

GUIDELINES for BASIC INTRAVENOUS FLUIDS and ELECTROLYTE PRESCRIBING in CHILDREN OVER 1 MONTH



TARGET AUDIENCE	Secondary care
PATIENT GROUP	Paediatric patients who are over one month to 16 years who require intravenous fluids within secondary care

Clinical Guidelines Summary

Prescribing the wrong type of fluid at the wrong rate can do serious harm. Assessing fluid requirements calls for care and attention, with adjustment for the individual patient. This is as important as safe drug prescribing.

This guideline advises fluid and electrolyte management in paediatric patients over ONE month only.

Remember there are some situations where intravenous fluids need to be prescribed differently. For specific indications see appropriate clinical guideline:

- Diabetic ketoacidosis: BSPED DKA protocol
- Bloody diarrhoea/ haemolytic uraemic syndrome: NHS GGC paediatric guideline
- Traumatic brain injury/Renal/Hepatic/Cardiac patients: NHS GGC paediatric guidance

Also, during acute illness, the standard maintenance rate should be adjusted to **TWO THIRDS maintenance** as patients are at risk of syndrome of inappropriate antidiuretic hormone (SIADH).

Urine output is usually less during illness or after trauma such as surgery because the kidneys conserves both salt and water. Too much intravenous fluid can result in cellular dysfunction and potassium loss. Excess chloride leads to renal vasoconstriction and increased sodium and water retention. Urine output is an unreliable guide for fluid requirements in sick patients. In particular, **Oliguria is not always caused by dehydration (consider pre and post renal causes).**

It is vital that sick patients receive the RIGHT amount of the RIGHT fluid at the RIGHT time.

Guidelines for Basic IV Fluid & Electrolyte Prescribing in children over 1 month to 16 years

Questions to ask before prescribing fluid:

1. Does my patient need to receive fluids?
2. Does my patient need intravenous (IV) fluids?
3. Is my patient in shock or dehydrated?
4. Do they need a fluid bolus, **Resuscitation fluids**?
 - a. If yes, consider special circumstances (i.e DKA – see BSPED) first before giving 10ml/kg of sodium chloride 0.9% or Plasma-Lyte® 148
5. Consider the need for **Replacement fluids**
6. How much **Maintenance fluids** will my patient need?
7. What types of fluid does my patient need?

Does my patient need IV Fluids?

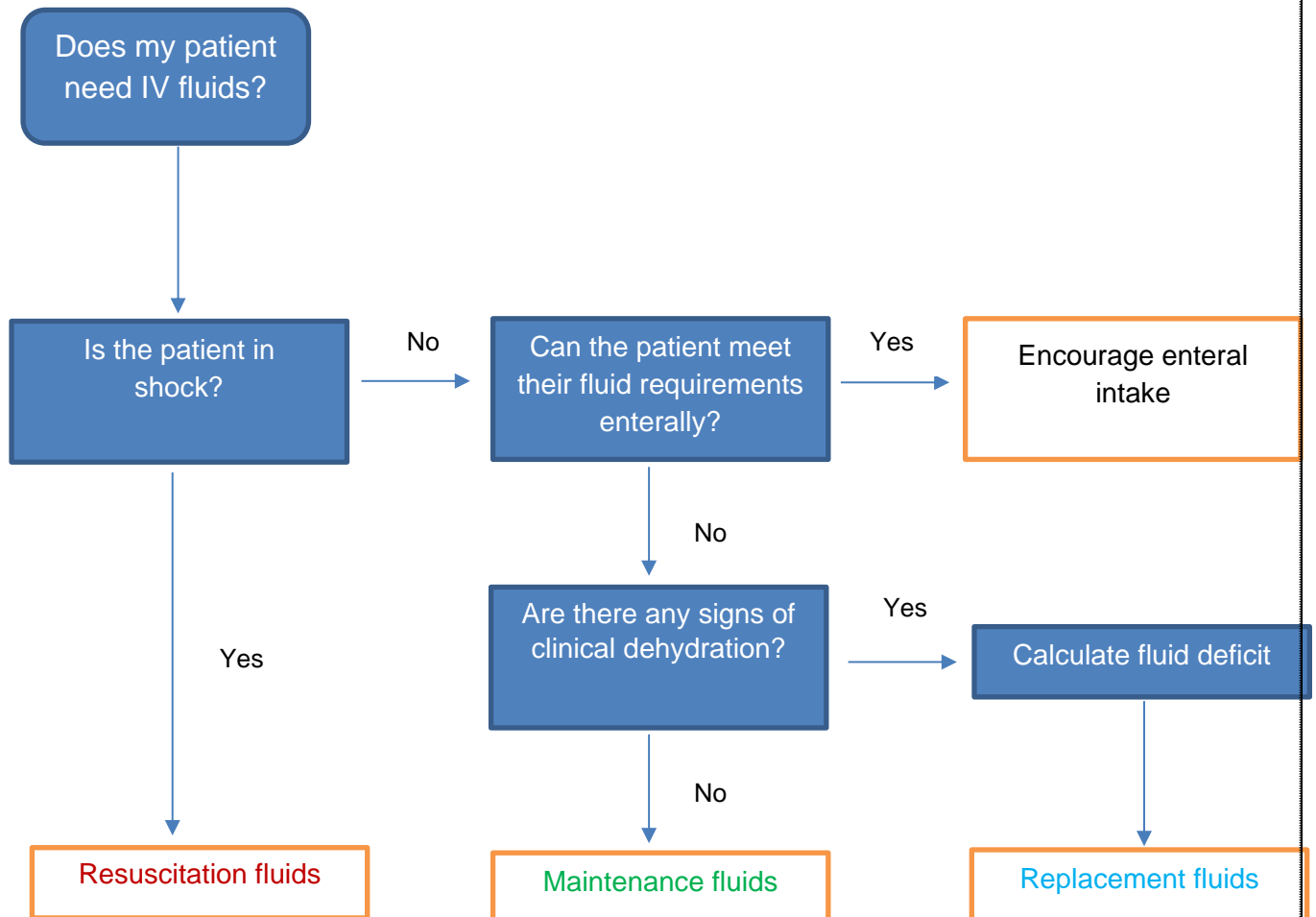
IV fluids should be given in the following circumstances:

- Patients with suspected or confirmed **shock**
- Patients who **persistently vomit the oral rehydration solution**, given either orally or via a nasogastric tube
- Patients with clinical evidence of deterioration despite oral rehydration
- Patients with **red flag symptoms or signs** (see below)

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The reason for giving intravenous fluid, is it to provide:
Resuscitation fluids, Maintenance fluids or Replacement fluids



Clinical features suggesting dehydration include:

- Appears unwell/deteriorating*
- Altered responsiveness (irritable, lethargic)*
- Sunken eyes*
- Tachycardia*
- Tachypnoea*
- Reduced skin turgor*
- Dry mucous membranes (not reliable if the child is mouth breathing or just after a drink)
- Decreased urine output

*These clinical features are **red flags**, the presence of which may predict a higher risk of progression to shock.

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IV Resuscitation fluids

Boluses of fluid are required if the patient is in shock.

The standard for **IV resuscitation fluid** is **0.9% sodium chloride** with no additives via intravenous or intraosseous routes (if IV access is not possible) in a standard bolus of **10 ml/kg over <10 minutes**.

Exceptions to this rule are special circumstances when **smaller boluses** may need to be used:

- Neonatal period (<28 days of age)
- Diabetic ketoacidosis (BSPED)
- Septic shock
- Trauma
- Cardiac pathology (e.g. heart failure)

After the bolus has been administered, the **volume status** should be re-assessed (e.g. heart rate, respiratory rate, capillary refill time).

If the patient is still in shock after the initial fluid bolus, another **10ml/kg 0.9% sodium chloride** can be given, and the volume status reassessed. If a further bolus is then required seek urgent senior advice.

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How much IV Replacement fluid does my patient need?

Depending on the clinical picture of the dehydrated child, rehydration can be achieved via either **oral rehydration solution or IV fluids**. All patients should have **fluid balance charts** to assess fluid input, ongoing losses and urine output.

IV Replacement fluid therapy should be based on the **percentage-dehydration**. Clinical signs of dehydration are only detectable when the patient is **2.5 – 5% dehydrated**. Therefore, a child that has symptoms/signs of dehydration, but no **red flag** features will be approximately 5% dehydrated. If any **red flag** features of dehydration are present, or the child is clinically shocked, then it is common practice to assume 10% dehydration.

How much fluid (maintenance + replacement) does my patient need?

Once percentage dehydration is known, a **fluid deficit** is calculated using the following formula:

$$\text{Fluid deficit (ml)} = \% \text{ dehydration} \times \text{weight (kg)} \times 10$$

Aim to correct fluid deficit with IV replacement fluids over 24 hours unless the child has hypernatraemia ($\text{Na} > 145 \text{mmol/l}$) then replace over 48 hours.

$$\text{Dehydrated child fluid requirements (ml/hr)} = (\text{fluid deficit}/24\text{hours}) + \text{maintenance (ml/hr)}$$

Significant ongoing losses through, for example, vomiting or diarrhoea should be documented on the patient's fluid balance chart and replaced in addition to fluid deficit correction.

Selection of initial IV replacement fluids:

Sodium chloride 0.9%/glucose 5% is normally the first-choice IV replacement fluid, thereafter the fluids prescribed will need to be adjusted based on patient's serum electrolytes and their response to the fluids. The inclusion of potassium in maintenance fluids should be considered after checking electrolyte and renal function. Not every bag prescribed requires the addition of potassium.

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IV Maintenance fluids

For children who do not have excess losses above insensible losses and no other intake, IV fluid **maintenance** requirements are shown in table 1 below. If a child is receiving other fluids, they may only need part of the calculated **maintenance** fluids. **Also, during acute illness, the standard maintenance rate should be adjusted to TWO THIRDS maintenance as patients are at risk of syndrome of inappropriate antidiuretic hormone (SIADH).**

How much IV maintenance fluid does my patient need?

1. Obtain weight (estimate if required).
 - a. Underweight child – calculate **maintenance fluid** requirements using the child's actual weight.
 - b. Overweight children - require less fluid than calculated volume per kg (use ideal body weight for calculating **maintenance fluid** requirements).
2. All children should have electrolytes and glucose checked when starting IV fluids.
3. Consider recent events e.g. fasting, losses, sepsis, operations.
4. Check patient's fluid balance chart.
5. Follow table 1 to calculate 24-hour fluid requirement.
6. The baseline **IV maintenance fluid** requirements shown in the table may need to be adjusted to take account of factors that reduce water loss, **TWO THIRDS maintenance** rates should be used in most unwell children unless they are dehydrated. Unwell children are likely to secrete excess ADH so will need less fluid to avoid water overload and hyponatraemia.

Table 1: IV **maintenance fluid** requirements for children over 1 month

Body weight (kg)	IV maintenance fluid 24 hours fluid requirements
Under 10kg	100ml/kg
10-20kg	100ml/kg for the first 10kg + 50ml/kg for each 1kg body-weight over 10kg
Over 20kg	100ml/kg for the first 10kg + 50ml/kg for each 1kg body weight between 10-20kg + 20ml/kg for each 1kg body weight over 20kg (max. 2 litres in females, 2.5 litres in males)

Selection of initial IV Maintenance fluids:

Sodium chloride 0.9%/glucose 5% is normally the first-choice **maintenance** fluid, thereafter the fluids prescribed will need to be adjusted based on patient's serum electrolytes and their response to the fluids. The inclusion of potassium in **maintenance** fluids should be considered after checking electrolyte and renal function. Not every bag prescribed requires the addition of potassium.

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Administration and Monitoring of IV fluids:

1. Prescribe the IV fluid and rate (ml/hr) on the paediatric fluid balance and daily fluid/infusion prescription chart.
2. IV fluids should be given via volumetric pump.
3. Never give **maintenance** fluids at more than 110ml/hr.
4. Remember to record input and output in the paediatric fluid balance and daily fluid/infusion prescription chart.
5. All children should have electrolytes and glucose checked when starting IV fluid treatment and at least every 24 hours if IV fluids are continued.
6. Intravenous fluid bags **MUST** be changed at the latest every 12 hours.

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Electrolyte Disturbance

Hypernatraemia (>145mmol/l or rising significantly on repeat measures)

Hypernatraemia is usually due to dehydration with resistant hyperosmolality, rather than a problem of sodium homeostasis. When correcting hypernatraemia, ensure that plasma sodium does not fall by more than 12mmol/l in a 24-hour period. In patients who develop hypernatraemia, review the fluid status and take the following actions:

- If dehydration is diagnosed, calculate the water deficit and replace it over 48 hours, initially with 0.9% sodium chloride.
- If the fluid status is uncertain, measure urine sodium and osmolality.
- If hypernatraemia worsens or is unchanged after replacing the deficit at 48 hours, review the fluid type and consider changing to 0.45% sodium chloride.

Hyponatraemia (<135mmol/l that develops during intravenous fluid therapy)

Low serum sodium is commonly caused by excess water rather than too little sodium. When symptoms of hyponatraemia have resolved, ensure that plasma sodium does not increase by more than 12mmol/l in a 24 hour period.

Asymptomatic hyponatraemia

- If a child is prescribed a hypotonic fluid change to an isotonic fluid.
- Restrict maintenance IV fluids in patients who are hypervolaemic or at risk of hypervolaemia.

Acute symptomatic hyponatraemia

This is a medical emergency and appropriate help/advice should be sought. Manage acute hyponatraemic encephalopathy with fluid restriction and:

- Consultant paediatrician can consider giving a bolus of 2ml/kg (max 100ml) of 2.7% sodium chloride over 10-15min. This can be repeated if needed.
- Measure the plasma sodium concentration hourly until symptoms resolve. Subsequently, as symptoms resolve, the frequency of plasma sodium measurements can be decreased.

Potassium

A blood potassium value in the normal range does not mean that there is not total body potassium deficit as potassium is mainly an intracellular ion.

Hypokalaemia

Consult paediatric treatment of hypokalaemia guideline.

Discuss urgently with a consultant paediatrician if a child requires more than 40mmol/litre potassium, as a central venous catheter is needed for

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intravenous administration of potassium solutions above 40mmol/litre.

Intravenous fluids routinely used and stocked in paediatrics that contain potassium are:

- Sodium chloride 0.9% and 20mmol Potassium chloride in 500ml
- Sodium chloride 0.9% and Glucose 5% and 10mmol Potassium in 500ml
- Sodium chloride 0.9% and Glucose 5% and 20mmol Potassium in 500ml
- Sodium chloride 0.9% and Glucose 10% and 20mmol Potassium in 500ml

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References/Evidence

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Appendices

1. Governance information for Guidance document

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