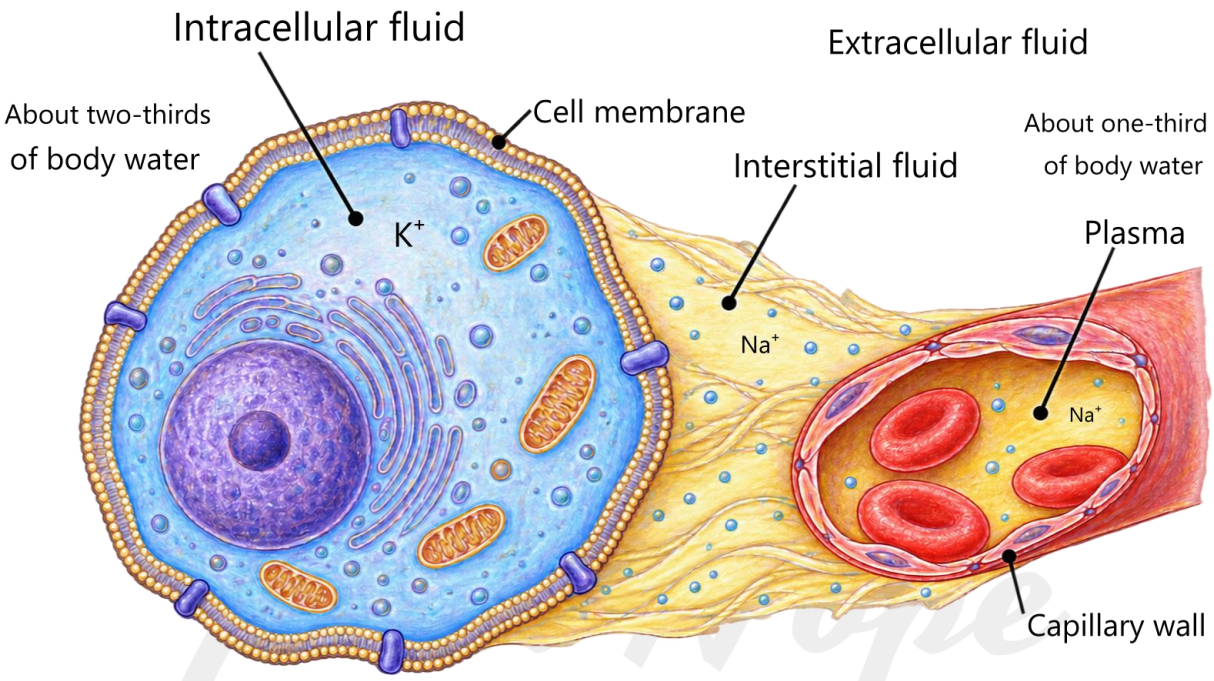
Pediatrics - Topic 15 - Fluid and electrolyte balance

Fluid and Electrolyte Management

- Body water is divided into intracellular and extracellular compartments, and extracellular fluid includes plasma and interstitial fluid.
- Infants have a larger water fraction and a greater vulnerability to water loss than older children.

Water and Electrolyte Distribution



Sodium predominates outside cells and potassium inside cells; body-water proportions vary with age

- Sodium is the main extracellular cation, while potassium is mainly inside cells.
- Water movement, kidney function and hormonal responses link fluid balance with electrolyte concentrations.

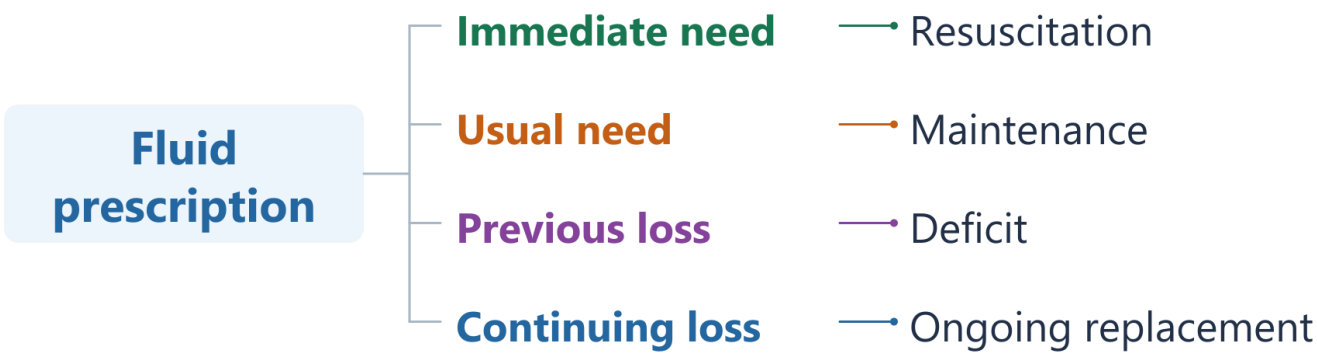
Assessing the Child

- Record weight, recent intake, urine output, vomiting, stools, fever and other ongoing losses.
- Assess mental state, thirst, pulse, capillary refill, blood pressure, breathing, mucous membranes and skin signs.
- A recent reliable weight change is often more useful than one isolated physical sign for estimating fluid loss.
    - A 1 kg acute fall in weight corresponds approximately to a loss of 1 litre of water, although longer-term weight change may also reflect tissue loss.
- Look for edema, hepatomegaly, crackles and increasing respiratory effort because they can indicate fluid overload.
- Check glucose and electrolytes before substantial intravenous treatment when feasible, but do not delay urgent resuscitation.

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Calculating and Prescribing Fluids

Components of the Fluid Prescription



- Resuscitation treats immediate circulatory failure, while maintenance replaces ordinary daily water needs.
- Deficit replacement corrects water already lost, and ongoing-loss replacement accounts for losses that continue during treatment.
- Calculate these components separately and record fluids already given to avoid accidental duplication.
- Use oral or nasogastric fluids when they are safe and effective, since intravenous treatment is not automatically better.

Maintenance in a Stable Child

- For a child beyond the neonatal period, the Holliday–Segar calculation provides an initial daily maintenance estimate.

Weight component	Daily estimate
First 10 kg	Use 100 mL/kg/day.
Next 10 kg	Add 50 mL/kg/day for the portion from 10 to 20 kg.
Weight above 20 kg	Add 20 mL/kg/day for the portion above 20 kg, with an age-appropriate total limit.

- A 15 kg child has a calculated daily requirement of 1,000 + 250 = 1,250 mL, or approximately 52 mL/hour.
- The commonly used hourly 4–2–1 rule is an approximation and gives 50 mL/hour for the same child.
- Use one clearly documented method and adjust it to clinical needs rather than switching between methods during a prescription.
- Newborns require a separate plan based on postnatal age, gestation, weight, urine output and clinical condition.

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Fluid Type and Adjustments in Illness

- Isotonic maintenance fluid with appropriate glucose is generally preferred for hospitalized children who cannot take enteral fluids.
- Add potassium only after assessing the potassium concentration, renal function and urine output.
- Many sick children retain water because of increased antidiuretic hormone and may need less than the calculated full maintenance volume.
- Cardiac, renal and liver disease, severe malnutrition, burns and diabetic ketoacidosis require condition-specific plans.
- Prescribe the fluid name, additives, total volume, rate, duration and review time, and include drug infusions in the total intake.

Deficit and Ongoing Losses

Estimating the Deficit

- An estimated deficit in milliliters equals body weight in kilograms multiplied by the dehydration percentage and by ten.
- For example, an estimated 5% deficit in a 10 kg child equals 500 mL.
- This estimate is only a starting point because clinical dehydration percentages are imprecise.

Replacement Rate and Measured Ongoing Losses

- Choose the replacement rate according to the cause, sodium level, circulation and applicable disease protocol.
- Measure significant stool, drain or gastric losses and replace them with a suitable fluid at scheduled reassessments.
- Do not simply add unlimited extra fluid for every fever or episode of vomiting without reassessing the child.

Resuscitation and Reassessment

- A child with shock needs urgent assessment and a resuscitation plan matched to the likely cause.
- A common initial isotonic crystalloid bolus is 10 mL/kg, followed immediately by reassessment of perfusion and signs of overload.
- Repeat fluid only when the response and diagnosis support it, and obtain early senior help if shock persists.
- Hemorrhage may require blood, while cardiogenic shock and severe malnutrition need particularly cautious fluid strategies.
- In settings without intensive care, fluid boluses in febrile illness require strict assessment of true shock and the relevant emergency protocol.

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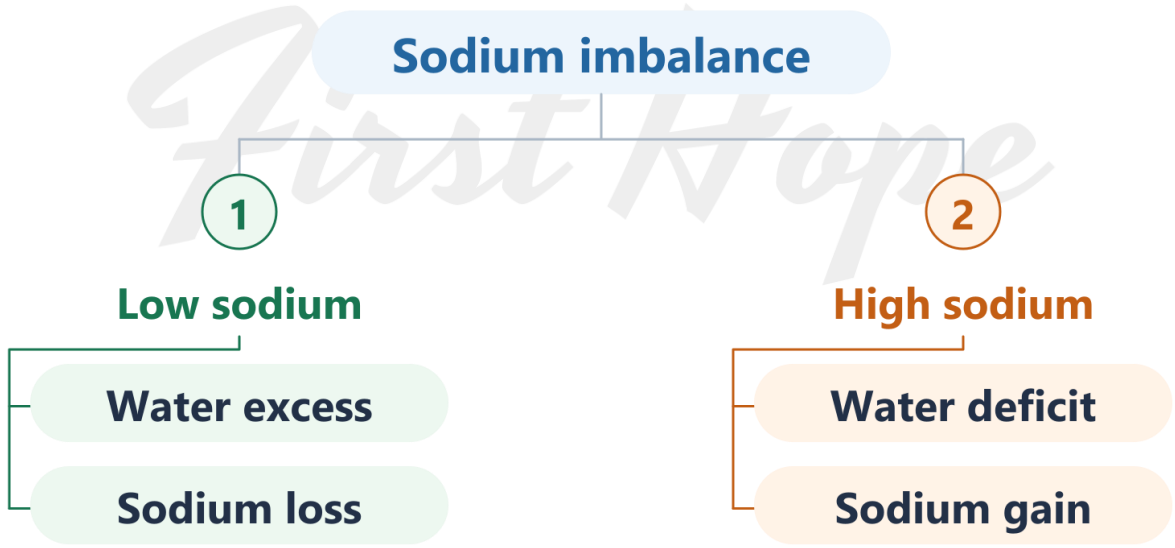
Monitoring

- Document input and output, daily weight, vital signs and repeated hydration assessment.
- Measure electrolytes and glucose at least daily during ongoing substantial intravenous maintenance, and more often when abnormal or changing rapidly.
- Review every prescription when the child's condition changes and stop intravenous fluids when adequate enteral intake resumes.

Interpreting a Fluid Balance Chart

- Add all oral, enteral and intravenous inputs, including drug carriers, flushes and blood products.
- Compare them with measured urine, stool, vomit and drain losses, while recognising that insensible losses are not directly collected.
- A positive recorded balance with increasing weight and respiratory distress may indicate fluid accumulation rather than successful rehydration.

Sodium Disturbances



Hyponatremia

- Hyponatremia means a serum sodium concentration below 135 mmol/L and usually reflects excess water relative to sodium.
- Causes include gastrointestinal sodium loss with water replacement, inappropriate antidiuretic hormone activity, adrenal disease and fluid overload.
- The speed of the fall influences neurological risk, so acute symptomatic hyponatremia is particularly dangerous.

Assessment and Treatment

- Assess volume status, medicines, glucose and neurological signs, and obtain paired serum and urine studies when indicated.

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Acute Neurological Symptoms

- Seizures or markedly reduced consciousness require urgent controlled hypertonic saline treatment in a monitored setting.
- Do not rely on anticonvulsants alone because the underlying cerebral edema requires sodium correction.

Subsequent Controlled Correction

- After the immediate emergency is controlled, avoid excessive correction and monitor sodium frequently.
- In a non-seizing child, a usual correction limit is no more than 8 mmol/L in 24 hours, with an individualized lower target when risk is high.
- Treat the cause, such as sodium-containing fluid for hypovolemia or a carefully assessed water restriction for inappropriate antidiuretic hormone activity.
- Rapid correction of chronic hyponatremia can cause osmotic demyelination and must be avoided.

Hypernatremia

- Hypernatremia means a serum sodium concentration above 145 mmol/L and usually reflects insufficient water relative to sodium.
- Causes include inadequate intake, incorrectly concentrated feeds, diarrhea, renal water loss and excess sodium administration.
- A child can have substantial dehydration without the usual skin findings, so weight, history and serial assessment are important.
- Severe hypernatremia can cause neurological injury, and a concentration of 170 mmol/L or more requires urgent specialist care.

Controlled Correction

- Restore circulation first if shock is present, then replace the remaining deficit gradually under a monitored plan.
- For established hypernatremia, generally limit the sodium fall to about 0.5 mmol/L/hour and no more than 10–12 mmol/L/day.
- Recheck sodium early and repeatedly, and change the fluid plan if the concentration falls faster or slower than intended.
- A rapid fall can cause cerebral edema because the brain has adapted to the high extracellular osmolality.
- Investigate diabetes insipidus or renal loss when excessive dilute urine continues despite hypernatremia.

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