Queensland Government

Prescribing HYPO-Electrolyte Disturbances in Adults

To remain in end-of-bed folder

- **Electrolyte disturbances that are difficult to treat often indicate significant disease or coexisting ion disturbances – Seek Advice.**
- Unit-specific protocols for electrolyte disturbances take precedence over these guidelines.
- Where several treatment options are provided, undertake in a stepwise fashion not concurrently. Sufficient time between interventions should elapse to ensure maximal response has occurred.
- Rapid administration of electrolytes or correction of severe derangements may result in cardiac arrhythmias - consider cardiac monitoring.
- Electrolyte solutions are incompatible with blood products, some medications and often each other. Seek advice before mixing together in an infusion or giving simultaneously via the same IV line.

1. HYPOkalaemia (Mild: 3.1–3.5mmol/L, Moderate: 2.5–3mmol/L, Severe: less than 2.5mmol/L)

- Plasma levels below 3.0mmol/L may result in arrhythmias. Consider cardiac monitoring.
- May be due to Total Body Deficit (where a 1mmol/L drop in plasma level represents a total body loss of 200 to 400mmol) or trans-cellular redistribution caused by a range of conditions and drugs (e.g. metabolic acidosis, diabetic ketoacidosis, insulin and salbutamol).
- If resistant, check magnesium and replace if necessary, check for medications which may decrease potassium (e.g. diuretics). Ensure potassium containing fluid is administered as necessary (see *IV Fluid Guidelines*).

Moderate to severe hypokalaemia

- Treat with both IV and (where possible) oral supplementation. Patients usually require at least 60–80mmol potassium extra in next 24 hours (i.e. 100–140mmol in total, including normal daily requirements).
- Repeat plasma levels 4 hours after commencing treatment and review plan.

- **All potassium containing infusions must be given via an infusion pump or burette.**
- **Maximum CONCENTRATION peripherally = 40mmol/L** to prevent phlebitis.
- **If maximum concentrations are exceeded;** administer through a large vein with high blood flow (e.g. femoral vein) or central venous catheter.
- EXCEPTION: isotonic, premixed minibags (potassium 10mmol in 100mL) can be given peripherally. Minibags MUST be given via an infusion pump.
- **Maximum RATE:**
  - » **If potassium level above 2.5mmol/L =** 10mmol/hr
  - » **With burette =** 10mmol/hr
  - » **If potassium level below 2.5mmol/L and with infusion pump =** 20mmol/hr
- **If maximum rate (above) exceeded;** cardiac monitoring, frequent blood monitoring and an infusion device required. Administer through a large vein.

Mild hypokalaemia

- Treat with oral supplementation alone, if oral route available:
  - » Potassium chloride effervescent tablets (e.g. Chlorvescent®) 1–2 tablets (14–28mmol) two or three times daily; ***OR***
  - » Potassium chloride slow release tablets 600 mg (e.g. Span K® or Duro K®) 2 tablets (16mmol) twice daily. Up to six tablets (48mmol) daily in divided doses may be required; ***OR***
  - » If feeding tube present, potassium chloride 10% oral solution (20mmol potassium per 15mL) 15mL two or three times daily.

2. HYPOmagnesaemia (Mild: less than 0.9mmol/L, Moderate: less than 0.7mmol/L Severe: less than 0.4mmol/L)

- Hypomagnesaemia is common in hospitalised patients, especially the severely ill.
- Magnesium may not be included with all electrolyte pathology requests. A specific request may be needed.
- Beware of repeated doses in renal impairment.

Severe or symptomatic hypomagnesaemia (e.g. tremors, weakness, swallowing difficulties, cardiac arrhythmias or seizures)

- Correct with intravenous magnesium sulphate:
  - » Each 5mL ampoule contains 2.47g magnesium sulphate equivalent to 10mmol magnesium.
  - » Administer one to two ampoules (10–20mmol) magnesium in 100mL 0.9% sodium chloride over 1 hour. Can be given more rapidly in emergency situations.
- Review plasma levels or clinical symptoms within 6 to 12 hours.

Mild or asymptomatic hypomagnesaemia

- Treat with oral supplementation:
  - » Magnesium aspartate tablets 500mg (e.g. Magmin®) 1–2 tablets (1.54–3.08mmol) twice daily. Up to 6 tablets (9.24mmol) daily in divided doses may be required. Diarrhoea is a common side effect.

3. HYPOnatraemia (Mild: less than 135mmol/L, Moderate: less than 130mmol/L, Severe: less than 120mmol/L)

- Seek senior advice especially if severe or symptomatic (e.g. drowsiness, headache, seizures).
- Management requires careful assessment of fluid status and biochemical indices.
- Serum sodium concentration should be increased by:
  - » Not more than 0.5mmol/L per hour;
  - » Not more than 10mmol/L in 24 hours to prevent permanent neurological injury.
- The normal mainstay of IV therapy is 0.9% sodium chloride (not hypertonic saline).

Severe or symptomatic hyponatraemia (e.g. drowsiness, headache, seizures)

- Is a **medical emergency**. Consider management in an intensive care/high dependency setting. Hypertonic saline and airway access may be indicated.

Mild or asymptomatic hyponatraemia

- Assess fluid status:
  - » If **hypovolaemic**, correct intravascular deficit with 0.9% sodium chloride (see *IV Fluid Guidelines*);
  - » If **euvolaemic** or **hypervolaemic**, consider potential causes such as medications (SSRI's, diuretics, antiepileptics), conditions associated with inappropriate ADH secretion or reduced effective circulating volume (cirrhosis, cardiac failure). Manage with fluid restriction.
- Repeat plasma levels 6 hours after commencing treatment.

4. HYPOphosphataemia (Mild: less than 0.8mmol/L, Moderate: less than 0.5mmol/L, Severe: less than 0.3mmol/L)

- Phosphate does not normally need replacement until less than 0.6mmol/L except if: alcoholism/withdrawal, malnutrition, re-feeding syndrome, receiving TPN, renal phosphate wasting, recovery from diabetic ketoacidosis or respiratory failure.
- Sodium phosphate and potassium phosphate ("Low-K Phos") contains 13.4mmol of phosphate (and 2.6mmol of potassium) in a 20mL ampoule.

Severe or symptomatic hypophosphataemia (e.g. haemolysis, respiratory failure, cardiac arrhythmias)

- Correct with intravenous phosphate:
  - » Administer one ampoule (13.4mmol) of sodium phosphate and potassium phosphate in 100mL 0.9% sodium chloride over 2 hours (can be given peripherally).
- Repeat plasma phosphate and calcium levels 3 hours after commencing treatment.

Mild to moderate hypophosphataemia

- Treat with oral or IV phosphate:
  - » Administer one ampoule of sodium phosphate and potassium phosphate in a convenient volume of fluid (e.g. 250mL) and infuse slowly over 6 to 12 hours; ***OR***
  - » Effervescent phosphate tablets 500mg (e.g. Phosphate Sandoz®) 1–2 tablets (16.1–32.2mmol) three times daily. Diarrhoea is a common side effect.

5. HYPOcalcaemia (Mild: less than 2.15mmol/L corrected, Moderate: less than 1.9mmol/L corrected, Severe: less than 1.5mmol/L corrected or 0.75mmol/L IONISED)

- **REMEMBER**: Plasma calcium (even corrected for albumin) is an unreliable measure of functional (ionised) calcium.
- If resistant to treatment, exclude hypomagnesaemia.
- Calcium gluconate contains 2.2mmol of calcium in 10mL.
- Extravasation of calcium can cause significant tissue necrosis.

Severe or symptomatic hypocalcaemia (e.g. perioral/finger paraesthesia, seizures, tetany, positive Chvostek's/Trousseau's) or high risk of becoming symptomatic (e.g. post-parathyroidectomy)

- Correct with intravenous calcium gluconate:
  - » Administer two ampoules (4.4mmol) in 100mL 0.9% sodium chloride over 20 minutes.
  - » Consider central venous catheter
  - » A continuous infusion of calcium gluconate ten (10) ampoules (22mmol) in 900mL 0.9% sodium chloride at 50mL/hour (adjusted for calcium levels) should be prescribed for the next 1 to 2 days.
- Repeat plasma calcium level 4 hours after commencing treatment.

Mild to moderate hypocalcaemia

- Treat with oral supplementation:
  - » Effervescent calcium tablets 1g (Calsource®) 1–2 tablets (25–50mmol) daily; ***OR***
  - » Calcium carbonate 1500mg tablets, equivalent to 600mg of calcium, (Caltrate®) 1–2 tablets (15–30mmol) daily. Give **with** food.

Reviewed by Queensland Health Medicines Regulation and Quality, Fluid and Electrolyte Guideline Working Party

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- Rapid administration of electrolytes or correction of severe derangements may result in cardiac arrhythmias - consider cardiac monitoring.
- Electrolyte solutions are incompatible with blood products, some medications and often each other. Seek advice before mixing together in an infusion or giving simultaneously via the same IV line.

1. HYPERkalaemia (Mild: 5.1–5.9mmol/L, Moderate: 6.0–6.4mmol/L, Severe: more than 6.5mmol/L)

- Consider clinical situation. If asymptomatic confirm level. Consider possibility of sample haemolysis.
- Hyperkalaemia is more sinister in setting of acute rapid rise rather than chronic renal failure and, in patients with pre-existing heart failure.

Severe or symptomatic (e.g. muscular weakness and/or ECG changes [e.g. peaked T waves])

- *Institute continuous ECG monitoring.*
- **Seek senior advice**. Consider:
  - » Protecting heart:
    a. If ECG abnormalities are present - calcium gluconate one ampoule (2.2mmol of calcium) IV via a central vein or slowly over 2–3 minutes into a large vein. If ECG does not normalise within 10 minutes, dose may be repeated (to a total of 0.1mmol/kg).
  - » Reducing serum potassium level:
    a. Intravenous glucose and insulin - glucose 50% 50mL with 10 units short-acting insulin IV over 5 minutes. Monitor blood glucose levels hourly; **and/OR**
    b. Nebulised salbutamol 10 mg (2 of the 5mg/2.5mL nebules); **and/OR**
    c. If metabolic acidosis present, sodium bicarbonate 8.4% 50mL IV over 5–15 minutes.
  - » Removing potassium from the body:
    a. Resonium-A® - give 15–30g orally up to four times daily or 60g as a retention enema daily; **and/OR**
    b. Dialysis - urgent dialysis may be required.
  - » Reviewing medication:
    a. Withhold any potassium retaining drugs (ACE inhibitors, angiotensin receptor antagonists, potassium sparing diuretics) or potassium supplements.
- Monitor potassium level hourly.

Mild to moderate or asymptomatic

- Place on a low potassium diet.
- Withhold potassium-containing drugs (e.g. Span-K®) and if possible, drugs that may cause or aggravate hyperkalaemia (e.g. spironolactone, trimethoprim, β-blockers, NSAIDs, ACE inhibitors, angiotensin receptor antagonists, digoxin).
- Monitor potassium levels every 12 hours.

Long term management

- Review for possible reversible causes of hyperkalaemia (e.g. haemolysis, acidosis, renal impairment).

2. HYPERcalcaemia (Mild: 2.55–3.0mmol/L, Moderate: 3.0–3.2mmol/L, Severe more than 3.2mmol/L - corrected)

- Hypercalcaemia is most commonly due to primary hyperparathyroidism ***OR*** hypercalcaemia associated with malignancy.

Moderate to severe or symptomatic (e.g. lethargy, coma, ECG changes [shortened QT interval])

- Rehydration - intravenous sodium chloride 0.9%. Volume infused should be sufficient to maintain a large urine output (e.g. 60mL/hr). **Seek senior advice.**
- Bisphosphonate therapy - see local guidelines or if not available, consider intravenous disodium pamidronate.

Corrected Calcium (mmol/L)	**Total Pamidronate Dose** (mg)
3.0–3.5	30–60
3.5–4.0	90
More than 4.0	90; and consider dialysis

- Administer as infusion in 250mL sodium chloride 0.9% or glucose 5%.
- Infusion over 30 to 90 minutes at a rate not exceeding 1mg/minute.

N.B. Renal impairment: Pamidronate is not recommended in patients with CrCl less than 30mL/min. Seek expert advice. In less severe renal impairment, reduce the infusion rate to 20mg/hr.

Long term management

- Review for possible causes including diet/supplements (vitamin D or calcium); sarcoidosis and other granulomatous disease; drug causes such as calcitriol (Rocaltrol®) excess or thiazide diuretics; and hypercalcaemia due to spinal cord injury and/or immobility.

3. HYPERnatraemia (Mild to Moderate: 145–159mmol/L, Severe: more than 160mmol/L)

- Seek senior advice especially if severe or symptomatic.
- Often due to fluid deficit - refer to *IV Fluid Guideline.*
- Oral fluid replacement, with **water**, is safest.

Severe or symptomatic (e.g. hyperthermia, delirium, seizures, coma)

- Is a **medical emergency**. Consider management in an intensive care/high dependency setting.
- Serum sodium concentration should be reduced by:
  - » Not more than 0.5mmol/L per hour;
  - » Not more than 10mmol/L in 24 hours to prevent permanent neurological injury.
- Intravenous fluids without added sodium (generally glucose 5%) may be needed.
- Monitor every 4 hours in the first 24 hours.

4. HYPERmagnesaemia (Severe: 2.5mmol/L)

- **May be deliberate in pregnancy.** Magnesium is used to treat/prevent eclampsia/severe pre-eclampsia. **Always** contact Obstetrician.

Severe or symptomatic (e.g. loss of deep tendon reflexes, respiratory depression, paralysis, reduced consciousness)

- Intravenous calcium gluconate provides immediate but transient antagonism of toxic effects.
- One ampoule (2.2mmol) of calcium gluconate in 0.9% sodium chloride should be administered over 5 minutes. Repeat if necessary.
- Kidney excretion should be promoted with intravenous sodium chloride 0.9%, aiming for a urine output of at least 60 mL per hour.
- If this urine output can't be achieved, intravenous frusemide can be added.
- Dialysis may be needed.
- Review diet/medication use for antacids, enemas, supplements and lithium.