Children's Resuscitation Emergency Drug Dosage (CREDD)

3rd Edition

Sponsored by the Queensland Emergency Department Strategic Advisory Panel (QEDSAP)

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Acknowledgement of Country

We pay our respects to the Aboriginal and Torres Strait Islander ancestors and custodians of this land, their spirits and their legacy. The foundations laid by these ancestors—First Nations peoples—gives strength, inspiration and courage to current and future generations. We are committed to working towards a stronger and healthier Queensland community for Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander people.

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Cover artwork produced for Queensland Health by Gilimbaa. The motifs used represent the important network of people from Queensland communities and how they work together to empower Aboriginal and Torres Strait Islander Queenslanders to have long, healthy, productive lives.

For content enquiries or feedback email the CREDD team at CREDD@health.qld.gov.au

For distribution enquiries email the Simulation Training Optimising Resuscitation for Kids (STORK) at STORK@health.qld.gov.au

Purpose

This book is a weight-based equipment and medication guide intended for use by clinicians managing critically unwell children during the initial stages of resuscitation. It contains information on the recommended dosing, preparation and delivery of drugs administered in a wide range of paediatric emergencies.

The aim of providing this information by weight is to reduce the cognitive burden at the time of resuscitation thereby limiting the potential for error and improving the speed of medication delivery.

The CREDD book has been developed by a multidisciplinary team of clinicians and pharmacists with emergency, paediatric, paediatric intensive care and retrieval expertise.

The preparation methods contained in this book use standardised concentrations to align with the international safety standards of drug preparation.

Considerations

The CREDD book is not a substitute for clinically appropriate, carefully checked medication orders. It is designed to be used in conjunction with state and/or local resources which contain information on drug interactions, compatibilities, precautions and possible side effects.

The dosing information contained in this book reflects the latest evidence at the time of print and is subject to change. Refer to *references* and the *rationale for consensus decisions* at the back of this book for further information.

The infusion recommendations align with the Queensland Children's Hospital, Paediatric Intensive Care medication safety drug profiles. We recommend using drug error reduction software (DERS) on all pumps. For sites without DERS software we have included mL/hr relating to dosing recommendations for that particular medication when prepared as instructed. If you require information regarding the preparation of infusions not listed in CREDD, please refer to Children's Intensive Care Drug Directory (CIDD).

For online paediatric emergency resources including a digital version of CREDD and further paediatric resuscitation education by Simulation Training Optimising Resuscitation for Kids (STORK) visit the Queensland Paediatric Emergency Care page on the Children's Health Queensland website. Search "CHQ emergency care" or scan the code on the front cover with your phone's camera.

Third edition changes

In response to valuable feedback and review of new evidence we have made the following changes to the 3rd edition.

Addition of Antimicrobials section
The aim is to improve timely antimicrobial administration in critically unwell children. All medication doses are consistent with the Queensland Paediatric Sepsis Program. Preparation of the medications are in line with CREDD principles. We acknowledge this may be a change in current practice and recommend users familiarise themselves via the training resources. QR code and hyperlinks to the latest version of the Queensland sepsis program are at the beginning of the antimicrobial section.

Endotracheal Tubes (ETT)
Only one size of ETT will be recommended for each weight. Please prepare the recommended ETT and one size above and one size below. The CREDD team recommend using a microcuff ETT, these tubes are designed to seal at a lower cuff pressure with a more anatomically favourable design for paediatric patients.

Anaphylaxis
Adrenaline IM as per ASCIA guidelines and expert immunology opinion will be dose banded according to age:

Under 1 year (all weights) = 100 microg (0.1 mL of 1: 1000)
1–2 years (10 kg–12 kg) = 100 microg (0.1 mL of 1:1000)
2–3 years (13–15 kg) = 150 microg (0.15 mL of 1:1000)
4–6 years (16–20 kg) = 200 microg (0.2 mL of 1:1000)
7–10 years (22–30 kg) = 300 microg (0.3 mL of 1:1000)
11–12 years (35–45 kg) = 400 microg (0.4 mL of 1:1000)
Over 12 years (greater than 50 kg) = 500 microg (0.5 mL of 1:1000)

Respiratory
Hydrocortisone:
Maxiumum dose reduction to 100 mg.

Salbutamol:
- Lowering of intravenous doses due to emerging evidence and risk of Salbutamol toxicity with high doses.
- IV Salbutamol Loading/Bolus 15 microg/kg over 10 mins. Maximum 300 microg.
- IV Salbutamol Infusion dose 0.5 microg/kg/min to 1 microg/kg/minute. Maximum dose of 40 microg per minute.

Electrolytes
Glucose and Insulin – addition of a PUSH dose which can be given in management of a Hyperkalaemia causing cardiac arrest.

Acute behavioural disturbance
Medication dosing tables have been removed from all weights under 20 kg. It is recognised that use of these medications in an emergency is rare under the age of 6 years.

When caring for critically unwell children call for HELP early

If no paediatric critical care facility onsite, contact **Retrieval Services Queensland (RSQ) on 1300 799 127**.
If required, Paediatric Critical Care specialists can check dosing and guide clinicians through drug preparation.

How to use CREDD

Determine the weight of the child and find the respective pages for that weight in the book. If the exact weight is not known, it can be estimated (see *Table 1*).

Medications are grouped according to the condition in which they are used. Weights range from 2 to 70 kg in predefined increments. When the actual body weight is between a weight range, we recommend rounding up to the nearest kilogram.

Clinical judgement is needed for dose selection at the extremes of body weight for a given age.

Depending on the medication there is variability in the weight at which an adult medication dose is reached. Once adult dosing is reached all weights above this will reflect the adult dose.

Equipment selection

Equipment sizing is determined by age.

As this book is a weight based guide, the listed size is based on the expected weight for each age. See *Table 1*.

When using a cuffed Endotracheal tube (ETT) we recommend the use of an ETT with a microcuff. These tubes are designed to seal at a lower cuff pressure with a more anatomically favourable design for paediatric patients.

When choosing an Intercostal Catheter (ICC) size we have given a range of sizes according to weight. Simple calculation of 4x the ETT size is accepted as a good guide for size selection.

Age	Weight	Height	ETT microcuff size
Birth (term)	3.5 kg	50 cm	3.5
1 month	4 kg	55 cm	3.5
2 months	5 kg	58 cm	3.5
3 months	6 kg	61 cm	3.5
4 months	7 kg	63 cm	3.5
6 months	8 kg	67 cm	3.5
9 months	9 kg	72 cm	4.0
1 year	10 kg	75 cm	4.0
2 years	12 kg	87 cm	4.5
3 years	14 kg	96 cm	4.5
4 years	16 kg	103 cm	5.0
5 years	18 kg	110 cm	5.0
6 years	20 kg	115 cm	5.5
7 years	22 kg	122 cm	5.5
8 years	25 kg	127 cm	6.0
9 years	28 kg	134 cm	6.0
10 years	30 kg	139 cm	6.5
11 years	35 kg	144 cm	6.5
12 years	40 kg	150 cm	7.0
13 years	45 kg	156 cm	7.0
14 years	50 kg	162 cm	7.0

Table 1. Average weight and height for age with ETT microcuff sizes

Medication recommendations

Medication doses are expressed as the **recommended dose/kg** and the **dose** reflects the calculated dose for each weight.

Where a dosing range is displayed, the lower dose is provided in the dose column. Certain medications should be titrated to the desired effect. Careful judgement is needed when managing critically unwell children. A shocked child is particularly sensitive to the respiratory and cardio depressant effects of induction agents and analgesics. Titration of these drugs to effect with careful attention to correcting hypovolaemia and using vasoactive agents such as push dose pressor Adrenaline is recommended.

We have aimed to simplify medication administration, and comply with international medication safety standards, by guiding the user to prepare medications as standard concentrations, referred to as **final concentration**. This is familiar practice in most emergency departments. Where practical, and to minimise error the recommended practice is to draw up the entire volume of specific vials/ampoules and dilute according to the **preparation/dilution** instructions.

Unless otherwise indicated, the recommended diluent is Sodium Chloride 0.9%. The user is guided in preparing a **final concentration** of the drug and the **final volume to administer** the calculated dose.

Maximum volume of IM injections (vastus lateralis):

Less than 6 months 0.5 mL
Over 6 months up to 3 years 1 mL
Over 3 years up to 6 years 1.5 mL
Over 6 years 1.5–2 mL

Some medications do not require dilution; the preparation instructions for these state “Undiluted”.

When the recommended dose exceeds the contents of one vial, multiple vials may need to be draw into the syringe to give the dose and **final volume to administer**.

The wording “consult” replaces the dose when a medication would not be recommended due to the age of the child.

The **administration** column provides guidance on medication delivery. Medications to be administered as a “push” should be given as rapidly as the vein and volume allows unless a time frame is specified. IV refers to both intravenous and intraosseous routes of administration.

When the dose of IV/IO medication to be administered has a volume of less than 1 mL and is required to be given over any time period between 30 seconds to 5 minutes. The exact dose can be drawn up in a 1 mL syringe then diluted to a total volume of 1 mL with a compatible fluid. This enables an exact dose to be given as specified.

Medications given over longer than five minutes should preferably be given as a short infusion. However, where this is not possible, the medication can be pushed by a staff member over the specified time frame.

It is acknowledged that there is a variance in the average volume of the 100 mL and 250 mL infusion fluid bags. A consensus decision was made to NOT include this overage volume when diluting up to final volumes of 100 mL or greater. It was agreed that the faster time to medication administration by reducing the complexity of preparation outweighed a slightly decreased final concentration.

Rounding rules

Final volume to administer is calculated according to the following rules:

- the volume has been rounded to two decimal places for medication doses which are below 1 mL (accurately draw up into a 1 mL syringe)
  e.g. Adenosine dose 0.4 mg = final volume of 0.13 mL
- single decimal place used for medication doses with volumes between 1–20 mL
  e.g. Levetiracetam 440 mg = final volume of 8.8 mL
- dosing rounded to the nearest mL for medication doses with a volume above 20 mL

“The underlying principle of CREDD is to provide a safe and practical guide for medication administration in pressured situations. For this reason, doses are rounded to a volume that is easy to draw up and administer. Ideally, we would like to apply a blanket rule for rounding doses however this is not always appropriate. In most cases, medications with volumes less than 1 mL are rounded to two decimal places and volumes over 1 mL to one decimal place. In some medications, the dose is reflected as the actual calculated dose and the final volume is rounded to a practical and safe volume to administer.”

Administration

Push and titratable medications

The recommended procedure for medications to be administered as a push is as follows:

1. Prepare the **final concentration** (Mothership) syringe **(A)**. Ensure it is clearly labelled as per institutional labelling standards.
2. Attach a fluid dispensing connector **(B)** or 3-way tap **(C)** to an appropriate sized **dose** syringe **(D)** that is clearly labelled.
3. Draw the exact dose **final volume to administer (D)** into the dosing syringe.

Fig 1. Final concentration syringe connected to the dose syringe using a fluid dispensing connector.

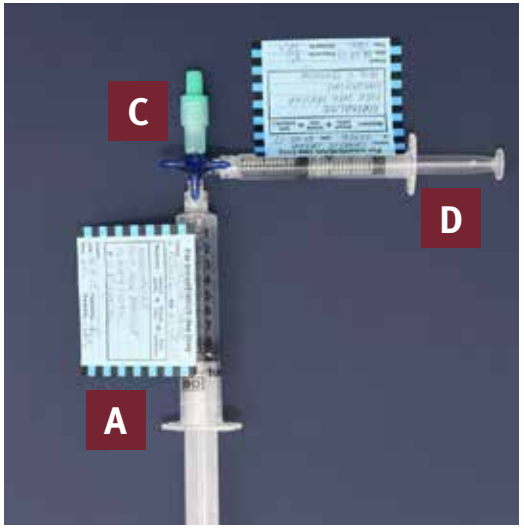

Fig 2. Final concentration syringe connected to the dose syringe using a 3-way tap.

Short infusions and loading doses

Having prepared the final concentration, ensure only the exact volume to be infused is attached to the syringe pump by either:

- Drawing up the **final volume to administer** into a different syringe of appropriate size.
- if **final volume to administer** less than 5 mL it is reasonable to dilute the dose up to a practical volume for the pump to infuse.
- or, if using the **final concentration** (Mothership) syringe, discard all excess solution so that the volume contained in the final concentration syringe is limited to the **final volume to administer**.

Administer the exact dose via an infusion pump over the specified time.

Infusions (page 7 of each weight)

All infusion preparations are prepared to produce a standardised concentration in line with the Children's Health Queensland and CHQ Retrieval Service and international drug safety standards. Unless specified, all infusions are made up to a concentration which can be safely administered via a peripheral vein. Where a central vein is advised, this may be achieved by using a central vein or intraosseous access.

Infusions are grouped according to the purpose of use. The user is guided in **preparation** instructions to produce a standardised **final concentration** of drug made up in a 50 mL syringe. The **recommended dose/kg** range is stated in appropriate units (e.g. units/kg/min or units/kg/hr). The final rate range reflecting this dose range is given in millilitres (mL) per hour. This is to assist sites without smart pumps and drug error reduction software.

Some infusions have small volumes and low rates which can result in delays in the medication reaching the patient. We recommend the infusion line is connected as close as possible to the patient IV and commenced at a rate which ensures the medication reaches the patient quickly. The patient should be observed continuously, and the infusion titrated to effect.

Higher concentration solutions options are offered in larger children, to minimise the need for infusion changes.

Antimicrobials

Having prepared the final concentration, ensure only the exact volume to be infused is attached to the syringe pump by either:

- Drawing up the **final volume to administer** into a different syringe of appropriate size.
- if **final volume to administer** less than 5 mL it is reasonable to dilute the dose up to a practical volume for the pump to infuse.
- or, if using the **final concentration** (Mothership) syringe, discard all excess solution so that the volume contained in the final concentration syringe is limited to the **final volume to administer**.

Administer the exact dose via an infusion pump over the specified time.

References

Provided below are the references to support the recommendations outlined in this book.

Table 2. References to support medication recommendations

Drug	Indication	Dose	Dilution and final concentration	Max dose/adult dose	Administration	References
Adrenaline	Anaphylaxis	10 microg/kg , now dose banded ref page 3. Auto-injector over 7 kg use 150 microg over 20 kg use 300 microg	1:1000 = 1000 microg/mL	0.5 mg	IM	Ascia, AMHc, APLS, ANZCOR
Adrenaline	Upper airway obstruction	5 mg	5 mL of 1:1000	5 mg	Nebuliser	Ascia, eTG
Adrenaline	Cardiac arrest	10 microg/kg	1:10,000 = 100 microg/mL	1 mg	IV	ANZCOR, APLS
D/C Shock	Cardiac arrest shockable rhythm	PAD selection size dependant on make of machine		Dependant on model Biphasic 150–200 J Monophasic 360 J		ANZCOR, APLS
AmiODAROne	Shock resistant VT/VF	5 mg/kg	Glucose 5% final concentration 10 mg/mL	300 mg Adult dose from 60 kg	IV	ANZCOR APLS
Fluid Bolus	Hypovolaemia	10 mL/kg	Sodium Chloride 0.9%			ANZCOR, APLS
Fluid Bolus	Hypovolaemia	20 mL/kg	Sodium Chloride 0.9%		IV	ANZCOR, APLS
Glucose 10%	Hypoglycaemia	2 mL/kg	Glucose 10%	150 mL repeat to effect	IV	APLS
Adenosine 1st	SVT	0.1 mg/kg	Undiluted	6 mg	IV	ANZCOR, APLS
Adenosine 2nd	SVT	0.2 mg/kg	Undiluted	12 mg	IV	ANZCOR, APLS, AMH
Adenosine 3rd	SVT	0.3 mg/kg	Undiluted	12 mg from 40 kg	IV	ANZCOR, APLS, AMH
Synchronised cardioversion		1–2 J/kg		Adult 50 J 100 J 200 J		APLS, ANZCOR
Atropine	Bradycardia	20 microg/kg	Dilute to 100 microg/mL	600 microg	IV	APLS, ANZCOR, AMH
Push Dose Pressor	Intermittent administration of small doses of vasopressors for hypotension particularly associated with Intubation. Useful as a temporizing bridge to inotrope infusion commencing. Below 40 kg Adrenaline is preferred over Metaraminol.					Ross et al 2018, Scott Weingart 2017
Adrenaline	Hypotension	1 microg/kg	10 microg/mL	50 microg at 50 kg	Push in 1 mL aliquots if multiple doses needed start infusion	Ross et al 2018, Scott Weingart 2017
Metaraminol	Hypotension	10 microg/kg	500 microg/mL	Max 0.5 mg per dose Use over 12 years	Max 1 mL boluses repeated up to 5 mg	BNFc
Fentanyl	Sedation	2–5 microg/kg	10 microg/mL	100 microg	Titrate to effect	AMH
Ketamine	Sedation	1–2 mg/kg	10 mg/mL	200 mg	Titrate to effect	AMHc
PropOFOl	Sedation	2–3 mg/kg	10 mg/mL		Titrate to effect	AMHc, BNFc
Midazolam	Sedation/seizure	0.15 mg/kg	1 mg/mL	10 mg	IV	AMHc
Rocuronium	Muscle relaxation	1.2 mg/kg	10 mg/mL		IV	QCH, Shann
Suxamethonium	Muscle relaxation	2 mg/kg	10 mg/mL	150 mg	IV	QCH

Drug	Indication	Dose	Dilution and final concentration	Max dose/adult dose	Administration	References
Vecuronium	Muscle relaxation	0.1 mg/kg	1 mg/mL	10 mg	IV	AMH, Shann
Sugammadex	Rocuronium reversal	16 mg/kg	100 mg/mL		IV	AMH, Shann
Flumazenil	Benzodiazepine reversal	5 microg/kg	100 microg/mL	Max single dose 200 microg can go up to total dose 2 mg	IV	AMHc, BNFc
Naloxone	Opioid reversal	10 microg/kg	400 microg/mL	400 microg	IV/IM	AMH, QCH
Dexamethasone	Severe croup	0.3 mg/kg	4 mg/mL	12 mg	IV/IM	CHQ
Magnesium Sulfate	Asthma Polymorphic VT	0.2 mmol/kg	0.2 mmol/mL	10 mmol	IV	AMHc, QCH, PIG
Hydrocortisone	Adrenal crisis, Asthma	4 mg/kg	50 mg/mL	100 mg	IV	AMHc, CHQ
Methylprednisolone	Asthma	1 mg/kg	40 mg/mL	60 mg	IV	CHQ
Salbutamol	Asthma load	15 microg/kg	0.1 mg/mL	300 microg	IV	CHQ
Aminophylline	Asthma load	5 mg/kg	5 mg/mL	500 mg	IV	CHQ
Midazolam	Seizure	0.2 mg/kg	5 mg/mL	10 mg	IM	AMHc
Midazolam	Seizure	0.3 mg/kg	5 mg/mL	10 mg	Nasal/buccal	AMHc
Phenytoin	Status epilepticus	20 mg/kg	10 mg/mL	1500 mg	IV	AMHc, APLS
Phenobarbital	Status epilepticus	20 mg/kg	20 mg/mL	1000 mg	IV	AMHc, APLS, BNFc
Levetiracetam	Status epilepticus	60 mg/kg	50 mg/mL	4.5 g	IV	Lyttle et al 2019
Sodium Valporate	Status epilepticus	40 mg/kg	40 mg/mL	3 g	IV	CHQ, AMHC
Mannitol 20%	Raised ICP	0.5 g/kg	0.2 g/mL		IV	CHQ, BNFc
Sodium Chloride 3%	Raised ICP	3 mL/kg	0.5 mmol/mL	150 mL	IV	CHQ
Potassium Chloride	Hypokalaemia	0.3 mmol/kg	0.1 mmol/mL premixed bag	20 mmol/hr	IV	CHQ
Calcium Gluconate	Hypocalcaemia, Hyperkalaemia	0.11 mmol/Kg	0.2 mmol/mL	4.5 mmol 20 mL 10%	IV	BNFc
Salbutamol Nebs	Hyperkalaemia	2.5 mg under 6 years 5 mg over 6 years			Neb	RCH
Furosemide		1 mg/kg	1 mg/mL		IV	AMHc, BNFc
Sodium bicarbonate 8.4%	Hyperkalaemia	1 mmol/kg	1 mmol/mL		IV	BNFc, RCH
Resonium A	Hyperkalaemia	0.25 g/kg	Dilution chosen for ease of administration		PO/PR	BNFc
Blood	Blood loss Anaemia	10 mL/kg	As clinically indicated. Blood loss 10–20 mL/kg and reassess. Elective transfusion equation child under 20 kg. mL = weight (kg) x desired Hb rise g/L (desired Hb g/L– Actual Hb g/L) x 0.5 10 mL/kg usually = 2 g/L rise			APLS, ANZCOR
Tranexamic acid	Large blood loss	15 mg/kg	10 mg/mL	1000 mg	IV	AMHc
Fentanyl	Analgesia	1.5 microg/kg	50 microg/mL	100 microg	IN	AMH
Fentanyl	Analgesia	0.1–1 microg/kg	10 microg/mL	100 microg	IV	AMH
Morphine	Analgesia	0.05–0.1 mg/kg	1 mg/kg	10 mg	IV	AMH

Antibiotics: Refer to paediatric sepsis pathway (https://clinicalexcellence.qld.gov.au/sites/default/files/docs/clinical-pathways/paed-sepsis-pathway.pdf)

Drug	Indication	Dose	Dilution and final concentration	Max dose/adult dose	Administration	References
Lidocaine (lignocaine) 1%	Analgesia for **IO** infusions	0.5 mg/kg	10 mg/mL	40 mg initial 20 mg subsequent MAX 60 mg	IO follow dose with 1 mL Sodium Choride 0.9% flush over 2 min. Dwell for 1 min. Rapid flush 5 mL. Half original dose can be repeated as above	QAS, PCCM
AmiODAROne (load)	Antiarrhythmic	5 mg/kg	Glucose 5% 2 mg/mL	300 mg	Use 0.22 micron Filter load over 4 hours = 20–25 microg/kg/min	ANZCOR, AMHc, PIG
Esmolol (load)	Beta blocker SVT	0.25–0.5 mg/kg	Undiluted	500 microg	Push over 1–2 min	AMHc, BNFc, PIG
Esmolol (infusion)	Beta blocker	50–300 microg/kg/min	Undiluted	500 microg/kg/min	Titrate in 25–50 microg/min increments	AMHc, PIG
Verapamil	SVT	0.1 mg/kg	1 mg/mL	10 mg	Infuse over 5–10 min	AMHc, BNFc, PIG, AID
Diazepam	Behavioural disturbance	0.2 mg/kg	1 mg/mL	10 mg	PO	QHG, RCH
Lorazepam	Behavioural disturbance	Less than 40 kg 0.5–1 mg Greater than 40 kg 1–2 mg		2 mg	PO Dose banding	CHQ, RCH
Olanzapine	Behavioural disturbance	Less than 40 kg 2.5–5 mg Greater than 40 kg 5–10 mg		10 mg	PO Dose banding	QHG, CHQ
Risperidone	Behavioural disturbance	0.02–0.04 mg/kg		2 mg	PO Dose banding	QHG, RCH
Droperidol	Behavioural disturbance	0.1–0.2 mg/kg	Undiluted 2.5 mg/mL	10 mg	IM	QHG, CHQ
Olanzapine IM	Behavioural disturbance	0.2 mg/kg Less than 40 kg 2.5–5 mg Greater than 40 kg 5–10 mg		10 mg	IM Dose banding	CHQ, RCH
Benztropine	Dystonic reaction	0.02 mg/kg	Undiluted 1 mg/mL	1 mg	IM/IV	CHQ, AMHc

Table 3. References to support equipment recommendations

Equipment	Recommendation	Reference
ETT	Tube sizes are calculated according to age. As this is a weight based book we have used 50th centile weights for age from AMH to determine weights at which tube size and depth of insertion change	APLS
ETT	Calculated as Age/4 + 4.0 for children 1 year or older. ETT with average weight for age represented	APLS
Depth at lips	Calculated as Age/2 + 12 for children 1 year or older. Newborn 8 cm, 6 months 10 cm, 1 year 12 cm	APLS
Depth at nose	Calculated as Age/2 + 15 for children 1 year or older. Newborn 10 cm, 6 months 13 cm, 1 year 14 cm	APLS
LMA size	Under 5 kg = 1, 6–10 kg = 1.5, 11–20 kg = 2, 21–30 kg = 2.5, 31 –50 kg = 3, 51–70 kg = 4	ANZCOR
IDC and Nasogastric tube	2 x uncuffed ETT	Standard practice
Intercostal catheter	4 x uncuffed ETT	Standard practice

Table 3. References to support antimicrobial recommendations

Drug	Initial Dose Refer to relevant resources for ongoing dosing, frequency and therapeutic drug monitoring adjustments for organ dysfunction	Maximum dose/adult dose	Dilution and final concentration	Administration	References
Aciclovir	Birth to 3 months of age = 20 mg/kg IV Greater than or equal to 3 months of age and 12 years of age = 500 mg/m² Greater than 12 years of age = 10 mg/kg	1 gram Consider using IBW or ABW for patients with large BMI	5 mg/mL Range 5 mg/mL – 7 mg/mL peripherally; 25 mg/mL via central line	Infuse over 60 minutes	PSP, PIG, AIDH
Amoxicillin	50 mg/kg Meningitis: 100 mg/kg/dose (on ID advice)	2 grams	50 mg/mL or weaker	Infuse over 30 minutes	PSP, PIG, AIDH
Ampicillin	50 mg/kg Meningitis: 100 mg/kg/dose (on ID advice)	2 grams	50 mg/mL for doses of 50 mg/kg or less than 500 mg 30 mg/mL for doses of 100 mg/kg or greater than 500 mg	• 50 mg/kg UP TO 500 mg: Inject over 3–5 minutes • 100 mg/kg OR greater than 500 mg: Infuse over 15–30 minutes	PSP, PIG, AIDH
Benzylpenicillin	60 mg/kg	2.4 grams	60 mg/mL or weaker	Infuse over 30 minutes	PSP, PIG, AIDH
Cefazolin	50 mg/kg	2 grams	100 mg/mL	Inject over 3–5 minutes	PSP, PIG, AIDH
cefOTAXIME	50 mg/kg	2 grams	200 mg/mL	Inject over 3–5 minutes	
cefOTAXIME IM	50 mg/kg	2 grams	330 mg/mL	cefOTAXIME IM can be diluted with lidocaine (lignocaine) 0.5%. To make 0.5% lidocaine, dilute 1% lidocaine with an equal quantity of water or sodium chloride 0.9% to make a 0.5% solution	Intramuscular injection: See *RCH Clinical Guidelines (Nursing): Intramuscular Injections* (rch.org.au) and *CHQ-PROC-01039 Medication administration*.
Ceftazidime	50 mg/kg	2 grams	100 mg /mL Range: 40–170 mg/mL	Inject over 3–5 minutes	PIG, AIDH
cefTRIAXONE	50 mg/kg	2 grams	40 mg/mL	Inject over 5 minutes cefTRIAXONE can be diluted with lidocaine (lignocaine) 1%”	PSP, PIG, AIDH
cefTRIAXONE IM	50 mg/kg	2 grams	350 mg/mL	cefTRIAXONE IM can be diluted with lidocaine (lignocaine) 1%	Intramuscular injection: See *RCH Clinical Guidelines (Nursing)*: Intramuscular Injections (rch.org.au) and *CHQ-PROC-01039 Medication administration*
Ciprofloxacin	Greater than 1 month of age = 10 mg/kg	400 mg	2 mg/mL or weaker	Infuse over 60 minutes preferably via a large vein	PSP, PIG, AIDH
Clindamycin	Less than or equal to 1 month of age = 7 mg/kg Greater than 1 month of age = 10 mg/kg	600 mg Doses of up to 900 mg may be required on specialist advice	10 mg/mL (for ease of measurement). Range: 18 mg/mL or weaker	Infuse over 20–60 minutes Maximum infusion rate: 20 mg/kg/hr or 30 mg/minute	CREDD consensus, PIG, AIDH

Drug	Initial Dose Refer to relevant resources for ongoing dosing, frequency and therapeutic drug monitoring adjustments for organ dysfunction	Maximum dose/adult dose	Dilution and final concentration	Administration	References
Flucloxacillin	50 mg/kg	2 grams	50 mg/mL or weaker	Infuse over at least 30 minutes OR inject over 3–5 minutes (phlebitis risk)	PSP, PIG, AIDH
Gentamicin	Less than 1 month of age = 5 mg/kg Greater than 1 month of age and less than 10 years of age = 7.5 mg/kg Greater than or equal to 10 years of age = 7 mg/kg Dose based on Adjusted Body Weight	Greater than 1 month of age and less than 10 years of age = 320 mg Greater than or equal to 10 years of age = 700 mg	10 mg/mL or weaker	Infuse over 30 minutes	PSP, PIG, AIDH
linCOMYCIN	Greater than 1 month of age = 15 mg/kg	1.2 grams	10 mg/mL or weaker	Infuse over 60 minutes Maximum infusion rate 1 g/hour	PSP, PIG, AIDH
Meropenem	40 mg/kg	2 grams	50 mg/mL or weaker	Inject over 3–5 minutes	PSP, PIG, AIDH
Metronidazole	Less than or equal to 1 month of age = 15 mg/kg loading dose, then 7.5 mg/kg Greater than 1 month of age = 7.5 mg/kg	500 mg	5 mg/mL or weaker	Infuse over 20 minutes. Maximum rate is 25 mg/minute	PSP, PIG, AIDH
Piperacillin-Tazobactam	100 mg/kg based on Piperacillin component	4 grams of piperacillin (4.5 g of combined piperacillin – tazobactam)	80 mg/mL Range: 15–90 mg/mL	Infuse over 30 minutes	PSP, PIG, AIDH
Vancomycin	Under 16 years: 15 mg/kg (max 750 mg) For critically ill or obese patients: Loading dose 25–30 mg/kg (max 1500 mg) Over 16 years: 15 mg/kg (max 750 mg) For critically ill or obese patients: Loading dose: 25–30mg/kg (max 3000 mg) Loading dose, if given, is considered to be first dose: Refer to local or statewide procedures for further guidance	Refer to local / statewide procedures for dosing guidance For patients greater than or equal to 16 years: Seek specialist advice For patients 16 years: max 750 mg	5 mg/mL	Infuse over 60–120 minutes	PIG, AIDH, CHQ-PMG-01293

Glossary

ABW	Adjusted Body Weight
AMH	*Australian Medicines Handbook July 2019*, amhonline.amh.net.au
AMHc	*Australian Medicines Handbook Children's Dosing Companion* July 2019, childrens.amh.net.au
ANZCOR	Australian Resuscitation Council, *Australian New Zealand Resuscitation Council (ANZCOR) Guidelines*; January 2016 resus.org.au/ guidelines/anzcor-guidelines
ASCIA	Australasian Society of Clinical Immunology and Allergy, July 2019, www.allergy.org.au
APLS	Australian Paediatric Life Support Australia; August 2017 www.apls.org.au
BNFc	*British National Formulary for Children* July 2019, www.medicinescomplete.com/#/browse/bnfc
CHQ	Children's Health Queensland Hospital and Health Service *Queensland Paediatric Guidelines*, August 2019, www.childrens.health.qld.gov.au/for-health-professionals/queensland-paediatric-emergency-care-qpec/queensland-paediatric-clinical-guidelines
eTG	*Therapeutic guidelines*, June 2019, tgldcdp.tg.org.au/etgAccess
IBW	Ideal Body Weight
PCCM	*Primary Clinical Care Manual - 10th edition Section 8: Paediatrics,* www.publications.qld.gov.au/dataset/primary-clinical-care-manual-10th-edition
PIG	The Royal Children's Hospital Melbourne *Paediatric Injectable Guidelines* 2019 July 2019, pig.rch.org.au/monographs
PSP	Peadiatric Sepsis Pathway
QAS	*Queensland ambulance service field reference guide*
QCH	*Queensland Children's Hospital Paediatric Emergency Drug Preparation Guide*
QHG	Queensland health guideline *Acute behavioural disturbance in Emergency Departments,* www.health.qld.gov.au/__data/assets/pdf_file/0031/629491/qh-gdl-438.pdf
RCH	The Royal Children's Hospital Melbourne *Royal Children's Hospital Clinical Guidelines* www.rch.org.au/home

Maximal amounts of solutions to be Injected into Muscle Tissue CREDD consensus
For more infomation, refer to *Clinical Guidelines (Nursing) : Intramuscular Injections* (rch.org.au) and *CHQ-PROC-01039 Medication administration*.
References: *CHQ-PROC-01039, RCH Intramuscular Injection* (rch.org.au), Hockenberry, M. & Wilson, D. (2018). *Wong's Nursing Care of Infants and Children*. (11th ed.) St Louis: Mosby

Rationale for consensus decisions

Anaphylaxis
In line with the latest ASCIA recommendations January 2023 we have decided to apply dose banding to Intramuscular Adrenaline.

The minimum dose of 100 microg (0.1 mL of 1:1000) recommended by both ANZCOR and ASCIA aims to remove the risk of error when drawing up volumes smaller than 0.1 mL.

It is acknowledged that 100 microg would be a large dose for a small infant below 7.5 kg.

This will result in pallor and tachycardia. This is acknowledged in the *ASCIA Guidelines – Acute Management of Anaphylaxis*.

www.allergy.org.au/hp/papers/acute-management-of-anaphylaxis-guidelines

"Infants with anaphylaxis may retain pallor despite 2–3 doses of adrenaline, and this can resolve without further doses. More than 2–3 doses of Adrenaline in infants may cause hypertension and tachycardia, which is often misinterpreted as an ongoing cardiovascular compromise or anaphylaxis. Blood pressure measurement can provide a guide to the effectiveness of treatment, to check if additional doses of adrenaline are required."

Mini-Jets
Due to unreliable availability we have opted to prepare most commonly used resuscitation drugs e.g. Adrenaline and Atropine instead of using mini-jets.

Metaraminol
We have recommended the use of a pre-prepared diluted solution of Metaraminol 5 mg/10 mL = 500 microg/mL available through central pharmacy. This is to minimise the steps that would be involved in preparing the medication from the 10 mg/mL vial.

Intravenous Salbutamol
The current evidence to support the Salbutamol IV bolus and infusion dosing is limited and practice varies considerably throughout Australia. The dosages contained in this book align with the latest *Queensland Paediatric Emergency Care Asthma Guideline*.

Due to the potential significant side effects of Salbutamol toxicity and recent new evidence from a study published in 2022 "Optimising intravenous salbutamol in children: a phase 2 study" Walsh S, et al. Arch Dis Child 2022;0:1–7. doi: 10.1136/archdischild-2022-324008 we have chosen to lower both the loading and continuous infusion dose.

Higher doses may be delivered in conjunction with consultation of a Paediatric Intensive Care specialist.

Morphine
Morphine is available in a variety of concentrations.
To standardise preparation instructions, we have recommended using the readily available 10 mg/mL preparation to produce the final concentration of 1 mg/mL. If an alternate concentration of morphine is used it will be necessary to change the diluent volume to produce a final concentration of 1 mg/mL.

Insulin and Glucose
In response to several requests we reviewed the option to administer a faster dose of Glucose and Insulin. The context was a paediatric patient in cardiac arrest or cardiac instability secondary to hyperkalaemia. The review included current literature and protocols. The conclusion of the team is:

- Hyperkalaemia is a very rare cause of paediatric cardiac arrest less than 0.6% of cases.
- There is a very limited evidence base for of Insulin and Glucose in hyperkalaemia management.
- Paediatric emergency management plans of Royal Children's Hospital and Starship Children's Hospital reference a "slow push dose".
- Adult emergency practice is to give 50 mls of 50% Glucose with 10 units of Insulin.
- The paediatric patient has a high risk of becoming hypoglycaemic when unwell.
- Insulin should be used with caution due to high risk of hypoglycaemia.
- Endogenous Insulin response to Glucose bolus "may" be sufficient.
- Glucose and Insulin will only lower Potassium level by 0.6–1.2 mmol/L

Consensus
Glucose concentration should be 10% volume 5 mL/kg
Significant risk of hypertonic fluid administration and the challenges of extravasation using stronger concentrations of Glucose. Insulin dose 0.1 units/kg to be given only after bolus of Glucose given. A standard concentration of Insulin 1 unit/ml to be prepared in a 10 ml mothership syringe maximum of 10 units.

Authors and acknowledgements

This is the third version of CREDD. Since its first publication in November 2019, CREDD has become an established resource in managing critically unwell children in Queensland.

The initial version was developed by a multi-disciplinary group of clinicians from a wide range of facilities throughout Queensland. These clinicians, supporting organisations and external inspirations for the original development can be found in the *Historical acknowledgment* section.

The ongoing collation of feedback review and maintenance and editing of CREDD is lead by the following:

Medical lead
- Dr Christa Bell – Emergency and Paediatric Emergency Physician – Gold Coast University Hospital (GCUH)

Nursing lead
- Lauren Morgan – CNC– Queensland Children's Hospital

Pharmacy leads
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- Kayla Doyle, Senior Paediatric Pharmacist Operational Portfolio – Sunshine Coast HHS

Graphic design
- Megan Drew – Graphic Designer – Children's Health Queensland

The CREDD team consult with key stakeholders to ensure the resource remains consistent with the *Queensland Paediatric Emergency Care Guidelines* and *The Children's Intensive care Drug Dosage* (CIDD) infusion resource.

Antimicrobial section
A significant addition to CREDD version 3 is the Antimicrobial section. This body of work has been done in response to feedback from the Queensland Sepsis Program. The Antimicrobials included are current to the Queensland *Paediatric Sepsis Pathway* (V 2.00 11/2023).

The database has been created by the CREDD team leads.

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Salbutamol review team
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Anaphylaxis review team
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Historical acknowledgements

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CREDD team leads and steering committee

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CREDD database calculator creation

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The concept and layout have been endorsed by the Medicines Advisory Committee at GCUH, QCH, SCUH and TTH.

fluid recipes

Fluid recipes

Fluid ordered	Available as premade bag	Starting fluid			Additive		Final volume after mixing
			Volume required	Volume to remove and discard		Volume to add	
Sodium Chloride 0.9% with Glucose 5%	Use premade bag						1000 mL
Sodium Chloride 0.9% with Glucose 5%	If premade bag is not available	Sodium Chloride 0.9%	1000 mL	100 mL	Glucose 50%	100 mL	1000 mL
Sodium Chloride 0.9% with Glucose 10%	**No**	Sodium Chloride 0.9% with 5% Glucose	1000 mL	100 mL	Glucose 50%	100 mL	1000 mL
Sodium Chloride 0.9% with Glucose 10%	If premade not available	Sodium Chloride 0.9%	1000 mL	200 mL	Glucose 50%	200 mL	1000 mL
Sodium Chloride 0.9% with Glucose 12.5%	**No**	Sodium Chloride 0.9%	1000 mL	250 mL	Glucose 50%	250 mL	1000 mL
Sodium Chloride 0.9% with Glucose 5% and Potassium Chloride 20 mmol/L	Use premade bag						1000 mL
Sodium Chloride 0.9% with Glucose 5% and Potassium Chloride 20 mmol/L	If premade bag is not available	Sodium Chloride 0.9% with Potassium Chloride 20 mmol	1000 mL	100 mL	Glucose 50%	100 mL	1000 mL
Sodium Chloride 0.9% with Glucose 10% and Potassium Chloride 20 mmol/L	**No**	Sodium Chloride 0.9% with Glucose 5% and Potassium Chloride 20 mmol/L	1000 mL	100 mL	Glucose 50%	100 mL	1000 mL
Sodium Chloride 0.9% with Glucose 10% and Potassium Chloride 20 mmol/L	**No**	Sodium Chloride 0.9% with Potassium Chloride 20 mmol	1000 mL	200 mL	Glucose 50%	200 mL	1000 mL
Sodium Chloride 0.9% with Glucose 5% and Potassium Chloride 40 mmol/L	**No**	Sodium Chloride 0.9% with Potassium Chloride 40 mmol/L	1000 mL	100 mL	Glucose 50%	100 mL	1000 mL
Sodium Chloride 0.9% with Glucose 10% and Potassium Chloride 40 mmol/L	**No**	Sodium Chloride 0.9% with Potassium Chloride 40 mmol/L	1000 mL	200 mL	Glucose 50%	200 mL	1000 mL

Please be aware than when preparing fluids of different glucose concentrations in potassium containing base fluids, the removal of the required amount of the starting fluid will also result in removal of potassium. This reduces the concentration of potassium in the final product. When removing 100mL of solution, potassium concentration is reduced by 10%. When removing 200 mL of solution, potassium concentration is reduced by 20%.

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