Algorithms for IV fluid therapy in children and young people in hospital

**Algorithm 1: Assessment and monitoring**

- **Does the patient need fluid resuscitation?**
  - Yes: **Can the patient meet their fluid and/or electrolyte needs enterally?**
  - No: **Is an accurate calculation of insensible losses important (for example, weight above 91st centile, acute kidney injury, known chronic kidney disease or cancer)?**
    - Yes: **Provide fluid and electrolytes enterally**
    - No: **Use body weight to calculate IV fluid and electrolyte needs**
      - **Record assessment and monitoring criteria on the fluid balance and prescription chart**
      - **Measure plasma electrolyte concentrations using laboratory tests when starting IV fluids, and then at least every 24 hours**
      - **Risk of hypoglycaemia?**
        - Yes: Measure blood glucose more frequently than every 24 hours, Consider using point-of-care testing for plasma electrolyte concentrations and blood glucose
        - No: **Time-critical situation (for example, emergency, A&E, theatre, critical care)?**
          - Yes: **Measure blood glucose at least every 24 hours**
          - No: **Look for clinical dehydration and hypovolaemic shock**
            - **Patient needs fluids for routine maintenance**
            - **Patient has complex fluid or electrolyte replacement or abnormal distribution issues**

**Algorithm 2: Fluid resuscitation**

- **Yes:** Use body weight to calculate IV fluid and electrolyte needs
- **No:** **Record assessment and monitoring criteria on the fluid balance and prescription chart**
  - **Measure plasma electrolyte concentrations using laboratory tests when starting IV fluids, and then at least every 24 hours**
  - **Risk of hypoglycaemia?**
    - Yes: Measure blood glucose more frequently than every 24 hours, Consider using point-of-care testing for plasma electrolyte concentrations and blood glucose
    - No: **Time-critical situation (for example, emergency, A&E, theatre, critical care)?**
      - Yes: **Measure blood glucose at least every 24 hours**
      - No: **Look for clinical dehydration and hypovolaemic shock**

**Algorithm 3: Routine maintenance**

**Algorithm 4: Replacement and redistribution**
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Algorithm 2: Fluid resuscitation

Term neonate, child or young person requires IV fluid resuscitation?

No

Yes

Pre-existing condition (for example, cardiac or kidney disease)?

No

Take into account pre-existing conditions as smaller fluid volumes may be needed

Yes

Use glucose-free crystalloids that contain sodium in the range 131–154 mmol/litre, with a bolus of 20 ml/kg over less than 10 minutes for children and young people, and 10–20 ml/kg over less than 10 minutes for term neonates

Reassess after bolus completed

Seek expert advice (for example, from the paediatric intensive care team) if 40–60 ml/kg or more is needed as part of the initial fluid resuscitation

Algorithm 1: Assessment and monitoring
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**Algorithm 3: Routine maintenance**

Measure plasma electrolyte concentrations and blood glucose when starting IV fluids (except before most elective surgery) and at least every 24 hours thereafter

**Term neonate**

Calculate routine maintenance IV fluid rates using the following as a guide:
- From birth to day 1: 50–60 ml/kg/day
- Day 2: 70–80 ml/kg/day
- Day 3: 80–100 ml/kg/day
- Day 4: 100–120 ml/kg/day
- Day 5–28: 120–150 ml/kg/day

Is the neonate in a critical postnatal adaptation phase (for example respiratory distress syndrome, meconium aspiration, hypoxic ischaemic encephalopathy)?

**No**
Initially use isotonic crystalloids that contain sodium in the range 131–154 mmol/litre with 5–10% glucose

**Yes**
Give no or minimal sodium until postnatal diuresis with weight loss occurs

**Using body weight to calculate IV fluid needs?**

**No**

**Yes**

When using body surface area to calculate needs, estimate insensible losses within the range 300–400 ml/m²/24 hours plus urinary output

Calculate routine maintenance IV fluid rates for children and young people using the Holliday–Segar formula:
- 100 ml/kg/day for the first 10 kg of weight
- 50 ml/kg/day for the second 10 kg of weight
- 20 ml/kg/day for the weight over 20 kg.
- Be aware that over a 24-hour period, males rarely need more than 2500 ml and females rarely need more than 2000 ml.

Initially use isotonic crystalloids that contain sodium in the range 131–154 mmol/litre

Risk of water retention associated with non-osmotic antidiuretic hormone secretion?

**No**

**Yes**
Consider either:
- restricting fluids to 50–80% of routine maintenance needs or
- reducing fluids, calculated on the basis of insensible losses within the range 300–400 ml/m²/24 hours plus urinary output

Base any subsequent IV fluid prescriptions on the plasma electrolyte concentrations and blood glucose measurements
Algorithm 4: Replacement and redistribution

Adjust the IV fluid prescription to account for existing fluid and/or electrolyte deficits or excesses, ongoing losses or abnormal distribution.

Consider isotonic crystalloids that contain sodium in the range 131–154 mmol/litre for redistribution.

Need to replace ongoing losses?

No

Yes

Use 0.9% sodium chloride containing potassium to replace ongoing losses.

Base subsequent fluid composition on plasma electrolyte concentrations and blood glucose measurements.
Algorithm 5: Managing hypernatraemia (plasma sodium more than 145 mmol/litre) that develops during IV fluid therapy

If hypernatraemia develops, review the fluid status

Fluid status uncertain?

No

Evidence of dehydration?

No

If using an isotonic solution, consider changing to a hypotonic solution (for example, 0.45% sodium chloride with glucose)

Yes

Measure urine sodium and osmolality

Yes

Calculate the water deficit and replace it over 48 hours, initially with 0.9% sodium chloride

Ensure the rate of fall of plasma sodium does not exceed 12 mmol/litre in a 24-hour period

Hypernatraemia worsening or unresponsive?

No

Measure plasma electrolyte concentrations every 4–6 hours for the first 24 hours, and after this base the frequency of further plasma electrolyte measurements on the treatment response
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Algorithm 6: Managing hyponatraemia (plasma sodium less than 135 mmol/litre) that develops during IV fluid therapy

Be aware that the following symptoms are associated with acute hyponatraemia:
- Headache.
- Nausea and vomiting.
- Confusion and disorientation.
- Irritability.
- Lethargy.
- Reduced consciousness.
- Convulsions.
- Coma.
- Apnoea.

Hyponatraemia symptoms?

No

If a child is prescribed a hypotonic fluid, change to an isotonic fluid (for example, 0.9% sodium chloride)

If hypervolaemic or at risk of hypervolaemia, restrict maintenance IV fluids by either:
- restricting maintenance fluids to 50–80% of routine maintenance needs
- reducing fluids, calculated on the basis of insensible losses within the range 300–400 ml/m²/24 hours plus urinary output.

Yes

Seek immediate expert advice (for example, from the paediatric intensive care team)

Consider a bolus of 2 ml/kg (maximum 100 ml) of 2.7% sodium chloride over 10–15 minutes

Symptoms still present after the initial bolus?

No

Check plasma sodium level and consider a third bolus of 2 ml/kg (maximum of 100 ml) of 2.7% sodium chloride over 10–15 minutes

As symptoms resolve, decrease the frequency of plasma sodium measurements based on the response to treatment

Ensure that the rate of increase of plasma sodium does not exceed 12 mmol/litre per 24 hours