

Guideline

Intravenous Fluid Guidelines – Paediatric and Neonatal*

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Purpose

This Guideline provides recommendations regarding best practice for intravenous fluid therapy in paediatric patients and in neonatal patients* re-attending hospital/health services post discharge/transfer from maternity units.

This guideline is intended to assist staff prescribe and administer intravenous fluids appropriately. It is NOT intended to replace consultation with senior staff, which should always be sought if clinically relevant.

Scope

This guideline applies to all Children's Health Queensland (CHQ) Hospital and Health Service clinical staff working with paediatric patients and neonatal patients* attending hospital post discharge/transfer from maternity units that require intravenous fluid therapy.

*This guideline is for use in neonates presenting to Emergency Department or being readmitted under a paediatric facility/service, but is not intended to be used for neonates admitted in Neonatal Intensive Care Units or specialised maternity services (where unit specific guidelines should be followed). Where a neonate is transferred to CHQ (generally from a maternity/neonatal facility), the referring consultant should provide a written handover of the plan for intravenous fluid therapy.

This guideline has been developed for use at the Lady Cilento Children's Hospital but has applicability to any paediatric patient or neonate* under the care of a Queensland Health facility, outside of specialised care areas, that requires intravenous fluid therapy. Facilities treating these patients/with potential to treat these patients should conduct a review of intravenous fluids available for use in paediatric and neonatal patients and obtain local endorsement of this document through their local Medicines Advisory Committee.

This guideline is not intended for conditions where parenteral fluid therapy is more complex than outlined below. For the following conditions please refer to clinical practice guidelines for the specific conditions and consult with the relevant specialist medical or surgical unit.

- [Diabetic ketoacidosis](#)
- Burns
- Metabolic disease
- Renal failure
- Liver failure
- Pyloric stenosis
- Oncology Hyperhydration
- [Management of Paediatric Shock](#)
- [Gastroenteritis: Emergency Management in Children.](#)

Related documents

Procedures, Guidelines, Protocols

- CHQ Guidelines for the for the prescribing and administration of Intravenous and Oral Potassium http://qheps.health.qld.gov.au/childrenshealth/resources/dug/docs/DUG_Potassium.pdf
- Medication Safety Alert - Intravenous Potassium Can be Fatal if Given Inappropriately http://qheps.health.qld.gov.au/medicines/documents/general_policies/potass_chloride_alt.pdf

Forms and templates

- Paediatric Intravascular and Subcutaneous Fluid Order Form. See [Clinical Forms Catalogue](#)
- [CHQ 24 Hour Paediatric Fluid Balance Chart](#)

General Principles

- Intravenous fluid therapy is a high risk activity in the paediatric population. Incorrect prescription or administration of intravenous fluids has caused harm and deaths in children.
- Use the enteral route for fluid replacement where possible. Patients fasting for general anaesthesia or non-conscious sedation can drink clear fluids until two hours pre-anaesthesia. Refer to [CHQ Fasting Guideline](#).
- Always check intravenous fluid orders written by other staff when you take over the patient's care and check that the prescribed intravenous fluid order matches the actual fluid infusing with staff when accepting care of the child or at handover of care.
- Careful clinical monitoring and review is key to safe use of intravenous fluids. All paediatric patients on intravenous fluids will have minimum daily electrolyte monitoring.
- Use of intravenous fluid with a sodium concentration of 140mmol/L has a lower risk of hyponatraemia than fluids containing less than 140mmol/L sodium.
- Communicate any concerns promptly to the child's consultant, particularly if the child develops hyponatraemia (Serum sodium less than 135mmol/L) or hypernatremia (Serum sodium greater than 145mmol/L).

- Prescribe Intravenous fluids on the Queensland Health Paediatric Intravascular and Subcutaneous Fluid Order Form, (or electronic prescribing system e.g. Metavision) reviewing and renewing orders at least daily.
- Each intravenous 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.
- Prescribe pre-mixed solutions rather than compounding from base solutions and making additives.
- When prescribing intravenous medications, consider the type and total volume of fluid administered with the medication, and the contribution of this fluid to the risk of hyponatraemia for the patient.
- If a paediatric patient has required intravenous fluids for five days and is not able to receive sufficient nutrition through the enteral route, consider referral to dietician for assessment of requirement for parenteral nutrition.

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Medication Safety Initiatives for intravenous fluid prescribing and administration.

- Lady Cilento Children's Hospital has standardised on the provision of 1000mL sized Intravenous Fluid Bags to the clinical areas within our paediatric service. Rarely, 500mL bags are provided to specialised areas where neonates are treated, and where this occurs the bags are overlabelled with a fluorescent "500mL bag" label.
- The use of intravenous pumps (with medication safety software) is mandated for patients at Lady Cilento Children's Hospital receiving intravenous fluid therapy. In addition, the use of an inline burette is recommended for all intravenous fluid therapy as an additional safety mechanism.
- Never re-spike or re-hang an intravenous fluid bag. Consider supply/purchase of intravenous bags and lines that do not allow respiking.
- The [National Standard for User-applied Labelling of Injectable Medicines, Fluids and Lines](#) must be adhered to when preparing intravenous fluids and lines for administration.
- All clinicians administering intravenous fluid will perform an independent second check of the six rights of administration prior to administration and at handover of care. The check will include patient identification, the patency of the intravenous access, type of intravenous fluid, calculated rate, pump settings and recent pathology results.



Paediatric and Neonatal* Fluids

Assessment of fluid requirements: Unwell children (+/- abnormal hydration)

Hypovolaemia

If required, administer initial bolus/(es) of fluid to correct intravascular depletion.

- Administer **10-20mL/kg of Sodium Chloride 0.9%** and assess response promptly. Dose may be repeated. Use **20mL/kg** if patient is suffering shock.
- Consider **10-20mL/kg of Albumin 4%**, based on the patient's clinical condition, in conjunction with the patient's medical consultant.

Total Volume Required Daily:

- **Maintenance requirement**, plus **Deficit volume**, plus **Replacement of significant ongoing losses**

Calculating Maintenance fluid requirement:

Maintenance Fluid is

- Daily fluid intake which replaces the insensible losses (from breathing, through the skin, and in the stool)
- Allows excretion of the daily solute load (products of metabolism)
- Volume is calculated according to the schema described below.

Maintenance fluid requirement needs to be carefully considered and individualised for all children. High levels of anti-diuretic hormone (ADH) are common in children being treated with IV fluids in an acute care setting. Adjustments to the maintenance fluids will be required in these patients. Conditions associated with high levels of anti-diuretic hormone (ADH) include:

- Central nervous system injury,
- Bacterial meningitis,
- Respiratory distress eg pneumonia,
- Infection,
- Post surgery patients eg with pain, nausea or narcotic administration.

In non-dehydrated children with these conditions, consider using 2/3 of maintenance volume, especially those with pneumonia or meningitis

Maintenance Fluid Calculation

Patient Weight	Maintenance Fluid mL/hour
3-10kg	4 x weight
>10kg-20kg	40 plus 2 x (weight-10)
>20kg	60 plus 1 x (weight – 20)
Maximum: 100mL/hour (2400mL/day)	

Fluid Deficit

Children with dehydration require replacement of the fluid deficit. The degree of dehydration is expressed as a percentage of body weight. The most accurate method of assessing the degree of dehydration is comparing a current weight to a recent weight; however, often the latter is not available.

Signs of dehydration include:

- Decreased peripheral perfusion (prolonged capillary refill time)
- Decreased tissue turgor
- Abnormal rapid or deep breathing
- Increased thirst.

The degree of dehydration can be classified:

Degree	%	Clinical Signs
Mild / none	<4%	No clinical signs
Moderate	4-6%	Some physical signs. Individual signs mildly or moderately abnormal
Severe	>7%	Multiple physical signs. Individual signs may be markedly abnormal. May develop hypotension and acidosis.

The time period used to replace the deficit varies according to the condition of the patient.

Fast Rehydration

- In patients with mild to moderate dehydration from Gastroenteritis, rapid re-hydration may be required in the Emergency Department. Refer to [Gastroenteritis: Emergency Management in Children](#)
- Administer 50mL/kg of Sodium Chloride 0.9% with 5% Glucose over a period of four hours.

Slow/very slow rehydration

Slow re-hydration, over at least 24 hours is required for:

- Meningitis

Very slow re-hydration, over 48 hours is required for:

- Severe diabetic ketoacidosis
- Hyponatremia
 - The fall in sodium should not be more than 1mmol/L/hr.

Formula for Calculating Fluid Deficit:

Fluid deficit (mL) = % dehydration* X weight (kg) X 10

*% dehydration as determined;

(a) clinically (see above) **OR**

(b) weight change – $\frac{\text{Previous weight} - \text{current weight}}{\text{previous weight}} \times 100$

Sample Calculation of Fluid Requirement

A 10kg child with no ongoing losses who is estimated to be 5% dehydrated requires IV fluid therapy.

1. Calculate Fluid Deficit

Fluid deficit = 5 (%dehydration) X 10 (weight in kg) X 10 = 500mL.

If choosing to replace the deficit over 24 hours, this equates to 20mL/hr (rounding for ease of measuring) which is added to the child's maintenance hourly fluid rate.

2. Calculate Maintenance hourly fluid rate

Maintenance rate (mL/hr) = 40 plus [2x (weight -10)]

This gives a maintenance rate of 40mL/hr

3. Consider additional fluid replacement if significant ongoing losses

- An increased rate of fluid administration is required in patients with significant ongoing losses (eg severe gastroenteritis, patients with drain losses, ileostomies, or high fever)
- Sodium Chloride 0.9% is the appropriate fluid to use for replacement of ongoing losses in most situations.

4. Calculate Total hourly fluid rate.

Adding (1) and (2) together (nil required for 3.) gives a total hourly rate 60mL/hr for the first 24 hours. This provides a starting point for intravenous fluid therapy which should be reassessed over time.

Which Fluid to Use:

Suitable choices for paediatric and neonatal* patients are:

Fluid*	Alternate Name	Uses
0.9% Sodium Chloride	Normal Saline* NaCl*	Initial boluses
0.9% Sodium Chloride (20mmol/L Potassium premix available 40mmol/L Potassium premix available)	Normal Saline* NaCl*	Replacement of deficit Replacement of losses
0.9% Sodium Chloride with 5% Glucose (20mmol/L Potassium premix available)	Normal Saline with 5% Glucose*	Maintenance
Compound Sodium Lactate Solution	Hartmann's Solution	Routine post-operative fluid Replacement of deficit

(contains 5mmol/L Potassium)		Acutely unwell
Compound Sodium Lactate with 5% Glucose (contains 5mmol/L Potassium)	Hartmann's Solution with 5% Glucose	Routine post-operative fluid Replacement of deficit Acutely unwell
Electrolyte Replacement Solution (Baxter Plasmalyte-148) (contains 5mmol/L Potassium)	Plasmalyte-148	Replacement of deficit Maintenance
Electrolyte Replacement Solution with 5% Glucose (Baxter Plasmalyte-148 with 5% Glucose) ## (contains 5mmol/L Potassium)	Plasmalyte-148 with 5% Glucose ##	Maintenance

***Always prescribe by the full fluid name rather than the alternate name to avoid confusion.**

The alternate name is error prone and not approved terminology and should not be used. Nursing staff may refuse to administer fluids where the prescribed name does not match the description on the fluid bag.

The electrolyte content of these suitable fluids is available in [Appendix 1: Electrolyte content of commonly used intravenous fluids](#)

Where medication is being administered by the intravenous route, check compatibility of intravenous medication with the prescribed intravenous fluid prior to administration.

Plasmalyte-148 with 5% Glucose (Baxter) is not on the List of Approved Medicines for Queensland Health. Note: Limited medication/fluid compatibility information is available for Plasmalyte-148 and Plasmalyte-148 with 5% Glucose. Prescribers must take this into consideration before prescribing these fluids.

Review the patient's potassium levels and consider the need for additional potassium. Premixed solutions containing Potassium Chloride are available and should be used in preference to adding concentrated potassium to intravenous bags. Refer to [CHQ Guidelines for the Prescribing and Administration of Intravenous and Oral Potassium](#).

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Risk of Hyponatraemia

Hyponatraemia caused by excess administration of solutions with less than 140mmol/L of sodium (hyponatraemic) intravenous fluid is a well described, potentially fatal iatrogenic complication of intravenous fluid therapy.



There are three (3) strategies aimed at preventing this complication.

- Adjusting maintenance fluid rates in acute illness (see above)
- Avoiding hypotonic intravenous fluids in children
- Monitoring the serum sodium

In most circumstances, intravenous fluid administered to children should have a minimum sodium concentration of 125mmol/L.

The following solutions are no longer recommended. Do not use:

- 0.3% Sodium Chloride with 3% glucose (for general patients)
- 0.18% Sodium Chloride with 4% glucose with potassium 20mmol/L
- 0.18% Sodium Chloride with 5% glucose
- 0.225% Sodium Chloride with 10% glucose
- 0.18% Sodium Chloride with 8% Glucose (RBWH Brisbane Neonatal 20/80 Solution)

The following solutions can be used in specialised clinical units under medical consultant supervision with caution and frequent monitoring:

- 0.45% Sodium Chloride with 5% Glucose - 77mmol/L Sodium – renal and specialised medical/oncology units only
 - 0.3% Sodium Chloride with 3% Glucose – specialist oncology centres during administration of high dose methotrexate under an approved chemotherapy protocol only.
-

Monitoring Required:

Weight:

- Weigh the child before commencing therapy with intravenous fluids and daily thereafter. Document this requirement in treatment plan and document the weight on the P-NIMC and in ieMR.
- Weigh infants bare and aim to weigh at children at the same time each day, wearing the same amount of clothing.
- Where possible use the same scales to weigh in-patients with ongoing intravenous fluid therapy needs.
- Weigh the child twelve hourly if they have ongoing dehydration/ongoing losses to assess hydration status.

Fluid Balance

- Children on intravenous fluids should have a fluid balance chart documenting input, ongoing losses and urine output.
- The fluid balance chart will be totalled at least every six to twelve hours and significant imbalances will be escalated to the medical officer.
- The volume of fluid with which medications are further diluted should be considered in the context of the child's total fluid requirements. This is particularly applicable to neonates, children who are fluid restricted and to children who are receiving their entire fluid requirements by the intravenous route.

Electrolytes

- All paediatric patients receiving intravenous fluids will have serum electrolytes and glucose monitored prior to commencement of the infusion (typically when the line is placed) and at least every 24 hours while the intravenous therapy is delivered.
- For unwell children, check the electrolytes and glucose 4 - 6 hours after commencing, and then according to results and the clinical situation, adjust the frequency, but check at least daily.

- Pay particular attention to the serum sodium on measures of electrolytes. If serum sodium is less than 135mmol/L (or falling significantly on repeat measures) or greater than 145mmol/L, escalate to treating Consultant.

Consultation

Key stakeholders who reviewed this version:

- Medical Lead, Patient Safety
- Director Oncology Services and Paediatric Oncologists
- Director of Emergency Department and ED Consultants
- Executive Director Critical Care Services and Intensive Care Consultants
- Director of Anaesthetics
- Director of Cardiology
- Director of Medical Services and General Paediatrician
- Executive Director Medical Services
- Executive Director Surgical Services
- Executive Director Nursing Services
- Director of Pharmacy
- Pharmacist Consultant, Pharmacist Safety and Quality, Pharmacist Medication Safety, Pharmacist Lead – Critical Care
- Medication Safety Officer, Medicines Regulation and Quality, Queensland Health

Definition of terms

Term	Definition	Source
NaCl	Chemical Symbol for Sodium Chloride. Error prone abbreviation not recommended for use.	Periodic Table
K	Chemical Symbol for Potassium. Error prone abbreviation not recommended for use.	Periodic Table
Dextrose	Outdated terminology to describe Glucose. Not recommended for use in relation to intravenous therapy	British Pharmacopoeia
Neonate	A term baby less than 30 days old	General definition
Neonate*	A neonate presenting to Emergency Department or being readmitted under a paediatric facility/service, excluding neonates admitted in Neonatal Intensive Care Units or specialised maternity services.	Consensus of IV fluid working group

References and suggested reading

Suggested Reading

- Keijzers, G. McGrath, M, Bell, C. (2012), 'Survey of paediatric intravenous fluid prescription: Are we safe in what we know and what we do?,' *Emergency Medicine Australia*, **Vol. 24**, pp.86-97.
 - Includes a quiz to test knowledge on intravenous fluid prescribing

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Guideline revision and approval history

Version No.	Modified by	Amendments authorised by	Approved by
1.0 (2010)	Quality Use of Medicines Pharmacist RCH	RCH Drug and Therapeutics Committee	Chief Operating Officer
2.0 (2013)	Intravenous Fluids Working Group RCH	RCH Medicines Advisory Committee	General Manager Operations
3.0	Pharmacist- Advanced Safety and Quality LCCH/ Intravenous Fluid Working Group	CHQ Medicines Advisory Committee	Executive Director Hospital Services

Keywords	Intravenous fluids, IV fluids, Plasmalyte, sodium chloride, Hartmann's, sodium, potassium, Glucose 5%, normal saline, saline, hyponatraemia, hypovolemia, fluid deficit, ongoing losses, 80-20, 80/20,
Accreditation references	NSQHS Standards (1-10): Standard 4 – Medication Safety EQulPNational Standards (11-15): Standard 15 –Corporate Systems and Safety

Appendix 1: Electrolyte content of commonly used intravenous fluids

Appendix 2: Recipes for Preparation of Specialised IV fluid bags

Appendix 3: Neonatal 80-20 Intravenous Fluid Mix – Not recommended for routine use

Appendix 1 Electrolyte content of commonly used intravenous fluids

Electrolyte content of intravenous fluids available at LCCH (Bag labels show approximate content)

Fluid	Na (mmol/L)	Cl (mmol/L)	K (mmol/L)	Ca (mmol/L)	Lactate (mmol/L)	Magnesium (mmol/L)	Acetate (mmol/L)	Gluconate (mmol/L)	Glucose (%)	Osmolality (mOsm/L)
0.9% Sodium Chloride	154	154	0	0	0	0	0	0	0	300
0.9% NaCl with 5% Glucose	154	154	0	0	0	0	0	0	5	578
0.9% NaCl with 5% Glucose and 20mmol/L Potassium	154	174	20	0	0	0	0	0	5	626
Compound Sodium Lactate (Hartmann's)	131	111	5	2	29	0	0	0	0	274
Compound Sodium Lactate (Hartmann's) with 5% Glucose	131	111	5	2	29	0	0	0	5	552
0.45% Sodium Chloride with 5% Glucose and 20mmol/L Potassium*	77	97	20	0	0	0	0	0	5	471
0.45% Sodium Chloride with 5% Glucose*	77	97	0	0	0	0	0	0	5	428
Electrolyte Replacement – Plasmalyte 148	140	98	5	0	0	1.5	27	23	0	271
Electrolyte Replacement – Plasmalyte 148 with 5% Glucose	140	98	5	0	0	1.5	27	23	5	584

***Note:** This fluid is not a first line agent due to risk of hyponatraemia in patients receiving fluids with a sodium concentration below 125mmol/L

Appendix 2 Recipes for Preparation of Specialised IV fluid bags

This table provides guidance on specifically the preparation of commonly-used intravenous fluids in paediatric and neonatal* patients. Where possible, use a pre-prepared bag of intravenous fluid, rather than mixing components. Where you are considering mixing, consider whether the closest match to the required electrolytes in a pre-prepared bag would be suitable.

Refer to related documents for prescribing, administration and monitoring instructions.

- Note: The recommendations in this document are generally based on the preparation of a 1 litre volume of fluid ordered. Pre-prepared intravenous fluid bags contain some overage* that may adjust the exact concentration of the final solution. As this overage is not significant, it will not be considered in the preparation of the final concentration.
- The following is intended as a guide only. Specialist advice should be sought if necessary.

Fluid Ordered 1000mL	Available as premade bag	Starting Fluid			Additive		Final Volume after mixing*
		Starting Fluid	Volume required	Volume to Remove and discard	Additive	Volume to add	
Sodium Chloride 0.9% with Glucose 5%	Use premade bag (AHB1064)						
Sodium Chloride 0.9% with Glucose 10%	No	Sodium Chloride 0.9% (AHB1324)	1000mL*	200mL	Glucose 50%	200mL	1000mL
Sodium Chloride 0.9% with Glucose 5% and Potassium Chloride 20mmol	Use premade bag (AHK6066)						
Sodium Chloride 0.9% with Glucose 5% and Potassium Chloride 40mmol	No	Sodium Chloride 0.9% with potassium chloride 40mmol/L (AHK6034)	1000mL*	100mL	Glucose 50%	100mL	1000mL
Sodium Chloride 0.9%	No	Sodium Chloride 0.9% with	1000mL*	100mL	Glucose 50%	100mL	1000mL

Fluid Ordered 1000mL	Available as premade bag	Starting Fluid			Additive		Final Volume after mixing*
		Starting Fluid	Volume required	Volume to Remove and discard	Additive	Volume to add	
with Glucose 10% with Potassium Chloride 20mmol/L		glucose 5% and Potassium chloride 20mmol/L (AHK6066)					
Sodium Chloride 0.9% with Glucose 10% with Potassium 40mmol/L	No	Sodium Chloride 0.9% with Potassium 40mmol/L (AHK6034)	1000mL*	200mL	Glucose 50%	200mL	1000mL
Sodium Chloride 0.9% Glucose 12.5%	No	Sodium Chloride 0.9% (AHB1324)	1000mL	250mL	Glucose 50%	250mL	1000mL

Appendix 3 Neonatal 80-20 Intravenous Fluid Mix – Not recommended for routine use

- **Neonatal 80-20 Intravenous fluid mix is not recommended for routine use:**

- It should only be prescribed and administered to neonates (from day 3 of life), transferring from a specialised Neonatal facility to LCCH, in the immediate post-transfer period, and on the instruction of the transferring Neonatologist.
- At initial intravenous fluid review post-transfer, the medical consultant should review the use of this fluid, and prescribe a fluid suitable for the patient from the list of recommended choices in the body of this guideline.

- **Use of Neonatal 80-20 Intravenous fluid is considered HIGH RISK because:**

- The low sodium concentration of the solution increases the risk of hyponatraemia in the neonate, and
- There is significant potential for error in interpretation of the order and preparation of the solution.

- Where this fluid is used in a neonate in the immediate post-transfer period:

- Prescribe as Sodium Chloride 0.18% with Glucose 8% (Neonatal 80-20 Mix) 50mL, with an appropriate rate of administration (as per transferring Neonatologist handover).
- Preparation: Neonatal 80-20 Intravenous Fluid is a ward-prepared admixture (not available as a pre-mixed fluid) containing:

Glucose 10%	80%
Sodium Chloride 0.9%	20%

- The final concentrations in the solution are Sodium Chloride 0.18% and Glucose 8%.
- Reconstitution/Dilution instructions are as follows:

Fluid Ordered	Available as premade bag	Starting Fluid			Additive		Final Volume after mixing*
		Starting Fluid	Volume required	Volume to Remove and discard	Additive	Volume to add	
Sodium Chloride 0.18% with Glucose 8% (Neonatal 80/20 Mix)	No	Glucose 10% (AHB0164)	40mL (withdraw using syringe suitable for syringe driver)	Remainder of bag	Sodium Chloride 0.9%	10mL	50mL

- Administer via syringe driver

Additional Information – Neonatal 80-20 Intravenous Fluid

- Published literature clearly defining the best choice for concentration of sodium chloride in intravenous fluid for ongoing fluid replacement in neonates readmitted to hospital is lacking.
- Specialist advice should be obtained for the ongoing fluid requirement for all neonatal patients.
- Expert opinion (NSW Health Standards for Paediatric Intravenous Fluids 2nd Edition) expresses concern over the ability for neonates to process the sodium content (0.9%) of the intravenous solutions available for paediatric patients at LCCH, however using a lower sodium concentration replacement fluid (0.225% or 0.18%) increases the risk of hyponatraemia and should be avoided.
- The use/preparation of lower sodium chloride/higher glucose concentrations through mixing fixed proportions of readily available solutions is error prone and has been shown to increase risk. Areas using/requiring these mixes must contact their pharmacy. Where appropriate and where available, a pre-prepared intravenous bag may be sourced and quarantined to dedicated areas within the unit.

References and suggested reading

1. NSW Kids and Families.(August 2015) 'Standards for Paediatric Intravenous Fluids: NSW Health (second edition) GL2015_008. Available at: http://www0.health.nsw.gov.au/policies/gl/2015/pdf/GL2015_008.pdf
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