200J (0.5J/kg ⇒ 1J/kg ⇒ 2J/kg)
  - polymorphic VT or unstable: 200J (4J/kg)

- **Adenosine**: 6mg, then 12mg, then 12mg then consider other causes (0.1mg/kg⇒0.2mg/kg,0.3mg/kg)
- β blocker: **Esmolol** 10mg titrated. **Metoprolol** 2.5mg boluses titrated (max 15mg)
- **Amiodarone**: 300mg slow IV push (5mg/kg)
- **Magnesium**: [torsades] 10mmol (5ml of 49.3%) over 2mins (0.1ml/kg), (Give slower for other causes)
30d. BRADYCARDIA

- Quick check patient monitors: is the patient oxygenated & anaesthetised?:
  - Anaesthetist’s A Airway, B SpO₂, C HR, D MAP, E Temp

- If MAP >65mmHg you have time (see causes listed in yellow box below):
  - Frequency gamble common causes
  - Systematically work through all causes

- If MAP <65mmHg +/- with evidence of ↓ perfusion then consider:
  - Atropine 600mcg (= 20mcg/kg) or glycopyrrolate 200mcg (= 10mcg/kg)
  - Ephedrine 9mg bolus titrated (= 0.1 mg/kg)
  - Adrenaline infusion (= see green box)
  - Isoprenaline bolus, followed by infusion (= see green box)

- If drug toxicity or overdose:
  - ßblocker = as above + high dose insulin infusion, Na bicarb (if propanolol OD)
  - Ca channel = as ßblocker + 10mls 10% Ca chloride slow push (can repeat)

- If severe refractory bradycardia try external temporary pacing:
  - attach defib & ECG leads
  - set to PACER mode
  - select rate 60/min
  - ↑mA of output until capture (normally 65-100mA required)
  - set final mA 10mA above capture
  - confirm pulse

- If PEA at any point start CPR - see tab 7e

- Consider timing of event eg drug administration, surgical event
- Possible causes (most common in bold):
  - **Primary causes:**
    - athlete
    - IHD
    - AV block
    - pacemaker malfunction
    - cardiomyopathy
    - sick sinus syndrome
    - myocarditis
    - pericarditis
    - valvular heart disease
    - pulmonary HTN
  - **Secondary causes:**
    - vagal stimulation
    - drugs eg error, overdose, anti-arrhythmics
    - electrolyte abnormality
    - ↓ thyroid
    - ↓ temperature
    - ↑ICP
    - cardiac tamponade
    - tension pneumothorax
  - **Anaesthetic causes:**
    - vasopressors
    - volatile
    - suxamethonium
    - opioids
    - high/total spinal
    - anticholinesterases
    - hypoxia
    - auto-PEEP
    - MH
    - ↑↓K+

- For paediatric normal heart rates see tab 9e

- **Isoprenaline:** bolus: dilute 200mcg amp into 20mls then give 1ml boluses titrated (= use infusion -see (tab 36r)). Infusion: dilute 1mg (5vials) into 50mls. Infuse at 0-60mls/hr
- **Adrenaline:** 5mg in 50mls saline. Infuse at 0-20ml/hr (= see tab 36r)
- **Na bicarb 8.4%** [ß blocker OD]: 50ml slow push. Can rpt every 2mins (target pH 7.45-7.55)
- **High dose insulin** [ß blocker/CCB OD]: Bolus= 50ml of 50% dextrose & 70u actrapid. Infusion= 100u actrapid in 50mls saline, run at 35ml/hr and 10% dex run at 250mls/hr (Monitor BISL & K every 30mins.)
Quick check patient monitors: is the patient oxygenated & anaesthetised?:
- Anaesthetist’s A Airway, B ETCO₂, C SpO₂, D Vent Settings, E MAP

Check accuracy of reading: check equipment (including transducer height)

Frequency gamble on common causes:
- Check for painful surgical activity - give analgesia
- Check recent drug infusions & recent doses for drug error (incl LA with adrenaline)
- Check tourniquet time
- Consider bladder volume/fluids infused

Systematically work through possible causes (see yellow box)

Once all reversible causes have been addressed then consider IV antihypertensive agents (as green box below) to SBP target of ~160mmHg

Consider timing of event eg drug administration, surgical event

Possible causes (most common in bold):

- Anaesthesia:
  - too light
  - pain
  - drugs - consider error
  - hypoxia
  - hypercapnia
  - MH
  - IV line - non-patent/tissue
  - A line transducer height

- Patient related:
  - essential HTN
  - rebound HTN - B blocker stopped
  - full bladder
  - pre-eclampsia
  - renal disease
  - phaeochromocytoma (always give α blocker before β blocker)
  - thyroid storm
  - ↑ICP

- Surgery:
  - pneumoperitoneum
  - tourniquet
  - aortic clamping
  - carotid endarterectomy
  - baroreceptor stimulation

- β Blocker = esmolol: 10mg boluses titrated; metoprolol: 2.5mg boluses titrated (max 15mg)
- a Blocker = labetalol (also β blocker): 5mg boluses titrated (max 100mg), phentolamine:
  5-10mg IV repeated every 5-15mins
- a Agonists = clonidine: 30mcg boluses titrated (max 150mcg)
- vasodilators = GTN: S/L spray or IV infusion: 50mg in 50ml saline at 3ml/hr and titrate;
  magnesium: slow bolus 5mls of 49.3%, repeat if required
32d. HYPOTENSION

- Check patient monitors: is the patient oxygenated & anaesthetised?:
  - Anaesthetist’s A Airway, B SpO₂, C HR, D MAP, E Temp

- Check accuracy of reading: check equipment (including transducer height)

- Assess severity: visualise patient, check ECG & EtCO₂/SpO₂ waveform:
  - No cardiac output or critical MAP: start CPR - see tab 6e or tab 7e
  - MAP <65mmHg & concern then consider:
    - Leg elevation
    - Rapid infusion of fluid +/- ready to transfuse blood (see tab 12e)
    - IV vasopressors or inotropes

- Consider reversible causes:
  - Frequency gamble on common causes
  - Systematically consider each cause in turn

- Consider:
  - ECHO (if skilled) to help differentiate causes
  - Other invasive monitoring to assist with diagnosis e.g. PPV SVV from arterial line, cardiac index monitoring

- Consider timing of event e.g. drug administration, surgical event, scope surgery (always suspect concealed haemorrhage)

- Possible causes (most common in bold):
  - ↓Preload:
    - blood loss/hypovolaemia
    - ↑ intrathoracic pressure
    - ↓VR - eg IVC compression, pt position, pneumoperitoneum
    - tamponade/tension pneumothorax
    - embolism
  - ↓Contractility:
    - drugs incl. volatiles
    - IHD
    - cardiomyopathy
    - myocarditis
    - arrhythmia
    - valvular heart disease
  - ↓Afterload:
    - drugs eg vasodilators incl anaesthetic agents, opioids, antiHTN drugs
    - neuraxial techniques
    - sepsis
    - tourniquet or clamp release
    - anaphylaxis
    - addisons crisis
    - ↓thyroid
  - Equipment/human:
    - artefact or failure
    - Invasive: wrong transducer height
    - NIBP: wrong cuff size
    - drug error

- ECHO: Consider LVEDV, LV function, gross valvular abnormality
- PPV SVV: >12% (only if: intubated, paralysed, Vt >8ml/kg, in sinus rhythm, norm abdo pressure) suggests hypovolaemia
- Normal CI = >2.6 L/min/m²

- Pressors: metaraminol 0.5mg (10mcg/kg), phenylepherine 100mcg, ephedrine 9mg (0.25mg/kg), adrenaline 10-50mcg
- noradrenaline/adrenaline infusion: 5mg in 50mls. infuse 0-20ml/hr
33d. FAILURE TO WAKE

☐ This is generally not a crisis. Use the time to consider the causes

☐ Airway: ensure patent unobstructed airway

☐ Breathing:
  - Ensure established respiratory pattern
  - Check SpO2
  - Check EtCO2 trace and value

☐ Cardiovascular: Ensure normal HR, MAP and ECG

☐ Drugs: Review all drugs given during anaesthetic:
  - Check muscle relaxation with nerve stimulator. Give reversal agent (see green box)
  - Consider timing and infusions of all agents
  - Consider drug errors
  - Consider drug interactions
  - Consider patient factors e.g. renal/hepatic failure, elderly

☐ Others:
  - Neurological:
    - check pupils
    - apply BIS for signs of seizure (frontal lobe seizure only)
    - consider need for CT
  - Metabolic: send an ABG - check PaO2, PaCO2, Na, glucose
  - Temperature: ensure >30°C

☐ Systematically work through all causes (see below)

- Possible causes (most common in bold):

  **Drugs:**
  - analgesic agents e.g. opioids, α2 agonists
  - anaesthetic agents e.g. volatile, propofol
  - muscle relaxants e.g. suxamethonium apnoea, inadequate reversal
  - sedative agents e.g. benzodiazepines, anticholinergics, antihistamines, antidopaminergics
  - magnesium toxicity

  **Metabolic:**
  - ↑↓ blood sugar
  - ↑↓ sodium
  - ↑ urea

  **Hypothermia**

- Respiratory Failure:
  - hypoxia or hypercapnia:
    - ↓ central drive e.g. stroke, COPD
    - lung disease e.g. PE, ARDS
    - muscle power e.g. obesity

- Neurological:
  - stroke - infarct, bleed or embolism
  - seizure (Non-convulsive status epilepticus or post-ictal)
  - local anaesthetic toxicity

- Other - Uncommon:
  - central anticholinergic syndrome
  - dissociative coma
  - thyroid failure
  - toxicity of other CNS drugs

- [rocuronium/vecuronium relaxant]: Sugammadex dose on TBW: PTC>2 = 4mg/kg (70kg=280mg); >T2 = 2mg/kg (70kg=140mg)
- [all non-depolarising relaxants]: Neostigmine 2.5mg (50mcg/kg) & glycopyrrolate 500mcg (10mcg/kg). Rpt at 15min
- [suxamethonium apnoea]: No reversal option ⇒ continue anaesthesia/refer to ICU
EMERGENCY OUT OF THEATRE
- MET Team

ANAESTHETICS & THEATRES
- Duty Anaesthetist
- Duty Technician
- Theatre Coordinator
- PACU Coordinator
- Perfusionist

OBSTETRICS
- Obstetric Doctor
- Delivery Technician
- Charge Midwife
- Paed/NICU Doctor

LABORATORY/X-RAY
- Blood bank
- Blood tests
- X-Ray Technician
- Duty Radiologist

REFERRALS
- ICU Doctor
- ICU Coordinator
- Haematology Doctor
- Surgical Doctor
- Paediatric Doctor
- Cardiology Doctor
<table>
<thead>
<tr>
<th>Drug</th>
<th>Bolus</th>
<th>Infusion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adenosine</strong></td>
<td>6mg, then 12mg, then 12mg.</td>
<td>-</td>
</tr>
<tr>
<td><strong>Adrenaline</strong></td>
<td>(1:10,000 = 1mg/ml) 10ml of 1:10,000 (1mg)</td>
<td>5mg in 50ml saline. Infuse 0-20ml/hr</td>
</tr>
<tr>
<td></td>
<td>(1:10,000 = 100mg/ml) 0.1ml - 1ml of 1:10,000 (10-100mcg). Titrate</td>
<td>-</td>
</tr>
<tr>
<td><strong>Alteplase</strong></td>
<td>-</td>
<td>[PE in cardiac arrest] 100mg in 20mls saline. Infuse at 80mls/hr</td>
</tr>
<tr>
<td><strong>Aminophylline</strong></td>
<td>400mg over 15mins</td>
<td>50mg in 50mls at 35ml/hr</td>
</tr>
<tr>
<td><strong>Amiodarone</strong></td>
<td>300mg slow push</td>
<td>900mg in 500ml D5W over 24hours</td>
</tr>
<tr>
<td><strong>Ca²⁺ Chloride</strong></td>
<td>(10%) 10mls slow push</td>
<td>-</td>
</tr>
<tr>
<td><strong>Clonidine</strong></td>
<td>30mcg. Titrate (max 150mcg)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Dobutamine</strong></td>
<td>-</td>
<td>250mg in 50ml saline. Infuse 0-10ml/hr</td>
</tr>
<tr>
<td><strong>Esmolol</strong></td>
<td>10mg. Titrate</td>
<td>-</td>
</tr>
<tr>
<td><strong>GTN</strong></td>
<td>[tocolytic] 100-250mcg</td>
<td>[ischaemia] 50mg in 50ml saline. Infuse 3-12ml/hr. Titrate to MAP/ECG</td>
</tr>
<tr>
<td><strong>Hydrocortisone</strong></td>
<td>200mg</td>
<td>-</td>
</tr>
<tr>
<td><strong>Insulin (actrapid)</strong></td>
<td>[β-blocker or CCB OD] 50ml of 50% dextrose &amp; 70u acrtapid (1u/kg). Give as bolus.</td>
<td>[1K+] 10units in 250ml 10% dextrose. Infuse quickly [β-blocker or CCB OD] 100u acrtapid in 50mls saline, run at 35ml/hr and 10% dextrose run at 250mls/hr. check BSL &amp; k :00min</td>
</tr>
<tr>
<td><strong>Intralipid</strong></td>
<td>(20%) 100ml bolus (1.5ml/kg), Rpt ev 5min, max x2</td>
<td>1000ml/hr (15ml/kg/hr). Can double rate @5mins (max total dose = 12ml/kg)</td>
</tr>
<tr>
<td><strong>Isoprenaline</strong></td>
<td>200mcg into 20mls saline. Give 1ml boluses titrated</td>
<td>1mg into 50mls saline. Infuse at 0-60mls/hr</td>
</tr>
<tr>
<td><strong>Ketamine</strong></td>
<td>[induction] 70-140mg (1-2mg/kg) [bronchospasm] 35-70mg (0.5-1mg/kg)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Labetalol</strong></td>
<td>5mg slow push. Titrate (max 100mg)</td>
<td>300mg in 60mls (neat). Infuse 0-30mls/hr</td>
</tr>
<tr>
<td><strong>Lignocaine</strong></td>
<td>(1%) [Arrhythmia] 7mls (0.1ml/kg). Can rpt ev 10mins (max 0.3ml/kg)</td>
<td>Neat 1% at 6-24ml/hr. (Total max in 1hr = 30mls ie 3mg/kg)</td>
</tr>
<tr>
<td><strong>Magnesium</strong></td>
<td>(49.3%) (1ml = 20moll = 0.5g) [bronchospasm] 5mls over 20min [torsades] 5ml slow push [eclampsia]8mls in 12ml saline. Slow push over 5min</td>
<td>[eclampsia]: Maintenance = 25mls in 100ml saline. Infuse 10ml/hr for 24hrs Rescue (another seizure). 4mls in 6mls saline. Push over 5min</td>
</tr>
<tr>
<td><strong>Metaraminol</strong></td>
<td>0.5-1mg. Titrate</td>
<td>10mg in 20mls saline. Infuse 0-40mls/hr</td>
</tr>
<tr>
<td><strong>Metoprolol</strong></td>
<td>1-2.5mg. Titrate (max 15mg)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Midazolam</strong></td>
<td>[seizures] 1-7mg. Titrate</td>
<td>-</td>
</tr>
<tr>
<td><strong>Miloridine</strong></td>
<td>-</td>
<td>10mg in 50ml saline. Infuse at 5ml/hr or 10ml/hr only</td>
</tr>
<tr>
<td><strong>Naloxone</strong></td>
<td>[emergency] 400mcg [titration] 40mcg (max 800mcg)</td>
<td>Infusion with hourly rate = 2/3 of bolus dose required for initial clinical effect</td>
</tr>
<tr>
<td><strong>Noradrenaline</strong></td>
<td>-</td>
<td>5mg in 50mls saline. Infuse 0-20ml/hr</td>
</tr>
<tr>
<td><strong>Oxytocin</strong></td>
<td>3units slow bolus (do not rpt) [emergency] 5units slow bolus (do not rpt)</td>
<td>40units in 1000ml saline. Infuse 250ml/hr</td>
</tr>
<tr>
<td><strong>Phentolamine</strong></td>
<td>5-10mg. Repeat every 5-15 mins as req'ed</td>
<td>-</td>
</tr>
<tr>
<td><strong>Phenylephrine</strong></td>
<td>100mcg bolus. Titrate</td>
<td>10mg in 100ml saline (100mcg/ml). Infuse 0-40ml/hr</td>
</tr>
<tr>
<td><strong>Salbutamol</strong></td>
<td>250mcg slow push (Inhaled: 12 puffs via circuit)</td>
<td>5mg in 50ml saline. Infuse 0-10ml/hr</td>
</tr>
<tr>
<td><strong>Sodium Bicarb</strong></td>
<td>(8.4%) 25-50ml slow push. Can rpt every 2mins (target pH 7.40-7.50)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Sugammadex</strong></td>
<td>[emergency post intubation] = 16mg/kg; [PTC&gt;2] 4mg/kg; [T&lt;2]= 2mg/kg</td>
<td>-</td>
</tr>
<tr>
<td><strong>Suxamethonium</strong></td>
<td>[laryngospasm] 35mg (0.5mg/kg)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Tranexamic Acid</strong></td>
<td>1g over 10mins (15mg/kg)</td>
<td>1g in 100ml saline. Infuse at 12.5ml/hr (8hrs)</td>
</tr>
<tr>
<td><strong>Vasopressin</strong></td>
<td>1 unit slow push</td>
<td>20units in 20mls saline. Infuse 1-4ml/hr</td>
</tr>
<tr>
<td>Drug</td>
<td>Bolus</td>
<td>Infusion</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td><strong>Adenosine</strong></td>
<td>0.1mg/kg, then 0.2mg/kg, then 0.3mg/kg</td>
<td>-</td>
</tr>
<tr>
<td><strong>Adrenaline</strong></td>
<td>[Arrest IV] 0.1ml/kg: 1:10,000 (10mcg/kg)</td>
<td>[↓bp] 0.15mg/kg (max 5mg) in 50mls saline. Infuse 0.5-10ml/hr</td>
</tr>
<tr>
<td>(1:1,000 = 1mg/ml)</td>
<td>[Arrest ETT] 0.1ml/kg of 1:1,000 (10mcg/kg)</td>
<td>1-9yrs: 55mg/kg into 50mls 5%dex. Infuse 1ml/hr</td>
</tr>
<tr>
<td>(1:10,000 = 100mcg/ml)</td>
<td>[Other] 0.01-0.05ml/kg: 1:10,000 (1-5mcg/kg)</td>
<td>10-15yrs &amp; &lt;35kg: 35mg into 50mls 5%dex. Infuse 1ml/hr</td>
</tr>
<tr>
<td></td>
<td>[IM dose] 0.01ml/kg of 1:1,000 (10mcg/kg)</td>
<td>10-15yrs &amp; &gt;35kg: neat drug. Infuse 0.028ml/kg/hr</td>
</tr>
<tr>
<td><strong>Aminophylline</strong></td>
<td>10mg/kg over 1hr diluted to 1mg/ml (max 500mg)</td>
<td>1-9yrs: 55mg/kg into 50mls 5%dex. Infuse 1ml/hr</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10-15yrs &amp; &lt;35kg: 35mg into 50mls 5%dex. Infuse 1ml/hr</td>
</tr>
<tr>
<td><strong>Amiodarone</strong></td>
<td>5mg/kg slow push (max 300mg)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Atropine</strong></td>
<td>20mcg/kg</td>
<td>-</td>
</tr>
<tr>
<td><strong>Ca^2+ Chloride</strong></td>
<td>0.05 - 0.2ml/kg (max 10mls) slow push</td>
<td>-</td>
</tr>
<tr>
<td>(10%)</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Dobutamine</strong></td>
<td>-</td>
<td>15mg/kg in 50ml saline. Infuse 0.5-4ml/hr</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Ephedrine</strong></td>
<td>0.25mg/kg (max 9mg/dose)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Esmolol</strong></td>
<td>500mcg/kg slow push. Titrate</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Glycopyrrolate</strong></td>
<td>10mcg/kg</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Hydrocortisone</strong></td>
<td>[asthma] 4mg/kg</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Insulin (actrapid)</strong></td>
<td>[1K] Periv IV: 0.1unit/kg in 5ml/kg 10% dex</td>
<td>15ml/kg/hr. Can double rate @5min (max total dose=12ml/kg)</td>
</tr>
<tr>
<td></td>
<td>[1K] CVL: 0.1u/kg in 2ml/kg 50% dex</td>
<td>-</td>
</tr>
<tr>
<td><strong>Intralipid</strong></td>
<td>1.5ml/kg bolus. Rpt ev 5min, max x2</td>
<td>-</td>
</tr>
<tr>
<td>(20%)</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Isoprenaline</strong></td>
<td>-</td>
<td>300mcg/kg in 50mls saline. Infuse at 1ml/hr (0.1mcg/kg/min) and titrate up (max 10ml/hr)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Ketamine</strong></td>
<td>[bronchospasm &amp; anaesthetised] 0.5-1mg/kg</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Labetalol</strong></td>
<td>0.25-0.5mg/kg slow push. rpt ev. 10min as req’ed</td>
<td>50mg/kg &amp; saline to make 50ml. Infuse 0-3ml/hr(0-3mg/kg/hr)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Lignocaine 1%</strong></td>
<td>[arrhythmia] 0.1ml/kg. Can rpt ev 10mins (max 0.3mg/kg)</td>
<td>-</td>
</tr>
<tr>
<td>(1ml = 1mg)</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Magnesium</strong></td>
<td>[asthma] 0.1ml/kg over 20mins</td>
<td>-</td>
</tr>
<tr>
<td>(49.3%)</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Metaraminol</strong></td>
<td>10mcg/kg</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Metoprolol</strong></td>
<td>0.1mg over 5mins</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Midazolam</strong></td>
<td>[emergency] IV: 0.1mg/kg; IM 0.2mg/kg; buccal 0.5mg. Can repeat dose @ 5mins</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Naloxone</strong></td>
<td>[titrate] 2mcg/kg (400mcg in 20mls give 0.1ml/kg)</td>
<td>300mcg/kg to 30ml 5% dex &amp; run at 0-1ml/hr (10mcg/kg/hr)</td>
</tr>
<tr>
<td></td>
<td>[titrate] 10mcg/kg (max 400mcg)</td>
<td>300mcg/kg to 30ml 5% dex &amp; run at 0-1ml/hr (10mcg/kg/hr)</td>
</tr>
<tr>
<td></td>
<td>(max 250)</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>[emergency post intubation] = 16mg/kg; [PTC&gt;2] 4mg/kg; [T&gt;2]= 2mg/kg</td>
<td>-</td>
</tr>
<tr>
<td><strong>Noradrenaline</strong></td>
<td>-</td>
<td>0.15mg/kg (max 5mg) in 50mls saline. Infuse 0.5-10ml/hr</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Phenylepherine</strong></td>
<td>2-10mcg/kg. Titrate</td>
<td>10mg in 100ml saline. Infuse 0-20mls/hr (1-5mcg/kg/min)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Salbutamol</strong></td>
<td>Inhaled: &lt;5yr=6puffs; &gt;5yrs 12puffs via circuit IV: &lt;2yr=5mcg/kg slow; &lt;18yr=10mcg/kg (max 250) Make neat salbutamol up to 50mls Infuse at 5-10mcg/kg/min for 1hr. Then 1-2mcg/kg/min</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Sodium Bicarb</strong></td>
<td>1ml/kg over 5min. Can repeat every 2mins (target pH 7.45-7.55)</td>
<td>-</td>
</tr>
<tr>
<td>(8.4%)</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Sugammadex</strong></td>
<td>[emergency post intubation] = 16mg/kg; [PTC&gt;2] 4mg/kg; [T&gt;2]= 2mg/kg</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Suxamethonium</strong></td>
<td>[intubation] IV: 2mg/kg; IM 4mg/kg [laryngospasm] 0.5mg/kg</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Tranexamic Acid</strong></td>
<td>15mg/kg diluted in 20-50mls saline over 10mins 2mg/kg/hr in 500ml saline over 8hrs</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Vasopressin</strong></td>
<td>1unit/kg in 50mls saline. Infuse 1-3mls/hr</td>
<td>-</td>
</tr>
</tbody>
</table>

**36r. PAEDIATRIC DRUG FORMULARY**
DIAGNOSING Problems

Anaesthetic Crisis Handbook
www.AnaestheticCrisisHandbook.com
By Adam Hollingworth
adamhollingworth@gmail.com

For Nichola. Thank you for your never-ending support and patience.

Second addition special thanks to Dr M Ku for your learned ideas and feedback.

Many other thanks to excellent colleagues who contributed to this manual. Without their suggestions, improvements, fact & error checking & so on, it wouldn’t have been possible.

This includes (but not limited to): CCDHB QA Committee, Dr D Borshoff, Dr J Cameron, Dr H Truong, Mr R Pryer, Mrs J Dennison, Dr D Mein, Dr N Chadderton, Dr L Kwan, Dr A Haq, Dr S McRitchie, Miss L Anderson, Dr D Heys, Miss D Hantom, Mr D Livesey, Dr J Dieterle, Dr V Singh, Dr P Tobin, Dr B Waldron, Dr J McKean, Miss K Chadwick-Smith & many more.

Version 2.6: June 2018

Disclaimer: Every effort has been taken to prevent errors/omissions/mistakes. However, this cannot be guaranteed. Graded assertiveness to query team leader decisions/management steps which are contrary to this manual are encouraged. However, clinical experience & acumen are vital in complex situations such as crises and may be more appropriate than this manual in certain situations.