Fluid and Electrolyte Management

In this outline you will learn
- How to assess and manage fluid and electrolyte requirements for an unwell child

Introduction
At birth 80% of the child’s body weight is water. This water is dispersed between the intracellular, interstitial and intravascular spaces from one compartment to another depending on the various pressure and osmotic gradients. In illness or injury these fluid shifts may be quick with significant clinical deterioration.

The goal of fluid and electrolyte management is to replace losses of water and electrolytes in order to maintain normal balance of these essential substances during growth and recovery from disease.

A subsidiary aim in the management of fluid and electrolyte balance is to proceed as per the child's age, weight and ways the child is coping with the body losses.¹

There are two aspects to fluid resuscitation:
1. Replacement therapy replaces any current existing water and electrolyte deficits (i.e. what has been lost), replaces any ongoing abnormal losses, and returns the child to a normal volume and electrolyte status.
2. Maintenance therapy replaces the expected ongoing losses of water and electrolytes from normal physiologic processes and maintains normal volume and electrolyte status i.e. the usual daily requirement.²

Route of Fluid Replacement
The route used for fluid replacement will be determined by a number of factors. Most children can be managed with oral fluids even with some vomiting present. A nasogastric tube is a good alternative for an hourly rate:²
- Frequent, small amounts is the best option
- Babies should continue with breast milk or formula as usual
- Older children: include water or oral rehydration fluids, e.g. Gastrolyte
- Fruit juice must be diluted 1:4
- Sugary drinks, jellies, and cordials should be minimised as they are too high in sugar
- Commercial sports drinks (Powerade, etc.) should not be used due to high sodium content

The safe use of IV fluid therapy in children requires accurate prescribing of fluid and careful monitoring. IV fluid is required in the case of:²
- Inability of the child to take oral fluids (e.g. alteration in mental status, ileus, or anatomic anomaly)
- Inability of the parent(s)/guardian to provide oral fluids
- Failure of oral fluids to provide adequate rehydration (e.g. persistent vomiting)
- The child’s physical presentation indicates a need for IV fluids i.e. “the sick child”
- Severe electrolyte problems in the clinical setting where oral fluids cannot be closely monitored or electrolytes frequently
If signs of circulatory collapse are present i.e. prolonged capillary refill time, tachycardia and/or hypotension then immediate resuscitation of intravascular volume must occur. This should be via intravenous or intraosseous access. Boluses of 20 mL/kg 0.9% sodium chloride (isotonic solution) should be used. Reassessment and repeat boluses are given as necessary with consideration of the cause of circulatory collapse i.e. blood loss or sepsis so that alternative resuscitation fluids can be considered if appropriate. Do not include this fluid volume in any subsequent calculations.

Incorrectly prescribed or administered fluids are potentially very dangerous. More adverse events are described from fluid administration than for any other individual drug. If you have any doubt about a child's fluid orders – check and recheck!!

Type of IV Fluids
Three good fluid solutions for sick children include:\(^3,^5\)

<table>
<thead>
<tr>
<th>Fluid</th>
<th>Alternative names</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9% NaCl</td>
<td>Normal saline</td>
<td>Initial boluses Replacement of deficit and losses</td>
</tr>
<tr>
<td>0.9% NaCl with 5% Glucose OR 0.45% NaCl with 5% Glucose</td>
<td>Normal saline with glucose 1/2 Normal saline with glucose</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

The dextrose component is required in children, as they tend to become hypoglycaemic due to their higher metabolic rate.

The use of 0.9% saline solutions will provide more than the required sodium maintenance for some children. In well children with normal renal function this additional sodium will be excreted.

Maintenance
Remember that the maintenance fluid volume will need to be adjusted in all unwell children. In unwell children who are not dehydrated, consider using 2/3 maintenance, especially those with pneumonia or meningitis.\(^3\)

For fluid options and management for the dehydrated child please refer to the module 4 content on Shock.

Calculation Of Maintenance Fluid Requirements
- Maintenance fluid is essentially the daily fluid intake which replaces the insensible losses (from breathing, through the skin, and in the stool)
- It 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
- The volume is calculated per kilo of body weight\(^6,^5\)
### Ongoing Losses

- Ongoing losses should be assessed every four hours - especially if: severe gastroenteritis; if there are drain losses; ileostomies; etc.\(^3,4,5\)
- Fluids used to replace ongoing losses should reflect the electrolyte composition of the fluid being lost\(^4,5\).

### Monitoring

- All children on IV fluids should be weighed prior to the commencement of therapy, and daily afterwards.
- Children with ongoing dehydration/ongoing losses may need 6 hourly weights to assess hydration status\(^4\).
- All children on IV fluids should have serum electrolytes and glucose checked before commencing the infusion (typically when the IV is placed) and again within 24 hours if IV therapy is to continue\(^3,4,5\).
- For more unwell children, check the electrolytes and glucose 4-6 hours after commencing, and then according to results and the clinical situation but at least daily\(^3,4\).
- Ideally, use the same sampling technique, either capillary or venous blood sampling, on each occasion. This can avoid potentially misleading changes in serial sodium measurements\(^4\).
- Pay particular attention to the serum sodium on measures of electrolytes:\(^3\)
  - If <135mmol/L (or falling significantly on repeat measures) refer to local [Hyponatraemia guidelines](#).
  - If >145mmol/L (or rising significantly on repeat measures) refer to local [Hypernatraemia guidelines](#).
- Urine chemistry may be useful in a small number of high-risk cases or when the cause behind an abnormal sodium result is unclear\(^4\).
- Children on IV fluids should have a fluid balance chart documenting input, ongoing losses and urine output.

### Additional Notes

There is often confusion about the difference between oral and IV fluid requirements for young infants. The water requirement is identical for both routes of administration. The relatively low energy density of milk means that infants need 150-200mls/kg/day to obtain adequate nutrition. That is why they pass more dilute urine than older children.\(^3\)

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#### Maintenance plus Deficit plus Ongoing Losses

<table>
<thead>
<tr>
<th>Child’s weight</th>
<th>mLs / day</th>
<th>mLs / hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st 10kg of weight</td>
<td>100 mLs/kg/24hrs</td>
<td>4 mLs/kg/hr</td>
</tr>
<tr>
<td>2nd 10kg of weight</td>
<td>50 mLs/kg/24hrs</td>
<td>2 mLs/kg/hr</td>
</tr>
<tr>
<td>All additional kg of weight</td>
<td>20 mLs/kg/24hrs</td>
<td>1 mL/kg/hr</td>
</tr>
</tbody>
</table>

**Example:** A 23 kg child will require

- 100 mLs/kg for the first 10kg = 1000mLs
- 50 mLs/kg for the second 10kg = 500mLs
- 20 mLs/kg for all additional Kg = 60 mLs

**Total** = 1560mLs

**Rate** = 1560/24 = 65mLs/hr
Consider consultation with local paediatric team when:

- Unsure of which fluid/how much fluid to use
- Electrolyte abnormalities
- Using a non-standard 'special' fluid i.e. 10 – 50% Dextrose

Consider transfer when:

- Children requiring care above the level of resourcing at a local hospital or clinic
- Severe electrolyte or glucose abnormalities

Summary

- The use of intravenous fluids requires careful prescribing and close monitoring
- 20mL/kg for initial bolus(es) using Normal Saline (NaCl) is recommended
- In calculations for maintenance fluids it is extremely important to include the child’s weight, ongoing losses and review of their electrolytes

References


3. Cliffe, L, 2008 Paediatric Practice Guidelines on Emergency 1.17 Intravenous Fluids. Nottingham University Hospitals, NHS Trust
