Ashford and St. Peter's Hospitals
NHS Foundation Trust

Intravenous Fluid Guidelines for Children aged 0-17 years

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Guideline History		
Date	**Comments**	**Approved By**
Nov 2016	First created by Dr Fiona Maccarthy	
July 2024	Review and update by Dr Panniker & Dr Hyde	

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Use of this Guideline

This guideline provides information about IV fluids for paediatric patients in the emergency department or on the paediatric ward. This guideline is not to be used for patients in DKA (diabetic ketoacidosis) - please refer to the separate BSPED DKA guidelines.
For patients on the neonatal unit, please refer to neonatal guidelines.

Consider whether IV Fluids are Necessary

Intravenous fluids should be used when a child or young person is unable to take adequate amounts by mouth eg due to vomiting or when made nil-by-mouth. There are risks to intravenous fluid infusions, which can cause morbidity and mortality. Therefore, oral or enteral (eg PEG or PEGJ) fluids are preferable if patients are able to tolerate these.

Signs and Symptoms of Dehydration and Shock

These should be used for initial assessment and monitoring of response to fluid treatment:

→ Increasing severity of dehydration			
	No clinically detectable dehydration	**Clinical dehydration**	**Clinical shock**
Symptoms	Appears well	Appears to be unwell or deteriorating	–
	Alert and responsive	Altered responsiveness (for example, irritable, lethargic)	Decreased level of consciousness
	Normal urine output	Decreased urine output	–
	Skin colour unchanged	Skin colour unchanged	Pale or mottled skin
	Warm extremities	Warm extremities	Cold extremities
Signs	Alert and responsive	Altered responsiveness (for example, irritable, lethargic)	Decreased level of consciousness
	Skin colour unchanged	Skin colour unchanged	Pale or mottled skin
	Warm extremities	Warm extremities	Cold extremities
	Eyes not sunken	Sunken eyes	–
	Moist mucous membranes (except after a drink)	Dry mucous membranes (except for 'mouth breather')	–
	Normal heart rate	Tachycardia	Tachycardia
	Normal breathing pattern	Tachypnoea	Tachypnoea
	Normal peripheral pulses	Normal peripheral pulses	Weak peripheral pulses
	Normal capillary refill time	Normal capillary refill time	Prolonged capillary refill time
	Normal skin turgor	Reduced skin turgor	–
	Normal blood pressure	Normal blood pressure	Hypotension (decompensated shock)

(Taken from NICE NG29: Intravenous fluid therapy in children and young people in hospital)

Fluid Boluses

For fluid boluses, use 10ml/kg of either 0.9% Sodium chloride or Hartmann's solution or Plasma-Lyte.
Hartmann's solution is contraindicated if K>5.5mmol/L or in hyperlactaemia.

Maintenance Fluid for Infants, Children & Young People

Fluid Volume

For children and young people, the Holliday-Segar formula should be used to calculate the maintenance volume required over a 24 hour period:

100ml/kg/day for the first 10kg of weight
+ 50ml/kg/day for the next 10kg
+ 20ml/kg/day for the weight over 20kg

For patients over 45kg, be aware that over a 24-hour period, males rarely need more than 2,500 ml and females rarely need more than 2,000 ml of fluids.

For example, for a child weighing 23kg:

100ml/kg/day for the first 10kg of weight:	100 x 10 = 1000ml
+ 50ml/kg/day for the next 10kg:	50 x 10 = 500ml
+ 20ml/kg/day for the weight over 20kg:	20 x 3 = 60ml
Total maintenance fluid	= 2100ml over 24 hours

Smaller volumes may be required in children with pre-existing medical conditions eg cardiac or renal disease. If there is a risk of water retention associated with non-osmotic antidiuretic hormone (ADH) secretion, consider restricting fluids to 50–80% of routine maintenance needs. ADH is frequently elevated post-op and in acute illness (eg bronchiolitis, pneumonia, asthma) or with other stimuli such as pain, fever, nausea, vomiting, stress or drugs (including NSAIDs, opiates)

Fluid Type

Use isotonic crystalloid fluids for maintenance fluids. Isotonic fluids include:

0.9% Sodium chloride
0.9% Sodium chloride + Glucose 5% or 10%
0.9% Sodium chloride + Glucose 5% or 10% + Potassium chloride 0.15% or 0.3%
Hartmann's solution
Plasma-Lyte

The standard IV maintenance fluid is 0.9% Sodium chloride + 5% Glucose.

Do NOT use hypotonic fluids (eg sodium chloride 0.45%) except in very rare circumstances under explicit specialist advice (eg renal or metabolic). There is a risk that these can cause hyponatraemia and cerebral oedema.
See the appendix for more detailed information on tonicity of IV fluids.

Potassium in maintenance fluids

- It is not necessary to add potassium if IV maintenance is for short duration only (<12 hours) and serum potassium is normal
- If the patient is going to receive IV maintenance for more than 12 hours or there are concerns about potassium loss (eg diarrhoea) then potassium should be included
- Ready-made bags of potassium-containing fluid should be used if possible. These come as potassium chloride 10mmol in 500ml (equivalent to potassium chloride 0.15%) or potassium chloride 20mmol in 500ml (equivalent to potassium chloride 0.3%). If no appropriate ready-made bag is available, sodium and/or glucose may be added to potassium-containing fluid if deemed necessary by a senior clinician and with guidance from pharmacy.
- The maximum concentration of potassium that can be given by peripheral venous access is 20mmol in 500ml. More concentrated solutions require central access.

Glucose concentration

- Should be adjusted as required
- Children older than 18 months may develop hyperglycaemia on 5% Glucose solutions and may need only 0.9% Sodium chloride, with ongoing glucose monitoring
- Children with inborn errors of metabolism may require higher glucose concentrations
- Glucose solutions of greater than 12.5% require infusion via central venous access

Maintenance Fluids for Neonates

Calculate routine maintenance IV fluid rates for term neonates according to their age, using the following as a guide:

From birth to day 1:	60 ml/kg/day
Day 2:	70 to 80 ml/kg/day
Day 3:	80 to 100 ml/kg/day
Day 4:	100 to 120 ml/kg/day
Days 5 to 28:	120 to 150 ml/kg/day

Smaller volumes may be required in children with pre-existing medical conditions eg cardiac or renal disease or acute illness with risk of SIADH.

For neonates aged 0-7 days, the sodium content of 0.9% Sodium chloride may be too high or sodium may not be needed. It may be appropriate to start with maintenance of 10% Glucose. Electrolytes can be added to 10% Glucose. Usual requirements for term babies from day 3 of life with normal electrolytes are:

Sodium 3 mmol/kg/day
Potassium 2 mmol/kg/day

This is a guide and in some clinical circumstances, requirements may be different.

For term neonates aged 8 days or over, it is appropriate to initially use 0.9% Sodium chloride + 5% or 10% Glucose.
Be aware that glucose concentrations of greater than 10% may be required in neonates.

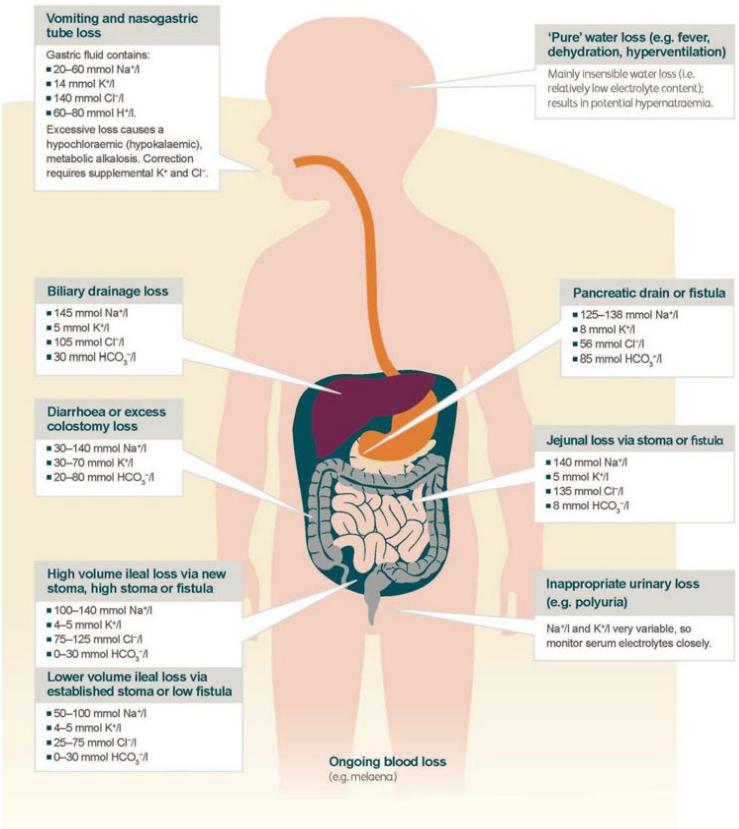
Monitoring while on Maintenance Fluids

1) Fluid balance – Fluid input and output should be documented hourly and fluid balance should be calculated every 12 hours and reviewed at the ward round.
2) Weight – Body weight should be measured daily.
3) Clinical assessment – clinical re-assessment of the current hydration status and whether oral fluids can be started should be performed 12 hourly.
4) Blood tests – Measure blood glucose and serum electrolytes including sodium and potassium when starting IV fluids then at least every 24 hours. Bloods should be measured more frequently if electrolytes are outside the normal range or there is a risk of hypoglycaemia. Consider 6-12 hourly bloods if electrolytes are outside of the normal range or 2-4 hourly bloods for more severe or rapidly changing electrolyte abnormalities and very high fluid losses.

Fluid Replacement and Redistribution

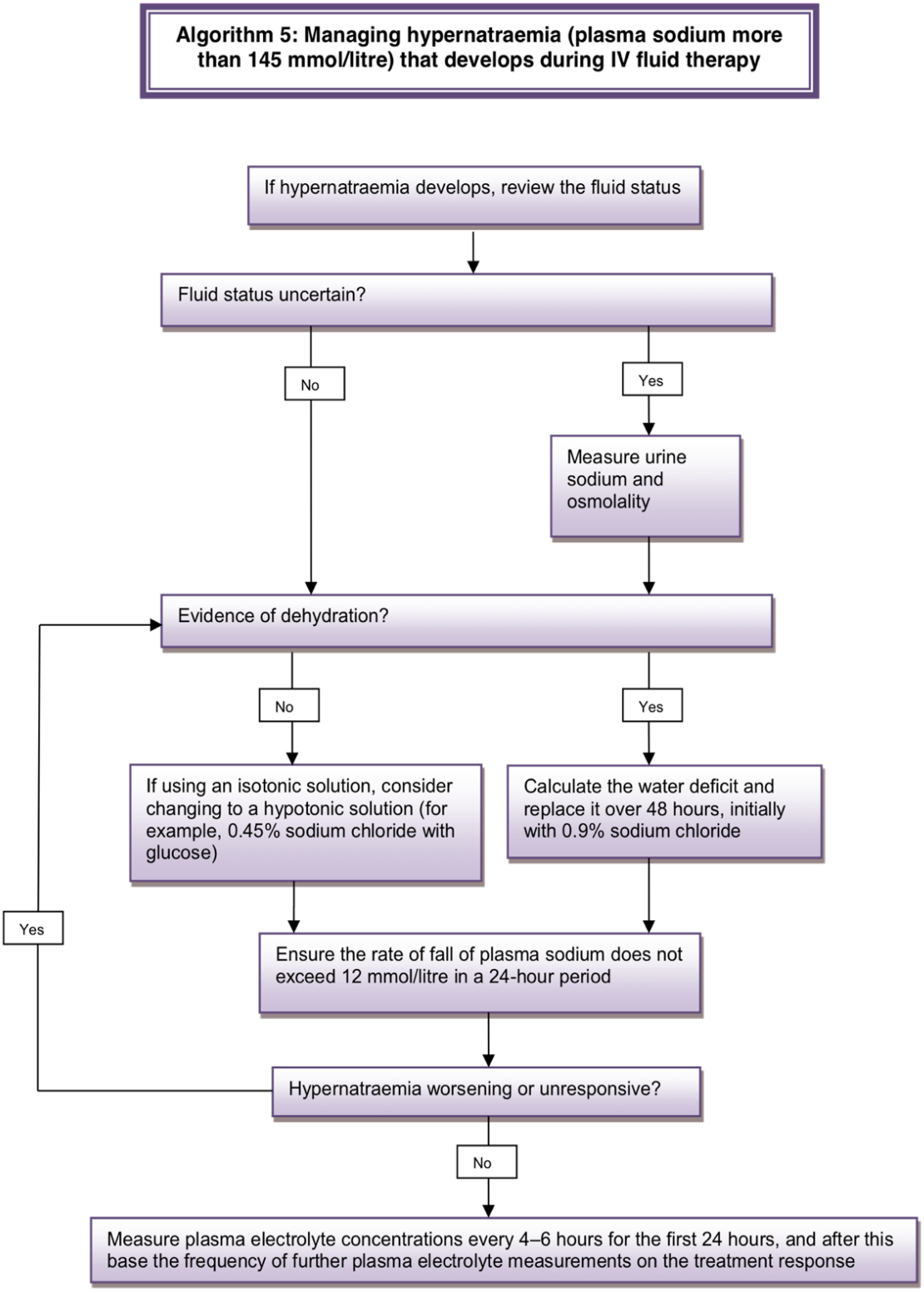
Some neonates, children and young people may need extra IV fluids (in addition to maintenance) to account for existing fluid and/or electrolyte deficiencies or ongoing losses. The diagram below provides further information about potential sources of losses.

Discuss the type of fluid replacement and strategy (eg 1:1 replacement or a fixed fluid replacement rate) with a consultant.



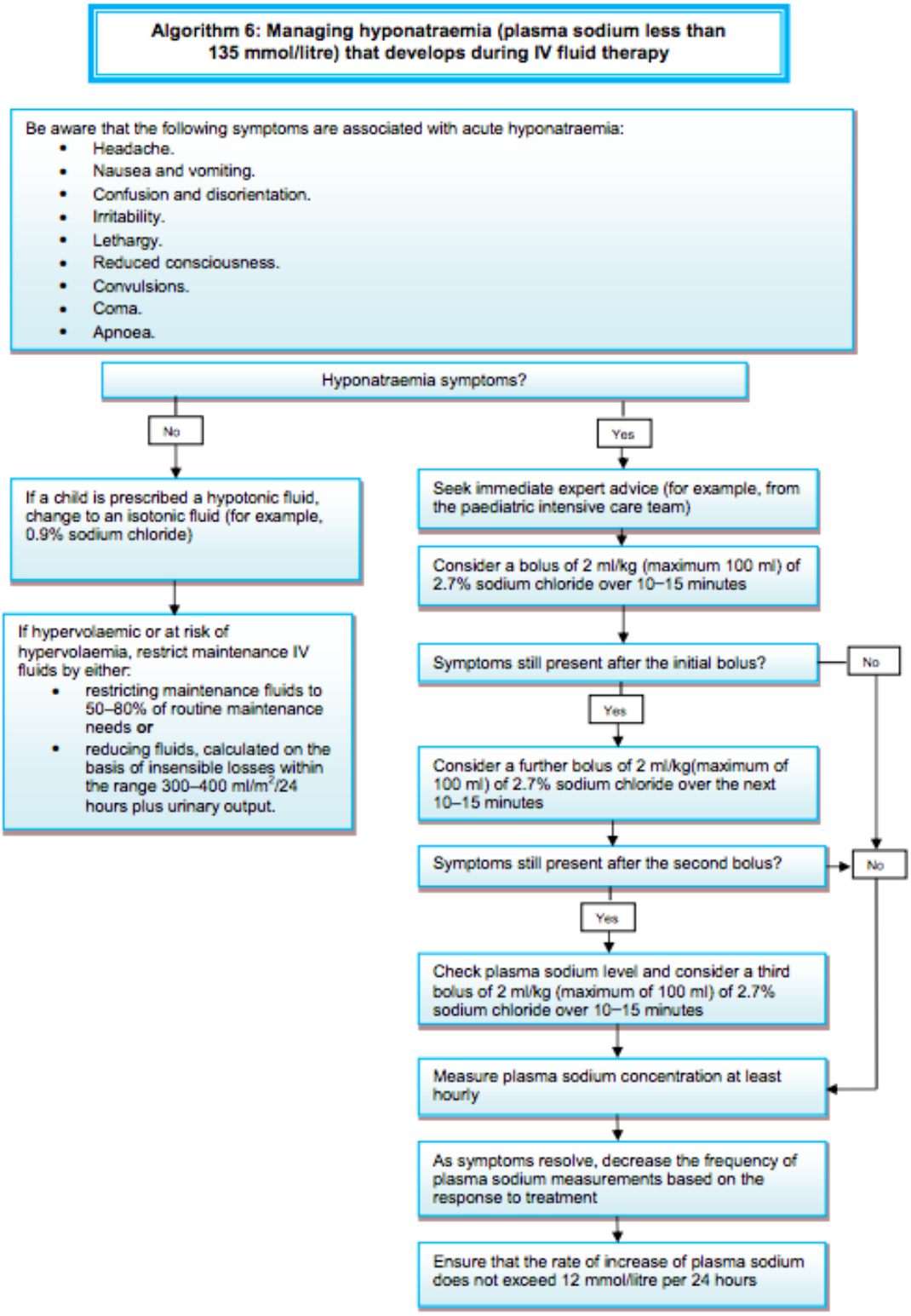
(Diagram taken from NICE NG29: Intravenous fluid therapy in children and young people in hospital)

Managing Hypernatraemia that Develops during IV Fluid Therapy



Aim to switch to enteral fluids as soon as possible

Managing Hyponatraemia that Develops during IV Fluid Therapy



Aim to switch to enteral fluids as soon as possible

Appendix 1: Types of Intravenous Fluids

Fluid type[a]	Osmolality (compared with plasma)	Tonicity (with reference to cell membrane)	Sodium content (mmol/L)	Potassium content (mmol/L)
0.9% sodium chloride	Isosmolar	Isotonic	154	0
Hartmann's solution	Isosmolar	Isotonic	131	5
Plasma-Lyte	Isosmolar	Isotonic	140	5
0.9% sodium chloride + 5% glucose	Hyperosmolar	Isotonic	150	0
0.45% sodium chloride + 5% glucose	Hyperosmolar	Hypotonic	75	0
0.45% sodium chloride	Hyposmolar	Hypotonic	75	0
5% glucose	Isosmolar	Hypotonic	0	0
10% glucose	Hyperosmolar	Hypotonic	0	0

Appendix 2: Making Specialist Fluids

a) To make 0.9% Sodium chloride + 10% Glucose

Remove and discard 56ml from a 500ml 0.9% Sodium Chloride + 5% Glucose bag
To the remainder of the bag, add 56ml of 50% glucose

b) To make concentrated glucose solutions:

Solution Required	10% Glucose Volume	50% Glucose Volume
12.5% Glucose	450ml	30ml
15% Glucose	420ml	60ml
20% Glucose	400ml	135ml

Solution Required	5% Glucose Volume	50% Glucose Volume
7.5% Glucose	450ml	30 ml

The maximum safe concentration of peripheral Glucose is 12.5%: any higher than this should go through a central line.

c) Glucose infusions for known metabolic patients

- Always refer to the patient's own protocol
- Otherwise look up on: **http://www.bimdg.org.uk/guidelines/guidelines-child.asp**
- Read the instructions very carefully, checking each step.
- Discuss with the Consultant. Liase with Evelina Children's Hospital Metabolic team if any concerns.

0.9% Sodium chloride + 10% glucose 500ml bag
a) Remove and discard 56ml from a 500ml 5% glucose + 0.9% Sodium Chloride
b) To the remainder of the bag add 56ml of 50% glucose

0.45% Sodium chloride + 10% glucose 500ml bag
a) Remove and discard 56ml from 500ml bag of 5% glucose 0.45% Sodium Chloride
b) To the remainder of the bag add 56ml of 50% glucose

0.45% Sodium chloride + 5% glucose 500ml bag (usually readily available!)
a) Remove and discard 50ml from a 500ml 0.45% saline
b) To the remainder of the bag add 50ml of 50% glucose

0.45% Sodium chloride + 2.5% glucose 500ml bag- For GLUT 1 deficiency only
a) Remove 25ml from a 500ml bag of 0.45% saline
b) To the remainder of the bag add 25ml of 50% glucose

0.18% Sodium chloride + 10% glucose 500ml bag (specialist advice only)
a) Using a 500ml bag of 10% glucose
b) add 3ml of 30% sodium chloride concentrate. Measure the sodium chloride very carefully

2. References

National Institute of Clinical Excellence (NICE). NG29: Intravenous fluid therapy in children and young people in hospital. Published Dec 2015 and updated June 2020. [Accessed June 2024]

Evelina Children's Hospital Guidelines. Intravenous Fluid Therapy [Accessed June 2024]

European Society of Pediatric and Neonatal Intensive Care (ESPNIC). ESPNIC clinical practice guidelines: intravenous maintenance fluid therapy in acute and critically ill children- a systematic review and meta-analysis. Intensive Care Med. 2022 Dec;48(12):1691-1708. doi: 10.1007/s00134-022-06882-z. Epub 2022 Oct 26. Erratum in: Intensive Care Med. 2023 Sep;49(9):1151-1153. doi: 10.1007/s00134-023-07119-3. PMID: 36289081; PMCID: PMC9705511. [Accessed June 2024]

British Inherited Metabolic Diseases Group (BIMDG)
http://www.bimdg.org.uk/guidelines/guidelines-child.asp

3. Supporting relevant trust guidelines

Electrolyte Emergencies

IV Fluid & Electrolyte Management in Neonates

4. Guideline Governance

a. Scope

This guideline is relevant to all staff caring for all children from 0-18 years old across the emergency department, inpatient ward and outpatient department.

b. Purpose

i. This guidelines aims to facilitate a common approach to the management of children. At times deviation from the guideline may be necessary, this should be documented and is the responsibility of the attending consultant.

ii. This guideline is subject to regular review to ensure ongoing evidence based practice.

c. Duties and Responsibilities

All healthcare professionals responsible for the care of all children 0-18years should be aware of practice according to this guideline.

d. Approval and Ratification

This guideline will be approved and ratified by the Paediatric Guidelines Group.

e. Dissemination and Implementation

i. This guideline will be uploaded to the trust intranet 'Paediatric Guidelines' page and thus available for common use.
ii. This guideline will be shared as part of ongoing education within the Paediatric Department for both medical and nursing staff.
iii. All members of staff are invited to attend and give comments on the guideline as part of the ratification process.

f. Review and Revision Arrangements

a. This policy will be reviewed on a 3 yearly basis by the appropriate persons.
b. If new information comes to light prior to the review date, an earlier review will be prompted.
c. Amendments to the document shall be clearly marked on the document control sheet and the updated version uploaded to the intranet. Minor amendments will be ratified through the Paediatric Guidelines Group. A minor amendment would consist of no major change in process, and includes but is not limited to, amendments to documents within the appendices.

g. Equality Impact Assessment

Background • Who was involved in the Equality Impact Assessment
Author and the supervising consultants.
Methodology • A brief account of how the likely effects of the policy was assessed (to include race and ethnic origin, disability, gender, culture, religion or belief, sexual orientation, age) • The data sources and any other information used • The consultation that was carried out (who, why and how?)
All groups of staff and patients were taken into consideration and there is no bias towards or against any particular group.
Key Findings • Describe the results of the assessment • Identify if there is adverse or a potentially adverse impacts for any equalities groups
There is no evidence of discrimination.
Conclusion • Provide a summary of the overall conclusions
There is no evidence of discrimination.
Recommendations • State recommended changes to the proposed policy as a result of the impact assessment • Where it has not been possible to amend the policy, provide the detail of any actions that have been identified • Describe the plans for reviewing the assessment
This guideline is appropriate for use.

h. Document Checklist

To be completed (electronically) and attached to any document which guides practice when submitted to the appropriate committee for approval or ratification.

Title of the document:

Policy (document) Author:

Executive Director: N/A

		Yes/No/ Unsure/NA	Comments
1.	**Title**		
	Is the title clear and unambiguous?	**N**	
	Is it clear whether the document is a guideline, policy, protocol or standard?	**Y**	
2.	**Scope/Purpose**		
	Is the target population clear and unambiguous?	**Y**	
	Is the purpose of the document clear?	**Y**	
	Are the intended outcomes described?	**Y**	
	Are the statements clear and unambiguous?	**Y**	
3.	**Development Process**		
	Is there evidence of engagement with stakeholders and users?	**Y**	
	Who was engaged in a review of the document (list committees/ individuals)?		**Pharmacists, paediatric guideline committee**
	Has the policy template been followed (i.e. is the format correct)?	**Y**	
4.	**Evidence Base**		
	Is the type of evidence to support the document identified explicitly?	**Y**	
	Are local/organisational supporting documents referenced?	**Y**	

		Yes/No/ Unsure/NA	Comments
5.	**Approval**		
	Does the document identify which committee/group will approve/ratify it?	**Y**	
	If appropriate, have the joint human resources/staff side committee (or equivalent) approved the document?	**Y**	
6.	**Dissemination and Implementation**		
	Is there an outline/plan to identify how this will be done?	**Y**	
	Does the plan include the necessary training/support to ensure compliance?	**Y**	
7.	**Process for Monitoring Compliance**		
	Are there measurable standards or KPIs to support monitoring compliance of the document?	**N/A**	
8.	**Review Date**		
	Is the review date identified and is this acceptable?	**Y**	
9.	**Overall Responsibility for the Document**		
	Is it clear who will be responsible for coordinating the dissemination, implementation and review of the documentation?	**Y**	
10.	**Equality Impact Assessment (EIA)**		
	Has a suitable EIA been completed?	Y	

Committee Approval (Paediatric Guidelines Group)			
If the committee is happy to approve this document, please complete the section below, date it and return it to the Policy (document) Owner			
Name of Chair	**Dr Alexandra Jones**	**Date**	**25/10/2024**
Ratification by Management Executive (if appropriate)			
If the Management Executive is happy to ratify this document, please complete the date of ratification below and advise the Policy (document) Owner			
Date: n/a			