

This Medicines Information Leaflet is produced locally to optimise the use of medicines by encouraging prescribing that is safe, clinically appropriate, and cost-effective to the NHS.

Guidelines for the Management of Hypokalaemia in Adults

Hypokalaemia is defined as a plasma potassium concentration of less than 3.5 mmol/L. This MIL summarises the preparations and methods of potassium supplementation recommended in this Trust. Potassium is essential for numerous metabolic and physiological processes, including nerve conduction, muscle contraction, and acid-base regulation. Potassium is primarily excreted by the kidneys. Abnormal potassium levels (both hypokalaemia and hyperkalaemia) increase the risk of life-threatening complications. Prompt treatment with concurrent monitoring is essential to resolve the hypokalaemia without causing hyperkalaemia.

Potassium levels in healthy Adults:

Normal: 3.5 to 5 mmol/L

Cardiac patients, aim: 4.5 to 5 mmol/L

Potassium levels in hypokalaemia (mmol/L):

Mild	Moderate	Severe
3 – 3.5	2.5 - 3	Less than 2.5

Common causes of hypokalaemia

- Excessive losses such as vomiting, diarrhoea, urinary output, or sweating.
- Inadequate oral intake.
- Medications: including diuretics*, insulin, corticosteroids, laxatives, sympathomimetics, enemas, or bowel preparations.
- Magnesium depletion and medicines causing this e.g., amphotericin, aminoglycosides.
- Acid-Base disturbances: Renal tubular acidosis, alkalosis

*For the long-term prevention of diuretic-induced hypokalaemia, adding a potassium-sparing diuretic

(i.e., amiloride) may be considered in preference to oral potassium supplementation.

Treatment

Correct any underlying disorder and start potassium supplementation via the enteral (oral or through feeding tubes) or parenteral (intravenously) route.

Choice of route depends on; the cause and degree of hypokalaemia, whether the patient has enteral or intravenous access and the severity of the patient's clinical condition (see table 1 below). Replacement requirements need patient individualisation with close monitoring.

Enteral Potassium Preparations

This is the preferred route of administration for preventing or treating asymptomatic, mild to moderate hypokalaemia because it is safe and easy to administer, and potassium is readily absorbed from the GI tract.

Wherever possible, give with or after food to minimise GI irritation and osmotic laxative effect.

The need for potassium supplementation should be reviewed **daily** and **especially at discharge**.

The usual dose for treatment at this Trust is potassium chloride 20-24mmol three times a day for 3 days. Potassium blood levels should be rechecked on day 3 as a minimum.

⚠ Enteral and intravenous (IV) potassium must NOT be given simultaneously owing to the risk of error and uncertain enteral absorption which has the potential to cause serious patient harm.

Table 1: Potassium chloride treatments (summary)

Serum potassium level and symptoms	Mild or moderate (3.5mmol/L – 2.5mmol/L) <u>and</u> asymptomatic	Severe (Less than 2.5mmol/L) <u>or</u> symptomatic
Patient's able to tolerate enteral therapy	Dose: 20-24mmol three times a day for 3 days 1st line: Potassium Chloride effervescent tablets [Sando-K®] – 12mmol of potassium per tablet. Disperse in water, monitor for diarrhoea 2nd Line: Potassium Chloride solution [Kay-Cee-L®] – 1mmol of potassium/ml. Recommended when Sando-K® is not tolerated or unsuitable. Check potassium at least every 3 days	Enteral rarely appropriate
Patient on IV therapy only	- Amount depends on clinical features such as losses or not (see appendix 1 below) - Use a ready diluted potassium bag (see choices below) at 10mmol/h - Check serum potassium levels daily	- Amount depends on clinical features such as losses and presence of arrhythmias (see appendix 1 below) - Use a ready diluted potassium bag (see choices below) at maximum 20mmol/h - Monitor cardiac rhythm with ECG - Check serum potassium levels every 2 hours whilst replacing or arrhythmias - In emergencies theatres and ED resus can request 20mmol/50ml potassium syringes (see appendix 2 below)



Mis-selection of potassium-containing solutions are documented on the list of “Never Events” issued by the Department of Health.

Death or severe harm has been associated with maladministration of potassium and is deemed a “serious, largely preventable patient safety incident”. This includes the wrong selection of potassium chloride concentrate injection instead of the intended medicine; peripheral instead of central administration of potassium, and infusion rate greater than intended.

Parenteral Potassium Chloride Preparations

Patients will require parenteral potassium if they have:

- Severe potassium deficiency (less than 2.5 mmol/L).
- Symptoms of hypokalaemia (regardless of levels).
- Unable to tolerate sufficient potassium enterally.

Replacing potassium too quickly can cause a rapid rise in the plasma potassium concentration, with cardiac complications associated with hyperkalaemia. **Slow IV infusion is essential**; potassium is potentially fatal if given too rapidly. The rate of IV replacement is limited by the slow transfer of potassium to the intracellular compartment.

Sodium chloride 0.9% is the preferred diluent.

Initial replacement with glucose infusions stimulates insulin secretion, which may further reduce the plasma potassium concentration.

No additives (including extra potassium) are permitted to premixed infusions without a local protocol that has been approved by MMTC.

Patients should be managed using a **pre-mixed potassium infusion**. Several specialist premixed infusions are kept in pharmacy, e.g., for use with intravenous insulin infusions, including Diabetic Ketoacidosis. Those available in the Trust are shown in Tables 3 and 4.

Potassium bags must be carefully mixed (including inversion) prior to use as potassium is dense and can settle at the bottom of the bag leading to a higher concentration in the initial stages of the infusion.

Available parenteral Potassium Chloride Preparations

Table 2: Pre-mixed infusions available at OUHFT

Potassium content	Bag size	Diluents available
10 mmol (0.15%)	500 mL	Sodium Chloride 0.9% Sodium Chloride 0.45% and Glucose 5% Sodium Chloride 0.18% and Glucose 10%* Sodium chloride 0.9% and Glucose 5%# Glucose 10%
20 mmol (0.3%)	500 mL	Sodium chloride 0.9% Sodium chloride 0.9% and glucose 5%# Sodium chloride 0.45% and glucose 5%# Glucose 10%#
20 mmol (0.15%)	1000 mL	Sodium chloride 0.9% Sodium chloride 0.18% and glucose 4% Sodium chloride 0.45% and glucose 2.5%# Glucose 5%
40 mmol (0.3%)	1000 mL	Sodium chloride 0.9% Sodium chloride 0.18% and glucose 4% Glucose 5%
Additional Information: May be administered peripherally (40 mmol/L maximum recommended concentration for peripheral administration) Maximum rate 20mmol per hour May be kept as ward stock or ordered via pharmacy Do not need to be ordered as controlled drugs		

Unlicensed medicine

* Special restricted – not readily available but can be ordered

Table 3: High concentration pre-mixed infusions for specialist use

Potassium content	Bag size	Diluents available
40 mmol (0.6%)	500 mL	Sodium chloride 0.9%# Glucose 5%#*
Additional Information: High concentration potassium Maximum rate 20mmol per hour Should be given centrally wherever possible May be given via a large peripheral vein when excessive fluid load is likely to be a concern where: ▪ ECG monitoring must be done concurrently ▪ The high risk of local pain and phlebitis which can occur at concentrations above 30 mmol/L should be balanced with concerns about fluid load Treat as a Controlled drug. Only supplied by pharmacy in response to an individual patient prescription or stock in authorised area. Only for use in patients with fluid restrictions, not for rapid potassium replacement in hypokalaemia		

Unlicensed medicine

* Reserved for situations when sodium chloride 0.9% is inappropriate

Table 4: High concentration pre-filled syringes for use in critical care and other urgent specialist care settings[§]

Potassium content	Syringe size	Diluents available
20 mmol	50 mL	Sodium Chloride 0.9% [#]
Must be administered by a central line only. Rate: • 10 to 20 mmol per hour with continuous ECG monitoring. The use of 20 mmol potassium in 50 mL outside these areas must be approved by a specialist registrar or consultant and supply must be authorised by medicines safety or senior on call pharmacist.		

[§] Urgent specialist care areas may include resuscitation in the emergency department, theatres with central access or in Haematology via a Hickmann central line.

[#] Unlicensed medicine

Potassium chloride concentrate ampoules are non-formulary for adult hypokalaemia, as ready-mixed infusion preparations are available. Death has occurred when they have been confused with other ampoules.

Monitoring and Administration

- All patients receiving IV potassium chloride should have plasma concentrations checked at least once daily. Potassium measured on a blood gas analyser is comparable to plasma concentrations, although using a consistent method for monitoring is preferable.
- Patients with severe renal failure and those taking medications that can increase potassium are particularly at risk of hyperkalaemia.
Caution: many elderly patients have mild renal impairment. Information regarding medicines that can increase potassium can be found in the [Management of hyperkalaemia MII](#).
- It is good practice to conduct **independent double-checks** for administration of all IV potassium chloride prescriptions, including a double check of the infusion rate. Independent double checks are **essential** for the administration of IV potassium chloride concentrations of 40 mmol/L and greater.
- Usual regular pump checks should be conducted and recorded for all infusions, ideally every hour, if practical.
- Continuous ECG monitoring is essential for infusion rates at or above 20 mmol per hour.
- For infusion concentrations of 40 mmol/L and above, the infusion rate must be accurately controlled by an infusion pump or syringe driver. Do not use drip rate counters or burettes.
- In unstable arrhythmia **where cardiac arrest is imminent**, potassium may be given more quickly than the rates advised above. Clinicians should **only** do so if trained and confident in the application of the

Resuscitation Council UK Advanced Life Support Guidelines 2021.

Potassium on discharge

- Patients who have had hypokalaemia during admission, or who are at risk of hypokalaemia, should have their potassium checked prior to discharge.
- Replacement should be considered if potassium is less than 3.5 mmol/L.
- Patients should not be discharged if they have severe or symptomatic hypokalaemia.
- All patients requiring supplementation on discharge should have arrangements made for their level to be re-checked by the GP.
- "Potassium chloride" should be clearly expressed in full; the chemical symbol should not be used.

Safe medication practice for potassium infusions

- The prescription must indicate the:
 - ✓ Potassium dose in millimoles (mmol)
 - ✓ Infusion rate
 - ✓ Volume and choice of diluent
 - ✓ Route, including special needs e.g., central
- If a patient is on TPN and the medical team have concerns about hypokalaemia, advice should be obtained by contacting the nutrition team or the on-call pharmacist out of hours.
- **Potassium chloride concentrate injection must never be used as an additive for intravenous infusions in adults, as ready mixed solutions are available in general wards.**

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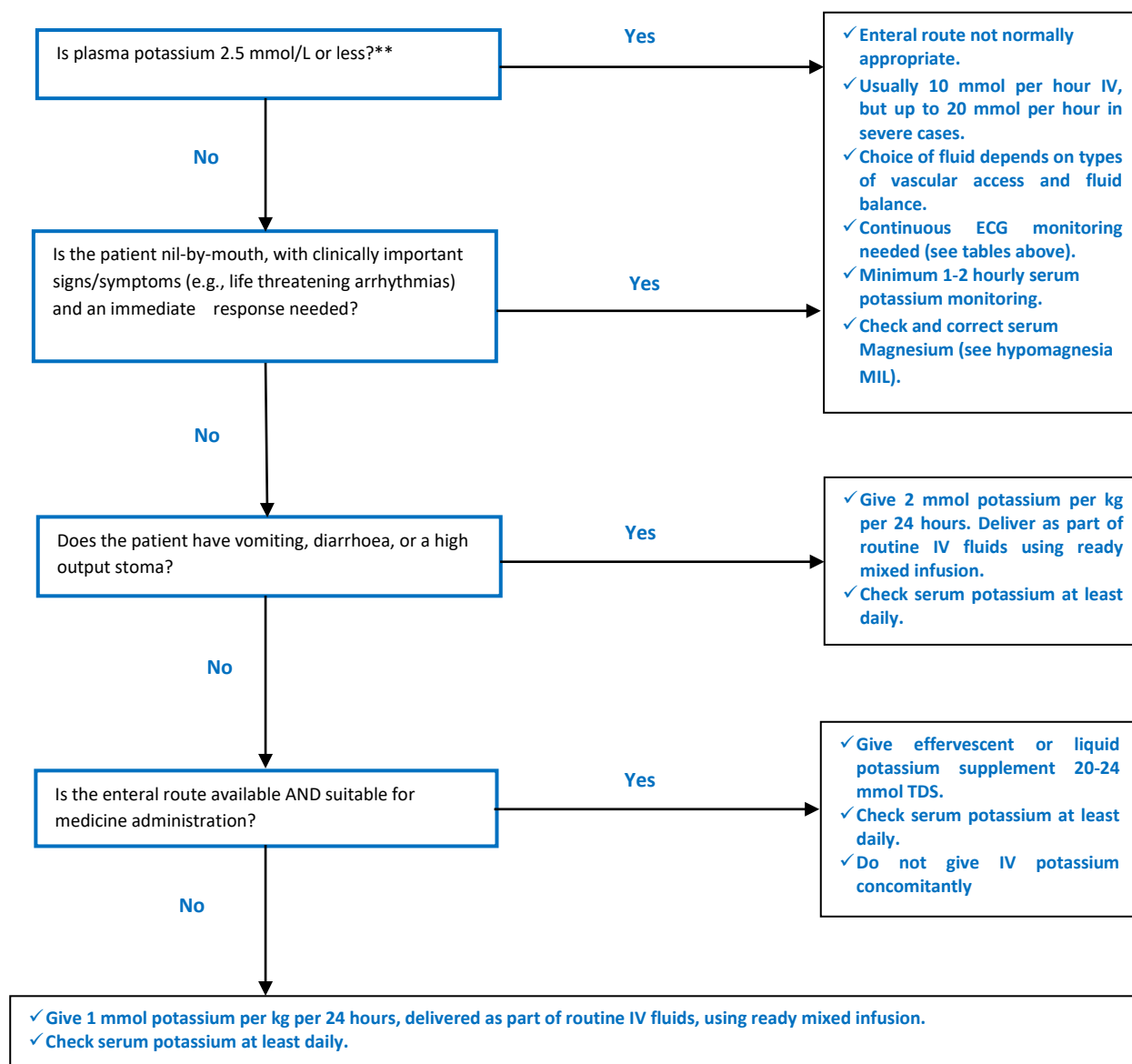
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Updated by C Hallett (Resident Pharmacist), May 2017.

Updated by L Ghigino (Critical Care and Anaesthetics pharmacist), August 2022

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Appendix 1: Algorithm for initial potassium replacement in adults (normal renal function and adequate urine flow)

Patients are more likely to be harmed from inappropriately aggressive IV potassium than by too slow replacement, unless significantly symptomatic or critically ill, in which case they require monitoring in a critical care environment.



****Patients with chronic hypokalaemia may have accommodated to their potassium concentrations and rapid changes should be avoided. Review the patient and their medications for remedial causes. Consider amiloride (5 mg daily) to reduce losses, as oral supplements are usually ineffective.**

Appendix 2: How to access potassium chloride 20mmol/50ml prefilled syringes in an Emergency

For use in theatres and emergency department resus area on the **John Radcliffe**, **Churchill**, and **Horton** sites in cases of **emergency** where the following conditions are satisfied:

Patient specific parameters

Patient must have:

- central access
- a cardiac monitor
- a potassium less than 2.5mmol/l (or there is strong clinical suspicion that potassium will fall to less than 2.5mmol/l shortly)
- signs of/risks from fluid overload
- an appropriate prescription

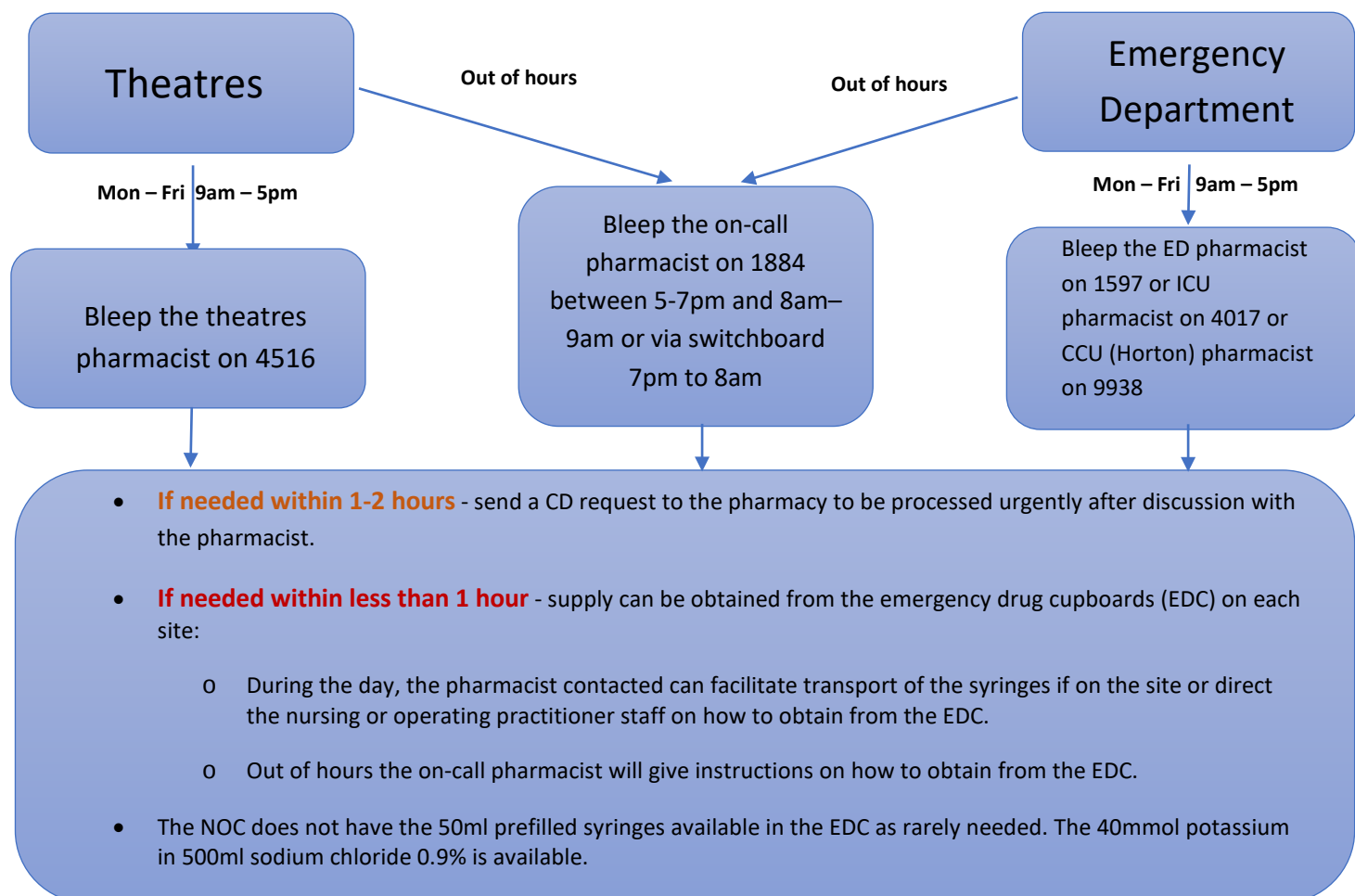
Requesting clinician parameters

The requesting clinician:

- is a registrar or consultant
- is trained in administering high strength potassium
- is willing to be the person to set up the potassium, routinely check on the administration of the potassium and ensures that monitoring is being carried out and is acted on
- hands over the usage of the high strength potassium
- ensures any unused potassium is appropriately disposed of
- ensures there is an appropriate label attached

The 20mmol/50ml prefilled syringes **cannot be given faster than 20mmol/hour** which is the same as other potassium containing fluid. If a patient has low potassium replace with available fluid and ensure appropriate monitoring until the concentrated potassium can be obtained.

ED areas have ward stock of the 40mmol potassium chloride in 500ml sodium chloride 0.9% which is available in the CD cupboards.



If the patient is **NOT** going to a critical care area the potassium syringe administration must be completed or stopped and the syringe removed and destroyed. **Handover** that potassium syringe has been given must happen regardless of receiving area.