

# South Australian Paediatric Clinical Practice Guidelines

# Intravenous (IV) Fluid Management in Children

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## Note:

This guideline provides advice of a general nature. This statewide guideline has been prepared to promote and facilitate standardisation and consistency of practice, using a multidisciplinary approach. The guideline is based on a review of published evidence and expert opinion.

Information in this statewide guideline is current at the time of publication.

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Health practitioners in the South Australian public health sector are expected to review specific details of each patient and professionally assess the applicability of the relevant guideline to that clinical situation.

If for good clinical reasons, a decision is made to depart from the guideline, the responsible clinician must document in the patient's medical record, the decision made, by whom, and detailed reasons for the departure from the guideline.

This statewide guideline does not address all the elements of clinical practice and assumes that the individual clinicians are responsible for discussing care with consumers in an environment that is culturally appropriate and which enables respectful confidential discussion. This includes:

- The use of interpreter services where necessary,
- Advising consumers of their choice and ensuring informed consent is obtained,
- Providing care within scope of practice, meeting all legislative requirements and maintaining standards of professional conduct, and
- Documenting all care in accordance with mandatory and local requirements

## Explanation of the aboriginal artwork.

The aboriginal artwork used symbolises the connection to country and the circle shape shows the strong relationships amongst families and the aboriginal culture. The horse shoe shape design shown in front of the generic statement symbolises a woman and those enclosing a smaller horse shoe shape depicts a pregnant woman. The smaller horse shoe shape in this instance represents the unborn child. The artwork shown before the specific statements within the document symbolises a footprint and demonstrates the need to move forward together in unison.



### **Cultural safety enhances clinical safety.**

**To secure the best health outcomes, clinicians must provide a culturally safe health care experience for Aboriginal children, young people and their families. Aboriginal children are born into strong kinship structures where roles and responsibilities are integral and woven into the social fabric of Aboriginal societies.**

**Australian Aboriginal culture is the oldest living culture in the world, yet Aboriginal people currently experience the poorest health outcomes when compared to non-Aboriginal Australians.**

**It remains a national disgrace that Australia has one of the highest youth suicide rates in the world. The over representation of Aboriginal children and young people in out of home care and juvenile detention and justice system is intolerable.**

**The cumulative effects of forced removal of Aboriginal children, poverty, exposure to violence, historical and transgenerational trauma, the ongoing effects of past and present systemic racism, culturally unsafe and discriminatory health services are all major contributors to the disparities in Aboriginal health outcomes.**

**Clinicians can secure positive long term health and wellbeing outcomes by making well informed clinical decisions based on cultural considerations.**

The term 'Aboriginal' is used to refer to people who identify as Aboriginal, Torres Strait Islanders, or both Aboriginal and Torres Strait Islander. This is done because the people indigenous to South Australia are Aboriginal and we respect that many Aboriginal people prefer the term 'Aboriginal'. We also acknowledge and respect that many Aboriginal South Australians prefer to be known by their specific language group(s).



# Intravenous (IV) Fluid Management in Children

## Recommended *routine* paediatric and enteroparental IV fluids

This is a modified version of the [NSW Health Paediatric IV Fluid Standards \(2015\)](#)<sup>18</sup>.

PAEDIATRICS (excludes neonates/complex ICU patients)	
SITUATION	RECOMMENDED FLUID
Resuscitation / bolus	Sodium chloride 0.9%
Correction of fluid deficit / dehydration	Sodium chloride 0.9% + glucose 5% +/- potassium chloride 20mmol (1L) <b>Alternatively and ONLY under direction of PICU/Specialist:</b> Plasma-Lyte 148 + 5% glucose
Maintenance	Sodium chloride 0.9% + glucose 5% +/- potassium chloride 20mmol (1L) <b>Alternatively and ONLY under direction of PICU/Specialist:</b> 0.45% sodium chloride + 5% glucose +/- potassium chloride 20mmol/L Plasma-lyte 148 + 5% glucose
Routine peri-operative IV fluid	Compound sodium lactate solution (Hartmann's)
Significant ongoing losses (e.g. gastric tube loss replacement)	Sodium chloride 0.9% +/- potassium chloride 20mmol (1L) <b>Alternatively and ONLY under direction of PICU/Specialist:</b> Plasma-lyte 148 + 5% glucose
NEONATES (where required, input should be sought from <b>neonatology</b> regarding the most appropriate fluid to prescribe)	
SITUATION	RECOMMENDED FLUID
Resuscitation / bolus	Sodium chloride 0.9%
Correction of fluid deficit / dehydration / significant ongoing losses	Sodium chloride 0.225% + glucose 10% + potassium chloride 10mmol (500mL)
Maintenance requirements	Sodium chloride 0.225% + glucose 10% + potassium chloride 10mmol (500mL)

**NB:** To review the Diabetic Ketoacidosis (DKA) in Children Clinical Guideline, please visit the [SA Health Practice Guideline App](#).



# Intravenous (IV) Fluid Management in Children

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## Purpose and Scope of PCPG

The Intravenous Fluid Management in Children Guideline is primarily aimed at medical staff working in any of primary care, local, regional, general or tertiary hospitals. It may however assist the care provided by other clinicians such as nurses.

The information is current at the time of publication and provides a minimum standard for the assessment (including investigations) and management of IV Fluids in children; it does not replace or remove clinical judgement or the professional care and duty necessary for each specific case.

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## Introduction

Intravenous (IV) fluids are frequently used in hospitalised children, predominantly to maintain hydration and haemodynamic stability as well as for glucose replacement.

Historically, low sodium content fluids have been used for both maintenance and deficit replacement. However, there is a risk of hyponatraemia associated.

More recent evidence supports the use of fluid with higher sodium content with adequate glucose to prevent hyponatraemia, as summarised by Moritz et al, Pediatrics 2011<sup>10</sup>.

Clinician discretion, informed by appropriate clinical and laboratory data and ongoing assessment, is vital in all situations.

## Important Points

- > These guidelines only apply to children who cannot receive enteral fluids by mouth, nasogastric tube or gastrostomy.
- > **These guidelines largely apply to children beyond the neonatal period (28 days or less). For neonates [see Special Fluids](#).**
- > Solutions containing higher sodium content (0.9%) are being recommended to minimise the risk of hyponatraemia. These guiding principles support this practice change but are **NOT** intended to replace individualised IV fluid replacement where appropriate.
- > Incorrect prescription or administration of intravenous (IV) fluids has been associated with harm and death in paediatric patients.
- > The enteral route (by mouth, nasogastric tube, gastrostomy etc.) should be used wherever possible.
- > If there is any doubt about an IV fluid order, clarification is required from a senior doctor.
- > The safe use of IV fluid therapy in children requires accurate prescribing of fluid and careful monitoring.
- > Specialist consultation is recommended when prescribing for infants < 3 months; neonatal fluids may be more appropriate.
- > More adverse events are described from fluid administration than with any other individual drug. Always check orders that you have written, and ensure that you double check orders written by other staff when you take over a child's care.



## Abbreviations

D	Dextrose
hr	hour
IV	intravenous
KCl	potassium chloride
kg	kilograms
mg/day	milligram(s) per day
mL/day	millilitre(s) per day
mmol/mL	millimole/millilitre
mmol/L	millimole/litre
NICU	Neonatal Intensive Care Unit
PICU	Paediatric Intensive Care Unit
SIADH	Syndrome of Inappropriate Antidiuretic Hormone Secretion
WCH	Women's and Children's Hospital
WCHN	Women's and Children's Health Network
wt	weight

## Prescribing

- > **Premixed solutions are available and these should be prescribed when IV fluid therapy is required.** ([Appendix 1](#))
- > The name of the IV fluid prescribed should match the name on the IV bag.
  - e.g. glucose NOT dextrose; names in full; no abbreviations or chemical symbols
    - Glucose 5% / sodium chloride 0.9% **NOT** D5% / NaCl 0.9%
- > IV fluids must be prescribed on the Parenteral fluid and drug order chart.
- > Each IV fluid order is valid for administration of a single bag of fluid, or a maximum of 24 hours (whichever is sooner).
  - Review and re-prescribe intravenous fluids at least every 24 hours.
  - It is acceptable to write orders for multiple bags to cover a 24-hour period.
- > Manipulation of standard IV solutions by the addition of concentrated additives (e.g. 1mmol/mL potassium chloride; 50% glucose) should be avoided unless absolutely necessary.
  - The clinical need for any non-standard premixed solutions should be documented in the patient's case notes outside of intensive care settings.

## Administration and Monitoring

- > All intravenous fluids for neonates and children, excluding boluses of fluid used during resuscitation, must be administered via an infusion device (IV pump or syringe driver).
- > Always check IV fluid orders when you take over the patient's care and check that the IV fluid order matches the actual fluid infusing.
- > All paediatric patients on ongoing IV fluids require at a minimum daily electrolyte monitoring.
- > IV fluid bags must never be re-spiked or re-hung.
- > The *National Standard for User-applied Labelling of Injectable Medicines, Fluids and Lines*<sup>17</sup> must be adhered to when preparing intravenous fluids and lines for administration.



## Well children with normal hydration

### How much fluid?

Well children with normal hydration but no oral intake require an amount of fluid that is often termed "maintenance".

The intention to give maintenance fluid is to replace the insensible losses (from breathing, through the skin, and in the stool), and at the same time allows excretion of the daily production of excess solute load (urea, creatinine, electrolytes etc.) in a volume of urine that is of an osmolarity similar to plasma.

A child's maintenance fluid requirement decreases proportionately with increasing age (and weight). The following calculations approximate the maintenance fluid requirement of well children according to weight in kg.

Patients weight (wt)	mL/day	mL/hour
3 – 10kg	100 x wt	4 x wt
10 – 20kg	1000 + 50 x (wt-10)	40 + 2 x (wt-10)
> 20kg	1500 + 20 x (wt-20)	60 + 1 x (wt-20)

**100mL/hour (2500mL/day) is the normal maximum amount.**

The following table may be used to estimate maintenance fluid requirements.

Weight (kg)	4	6	8	10	12	14	16	20	30	40	50	60	70
mL/hr	16	24	32	40	44	48	52	60	70	80	90	100	100

### Which Fluid?

The recommended fluid to be infused as maintenance for well children with normal hydration is:

**0.9% sodium chloride with or without 5% glucose + 20mmol potassium chloride /L**

#### Do NOT use this solution:

- > If the serum potassium is elevated
- > For volume resuscitation
- > For replacement of fluid deficit in dehydrated children
- > For initial treatment of older children with acute neurological conditions (e.g. meningitis)
- > Children who haven't passed urine and/or suspected to have acute renal impairment

See [Monitoring](#) below.



## Unwell children (+/- abnormal hydration)

### How much fluid?

Firstly check for clinical signs of hypovolaemic shock (tachycardia, tachypnoea, prolonged capillary refill > 2 seconds, hypotension) and, if present, administer an initial bolus of fluid to correct.

#### Hypovolaemic shock

**Give boluses of 10-20mL/kg of 0.9% sodium chloride, which may be repeated as clinically indicated for ongoing Hypovolaemic shock.**

**If 40 mL/kg fluid bolus fails to correct Hypovolaemic shock, urgent senior paediatric consultation should be obtained. Vasoactive support may be required in addition to further fluid resuscitation. MedSTAR Kids 136827**

Do not include this fluid volume in any subsequent calculations except for children with Diabetic Keto Acidosis and burns patients where it is included in correction of fluid deficit.

Include fluid volume used to administer medications when calculating the total volume of fluid delivered e.g. antibiotics.

Then calculate:

**Maintenance plus  
Deficit plus  
Ongoing losses**

Unwell children (+/- abnormal hydration) require maintenance fluids. They may also need extra to replace fluid deficit due to dehydration, and possibly more fluid to replace abnormal ongoing losses (e.g. from drain sites).

### Maintenance

Remember that the maintenance fluid volume may need to be adjusted in some unwell children.

Less if in a basal state (i.e. very inactive lying in bed)	-25%
Less in children on mechanical ventilation with humidified gasses	-33%
Less in children with suspected SIADH; excessive secretion of Antidiuretic Hormone, typically from significant intracranial/intrathoracic pathology (e.g. pneumonia, meningitis)	Varies (-20% to 40%)
More in children with high fever and losses	+ 10 to 20%
More if unable to concentrate urine (e.g. some renal diseases, diabetes insipidus)	Varies
Less if children are also being administered medications which also require a volume of fluid	- the volume of fluid



## Deficit

A child's water deficit in ml can be calculated following an estimation of the degree of dehydration expressed as % of body weight (e.g. a 10kg child who is 5% dehydrated has a water deficit of 10kg weight x 5% dehydration x 10 (conversion factor) = 500mLs.

Clinical signs of dehydration give only an approximation of the deficit. Clinical estimation of dehydration is usually inaccurate, even with experienced clinicians. Clusters of signs are more accurate than one or two signs alone.

The following signs have been found to be the most useful:

- > Comparison of body weights – may be available particularly in repeat presentations
- > Reduced skin turgor (prolonged time for pinched skin fold to return to normal)
- > Increased capillary refill time
- > Abnormal respiratory pattern
- > Sunken eyes

## Assessment of Degree of Dehydration

	None or minimal	Mild-moderate	Severe
% Body Weight Loss	< 5% loss	5-9% loss	>9%loss
Clinical signs	None or minimal	<ul style="list-style-type: none"><li>&gt; Thirst</li><li>&gt; Sunken eyes with minimal / no tears</li><li>&gt; Dry mucous membranes (not accurate in mouth breather)</li><li>&gt; Irritability or restlessness</li><li>&gt; Mild tachycardia</li></ul>	Signs from mild – moderate group (more marked) plus: <ul style="list-style-type: none"><li>&gt; Abnormal drowsiness or lethargy</li><li>&gt; Capillary refill &gt;2seconds</li><li>&gt; Poor peripheral perfusion</li><li>&gt; Tachycardia and tachypnoea</li><li>&gt; “Acidotic” breathing (deep rapid breaths)</li></ul>
Pinch test for skin turgor	Normal (retracts immediately)	Slow Skin fold visible up to 2 seconds	Very slow Skin fold visible more than 2 seconds

The deficit is replaced over a time period that varies according to the child's condition.

Replacement may be rapid in most cases of gastroenteritis (refer to gastroenteritis clinical guidelines) (although usually this is best achieved by oral or nasogastric fluids), but should be slower in diabetic ketoacidosis and meningitis, and much slower in states of hypernatraemia (aim to rehydrate over 48 to 72 hours, the serum sodium should not fall by >1mmol/litre/hour).

## Ongoing losses (e.g. from drains)



These are best measured and replaced - calculations may be based on each previous hour, or each 4 hour period depending on the situation. 0.9% sodium chloride may be sufficient, or 4% albumin may be used if sufficient protein is being lost to lower the serum albumin. See Burns (paediatric) guideline for additional losses from burns at [SA Health Practice Guideline App](#).

## Which Fluid?

Options of fluid solutions for sick children include:

1. 0.9% sodium chloride with 5% glucose is suitable as the standard fluid therapy.
2. 0.9% sodium chloride should be used as a bolus in treatment of hypovolaemic shock and is also suitable for ongoing fluid therapy in older children with normal BGL.

**\* Premade solutions with potassium chloride 20mmol/L are available and should be used unless the serum potassium is elevated.**

The choice of solution is a matter of individual circumstances, the patient's age, serum sodium and glucose.

**If in doubt, use 0.9% sodium chloride with 5% glucose is to be used in most circumstances. Do not use in resuscitation situations.**

**If the patient is hyper / hyponatraemic (serum Na more than 150 or less than 130) consult a Senior Medical Officer for advice as a change in fluid and/or rate may be appropriate.**

## Monitoring

All children on IV fluids should ideally be weighed prior to the commencement of therapy and then measure weight daily after that. Children with ongoing dehydration may need regular weights to assess hydration status. Ensure you request this on the treatment orders.

Serum electrolytes and glucose should be checked preferably before commencing the infusion (typically when the IV is placed). Recommended to be repeated at least every 24 hours if IV therapy is to continue. Seek senior medical help if electrolytes are deranged.

For sick children, check the electrolytes and glucose 4-6 hours after commencing, and then according to results and the clinical situation but at least daily.

Hyperchloraemia may occur with prolonged use of sodium chloride 0.9%. In adults, this has been associated with adverse effects on renal function. Alternative fluids such as Hartmann's solution or Plasmalyte-148 can be considered.



## Newborns

Newborns (especially those born pre-term) have greatly increased water loss via the skin.

### Where intravenous fluids are required the following are recommended:

- > Resuscitate with 0.9% sodium chloride
  - > Birth to Day 2: 10% glucose
  - > Day 3 to Day 28: 10% glucose, 0.225% sodium chloride 10mmol potassium chloride /500mL.
- This formulation run at a rate of 120mL/kg/day will provide:
- 4.6 mmol/kg/day of sodium, and
  - 2 mmol/kg/day of potassium.

Standard fluid rates for term newborn according to day of life are: D1: 60 mL/kg/day; D2: 80 mL/kg/day; D3: 100 mL/kg/day; D4: 120 mL/kg/day and D5 onwards: 150mL/kg/day.

For neonates < 32 weeks parenteral nutrition should commence as soon as possible preferable within an hour of birth.

## Special Fluids

Outside the newborn period, do not use these fluids apart from exceptional circumstances and check the serum sodium regularly

### 10% glucose

- > May be required in some patients under 12 months (with 0.45% saline).
- > Used for urgent treatment of hypoglycaemia in children (2mL/kg)
- > Sometimes used by infusion in neonates and children with metabolic disorders.
- > Check blood glucose regularly.

### 15-20% glucose

- > Very occasionally used by infusion in children with metabolic disorders.
- > Check blood glucose regularly.
- > Always follow guidance from the WCH treating team or from the retrieval service.

### 25% and 50% glucose

- > Should not be used outside of PICU & NICU, except for some metabolic patients.
- > Check with consultant before prescribing.
- > Usually administered by low volume (1-2mL/hour) infusion to correct hypoglycaemia.
- > Check blood glucose frequently.
- > If using glucose concentrations >10% for a prolonged period, these should be administered via a central line.



## IV Fluid Bags / Size / Labelling

It is strongly recommended that pre-packaged bags of appropriate IV fluids are available and used with the correct concentrations of sodium, glucose and potassium.

Beyond the neonatal period, the use of pre-packaged 1000mL bags is the statewide recommended standard of practice. If other pre-packaged fluid volumes such as 500mL are stocked in that hospital, they may be used until that hospital changes to the recommended standard.

The content of the IV fluid bag will be clearly indicated in an easy to read font and on a prominent location on the IV fluid bag. Suitability for use in children will be indicated, where appropriate.

IV fluids containing potassium chloride will separately identify this as an additive and in red font.

IV fluids containing 0.225%, 0.22% or 0.18% sodium chloride will include a warning regarding low sodium content.

## Pumps

It is highly recommended that an appropriate administration system of IV fluids be used in resuscitation to ensure specific fluid boluses may be rapidly delivered.

It is highly recommended that a **Paediatric infusion set with an inline burette must be used for all children requiring non resuscitative intravenous therapy. An infusion pump should be used in all children.** These aspects of the prior Policy Directive are maintained and strongly reinforced.

Current settings where variations of this policy are recognised include: Ambulance Service of SA, operating theatres and acute resuscitation scenarios.

**In all age groups, infusion pumps are recommended to be used with high risk fluids, for example fluids containing potassium chloride.**



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- > NSW Health: Standards for Paediatric Intravenous Fluids (second edition)<sup>18</sup>
- > The Royal Children's Hospital Melbourne: Intravenous fluids Clinical Practice Guideline<sup>19</sup>

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