# Hyponatraemia and hypernatraemia

## *Executive summary*

## Introduction

Abnormalities in serum sodium are relatively common in our admitted population – especially in those with hypertension, heart failure or liver disease. An abnormal sodium level has been shown to be associated with poor outcome following hospital admission. It is very important that these abnormalities are noticed and responded to as soon as possible.

Remember that abnormalities can result from laboratory errors or other factors around specimen collection and storage. It is very important to relate any abnormal results to the clinical state of the patient and to repeat the laboratory test whenever there is any uncertainty.

Note:

TBW (men) = 0.6 L/kg × weight in kg

TBW (women) = 0.5 L/kg × weight in kg

## Target users

* Doctors
* Nurses

## Target area of use

* Outpatient department
* Ward

## Key areas of focus / New additions / Changes

This guideline describes the correction of abnormal sodium results.

Note that great care should be taken in correcting the sodium level in malnourished children. Commonly, these children have raised total body sodium even if the serum sodium level is reduced. Usually the blood results will improve as the nutrition status improves.

Rapid shifts in serum sodium are associated with irreversible brain injury so correction must be undertaken cautiously.

## Limitations

We do not keep hypertonic or hypotonic sodium solutions.

# Hyponatraemia

This is defined as Na < 135 mmol/L. It is severe if ≤ 120 mmol/L.

## Causes

* Isotonic hyponatraemia: hyperlipidemia or proteinaemia
* Hypertonic hyponatraemia: glucose or mannitol infusion.
* Euvolemic hyponatraemia: syndrome of inappropriate ADH (SIADH) secretion, hypothyroidism, adrenal insufficiency and medications such as thiazide diuretics, NSAIDs and SSRIs
* Hypovolemic: haemorrhage, vomiting, diarrhoea, burns
* Hypervolemic: congestive heart failure, liver cirrhosis.

## Presenting symptoms and signs

Symptoms and signs are usually obvious in patients who have sudden onset of hyponatraemia or have severe hyponatraemia and they include :

* Headache
* Lethargy
* Nausea
* Depressed reflexes
* Disorientation
* Seizures
* Coma

Other symptoms and signs are dependent on the volume status of the patient:

* Dizziness, postural hypotension and syncope – hypovolaemia
* Peripheral oedema, pleural effusion or ascites – hypervolaemia

## Management

Medications such as diuretics should be reviewed or stopped if they are thought to be responsible for hyponatraemia.

The causes of hyperlipidaemia and hyperproteinaemia should be found and treated.

Endocrinologic disorders should be managed accordingly. SIADH is managed with fluid restriction at first and then diuresis if there is no improvement.

The treatment of hypervolemic hyponatraemia is with diuresis - preferably loop diuretics.

### Correction

* Na deficit (mmol/L) = Total Body Water (TBW) × (140 – measured serum Na concentration)

Normal saline is used for correction of hyponatremia in our setting and this can be calculated using the following formula:

* Change in serum Na = Infusate Na – Serum Na / (total body water +1)

This gives the change in serum sodium per litre of infusate. Note: Infusate Na is 154 mmol/L for 0.9% saline intravenous infusion.

Use the calculator on this website to determine the infusion rate: <https://www.mdcalc.com/sodium-correction-rate-hyponatremia-hypernatremia>

Correction should be done at a rate of 1-2 mmol/L/hour (in acute conditions) or 0.5 mmol/L/hour (in chronic conditions) over 40 hours. Fifty percent of the fluid should be given in the 1st 24 hrs and not exceeding 12 mmol/24hrs. This is to prevent cerebral pontine myelinolysis

Monitoring of serum Na should be done after every 4-6 hours.

# Hypernatraemia

This is defined as Na > 145 mmol/L. It is severe if ≥ 160 mmol/L.

## Causes

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| --- | --- |
| **Type of fluid loss or gain** | **Causes** |
| Net water loss | * Unreplaced insensible loss (dermal and respiratory) * Inadequate fluid intake/impaired thirst – typically in elderly people * Diabetes insipidus |
| Hypotonic fluid loss | * Renal causes, e.g. osmotic diuresis in uncontrolled diabetes * Medicines, e.g. loop diuretics, mannitol, urea, corticosteroids (increase production of urea), high protein supplements * Gastrointestinal losses, e.g. diarrhoea, vomiting, fistulae, use of osmotic laxatives (lactulose, sorbitol) * Cutaneous loss, e.g. burns, excessive sweating |
| Hypertonic fluid gain | * Ingestion of salt, salt water, sodium rich enemas * IV hypertonic infusions, e.g. sodium bicarbonate, sodium chloride |

## Presenting symptoms and signs

These become obvious as the hypernatraemia becomes more severe:

* Thirst
* Fever
* Sensorium change
* Seizure
* Focal neurological deficits
* Hyperventilation

## Management

Stop or decrease dosage of medications and infusions which are likely causes of hypernatremia.

### Adults

**Mild to moderate hypernatraemia** (Na 146-159 mmol/l): oral water therapy may be sufficient.

**Severe hypernatraemia** (Na > 160 mmol/l): use IV 5% Dextrose with the aim to reduce Na at a rate of 0.5 mmol/hr and not more than 10 mmol/24hrs. Monitor Na every 4 hours. Note that too rapid a correction of the Na can cause cerebral oedema, convulsions and brain injury.

### Children

**Mild hypernatraemia** (Na 146-149 mmol/l): enourage drinking. Stop any feed fortifications (eg extra scoops of formula – not F75 or F100).

**Moderate hypernatraemia** (Na 150-169 mmol/l):

If "shocked", resuscitate with boluses 20ml/kg of 0.9% saline as required.

After initial resuscitation, replace the deficit plus maintenance slowly at a uniform rate [over 48 hours](https://www.rch.org.au/clinicalguide/guideline_index/Hypernatraemia/#1)**.**

* Nasogastric rehydration is preferred
  + Carefully regulate fluid intake - do not allow excessive intake in a thirsty child.
  + If the serum sodium falls too rapidly (> 0.5 mmol/l/hr) slow the rate of rehydration (for example, by 20%) or change to intravenous fluids.
* If needing intravenous rehydration use **0.9% sodium chloride (normal saline) and 5% Glucose**. Add maintenance KCl once urine output established.
* Check U&Es and glucose frequently intially.
* If after 6 hours of rehydration therapy, the sodium is decreasing at a steady rate then check the U&Es and glucose 4 hourly.
* If serum sodium is falling faster than 1 mmol/l/hr, stop infusate and seek senior support.

**Severe hypernatraemia** (Na > 170 mmol/l):

This is a medical emergency. After initial resuscitation, aim to replace deficit and maintenance with **0.9% sodium chloride (normal saline) and 5% glucose** over 72 - 96 hours. Seek senior support early and monitor U&Es up to hourly. Involve lab staff as soon as possible.

### Calculation

* Water deficit (in litres) = TBW × ([Na/140] – 1

This determines the amount of fluid to be infused over 48 hours.

* Change in Na = Infusate Na – Na / (total body water +1)

This gives the change in Na per litre of infusate. If using 5% dextrose the infusate Na is 0.

You may use the calculator on this website to determine the rate of fluid infusion : <https://www.mdcalc.com/sodium-correction-rate-hyponatremia-hypernatremia>

## Key Issues for Nursing care

* Severe hyponatraemia and hypernatraemia can both have serious long term consequences. These can be worsened if the correction is too rapid.
* Follow the fluid instructions very carefully.
* Make sure repeat tests are done on time and are reviewed by a doctor promptly.
* All patients with abnormal Na levels should have strict monitoring of fluid input and output.

## References

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Kraft MD, Btaiche IF, Sacks GS, Kudsk KA. Treatment of electrolyte disorders in adult patients in the intensive care unit. American Journal of Health-System Pharmacy. 2005 Aug 15;62(16):1663-82.

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