Liverpool Heart and Chest Hospital NHS
NHS Foundation Trust

Reference Number: FOI202324/248
From: Commercial

Date: 25 August 2023

Subject: Quality Improvement projects within Urology, Clinical Guidelines within the field of Urology and Clinical Chemistry / Electrolyte Guidelines

Q1 A list of all current and past audits and quality improvement projects started within the urology and general surgical department over the last 10 years.

a. Please provide date started, date completed, title, objectives, summary, action plan, whether the action plan was completed, and any closing of the loop/repeat.

A1 Information not held – we do not have a Urology or General Surgery department

Q2 A list of all current clinical guidelines within the field of urology.

a. Please provide a summary table of each guideline, when it was first created, last updated, frequency of updates
b. Please provide a copy of each guideline in word document or pdf form.

A2 Information not held – we do not have a Urology department

Q3 A list of clinical chemistry/electrolyte guidelines (e.g. hyperkalaemia, hypokalaemia etc)

a. Please provide a summary table of each guideline, when it was first created, last updated, frequency of updates
b. Please provide a copy of each guideline in word document or pdf form.

A3 Please see attached document - Potassium Management Protocol V5.1 Sept 2023 - FINAL

Potassium Management

Protocol

For completion by Author			
Author(s) Name and Title:	Dr Ratnasingham, Consultant Anaesthetist / Intensivist, M Vincent / Deputy Chief Pharmacist		
Scope:	Trust Wide	Classification:	Clinical
Version Number:	5.1	Review Date:	18/05/2024
Replaces:	5.0		
To be read in conjunction with the following documents:	Medicines Policy, Medicines Administration Procedure, Parenteral Therapy Policy		
Document for public display:	No		
Executive Lead	Dr Perry		

For completion by Approving Committee				
Equality Impact Analysis Completed:			No	
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Authorised by:	Drug & Therapeutics Committee		Authorisation date:	18/05/2022

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Officer responsible for Archive:	IG and Document Control Facilitator				

Contents

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Document Statement

The purpose of this policy is to provide guidance to maintain every patient's potassium levels at an optimum range. This policy will outline:

a) Management and replacement of potassium within critical care,
b) Treatment of hyperkalaemia within all areas, and
c) Hypokalaemia management on ward areas.

1. Roles and Responsibilities

Nursing staff within the trust should be familiar with this guideline and know when to seek medical intervention on their patient's behalf. All Registered Nurses who have successfully completed a drug administration competency process and are familiar with the Medicines Policy, Medicines Administration Procedure and Parenteral Therapy Policy are able to apply this protocol to appropriate patients once the potassium has been appropriately prescribed.

It is the responsibility of medical staff to read and be familiar with the contents of the guideline as well as to be familiar with the physiology of potassium. Understanding the causes of hyper or hypokalaemia is vital and attention must be paid to future prevention as well as treating the acute problem. It is also the doctor's responsibility when caring for patients with this condition to seek more experienced help if indicated and to do so in a timely manner. Medical staff should ensure that patients have appropriate monitoring of their serum potassium measurements. The treatments included in this guideline will all need to be prescribed and supervised by doctors. Medical staff working on the ITU and POCCU who are familiar with, and have received training in the critical care protocol, are responsible for prescribing potassium chloride according to the Trust's Medicines Policy

2. Controlled Document Standards

Following cardiac surgery the ideal serum potassium concentration is between 4.5 and 5.0 mmol/L. Extremes of serum potassium both high and low are arrhythmogenic; patients who have undergone cardiac surgery are particularly sensitive to changes in potassium.

The guidelines are to be used by medical staff within the trust responsible for the management of patients with hyperkalaemia or hypokalaemia. Patients being cared for within this trust have a higher level of cardiac and renal disease both of which predispose them to hyperkalaemia. The hyperkalaemia guideline has been adapted from that produced by Drs J Tapson, M Brady, N Leech (Newcastle Freeman Hospital 2008).

3. Procedure

This protocol consists of 3 sections:

- 3.1 replacement of potassium within critical care,
- 3.2 treatment of hyperkalaemia and
- 3.3 treatment of hypokalaemia

3.1 Replacement of Potassium within Critical Care (ITU, POCCU)

This part of the protocol applies to all Registered Nurses within the POCCU and ITU who are deemed competent in intravenous drug administration.

The aim of treatment is to maintain serum potassium concentration of 4.5 -5.0 mmol/L

- **Inclusions** - the protocol is for use following any cardiac surgery.
- **Exclusions** - If urine output is less than 30 ml per hour, or if the patient has known renal impairment, the patient is not suitable to have the potassium protocol prescribed for them.

3.1.1 Prescribing and Administration

The responsible medical clinician (registrar) will prescribe the potassium protocol as follows:

Potassium 20 mmol in 50 mL infusion, prescribed using the electronic patient record which has a pre-set prescription (order set).

The administration of potassium in accordance with this protocol will only be administered by a registered nurse competent in intravenous drug administration.

3.1.2 Frequency of Potassium Estimations

1. In the first 6 hours after cardiac surgery the potassium level should be checked 1-2 hourly.
2. If there is a change in serum potassium of more than 0.5 mmol/L between any two samples then a further sample must be repeated within two hours after the last sample was analysed.
3. If there is a change in serum potassium of more than 1mmol/L then repeat the sample and inform the registrar on duty immediately.

3.1.3 Maintenance Fluids and Potassium Administration

When calculating the rate of administration of maintenance fluid, the volumes of fluid required for potassium administration should be taken into account.

If serum potassium is less than 3.0 mmol/L, call the surgical registrar on duty and also commence 20 mmol potassium in 50 mL infusion to run over 15 minutes I.V.

For patients unable to take oral or nasogastric medication:

If serum potassium is 3.1-3.4 mmol/L, commence 20 mmol potassium in 50 mL infusion and administer IV over 15 minutes. Recheck serum potassium 30 minutes after this is complete.

If serum potassium is 3.5-4.0 mmol/L, commence 20 mmol potassium in 50 mL infusion and administer IV over half hour. Recheck serum potassium 1 hour after this is complete.

If serum potassium is 4.1-4.5 mmol/L, commence 20 mmol potassium in 50 mL infusion and administer 25mL IV over next hour (to give 10mmol potassium). Recheck serum potassium 1 hour after this is complete.

If serum potassium 4.6-5.5 mmol/L - no action required.

If serum potassium is greater than 5.5 mmol/L - inform surgical registrar on duty.

In patients who have progressed to oral or nasogastric medication the preferred route of administration of potassium should be oral or nasogastric. The following instructions for medical staff (for prescribing) and nursing staff (for administration) will then apply:

Serum potassium less than 3.0 mmols/L call surgical registrar on duty.

Serum potassium 3.1-3.6 mmols/L administer Sando K two (2) tablets given orally or via nasogastric feeding tube, then repeat potassium estimation in 4 hours.

Serum potassium 3.7-4.5 mmols/L administer Sando K two (2) tablets given orally or via nasogastric feeding tube. Recheck serum potassium after 24 hours.

Serum potassium 4.5-5.5 mmols/L no action.

Serum potassium greater than 5.5 mmols/L call surgical registrar on duty.

3.1.4 Access

The intravenous administration of potassium should be via a central venous line and dedicated lumen of the central line must be used and not in conjunction with other infusions.

All intravenous infusions will be clearly labelled at the patient end of the line where the line accesses the indwelling central venous catheter (e.g. Multi-lumen catheter).

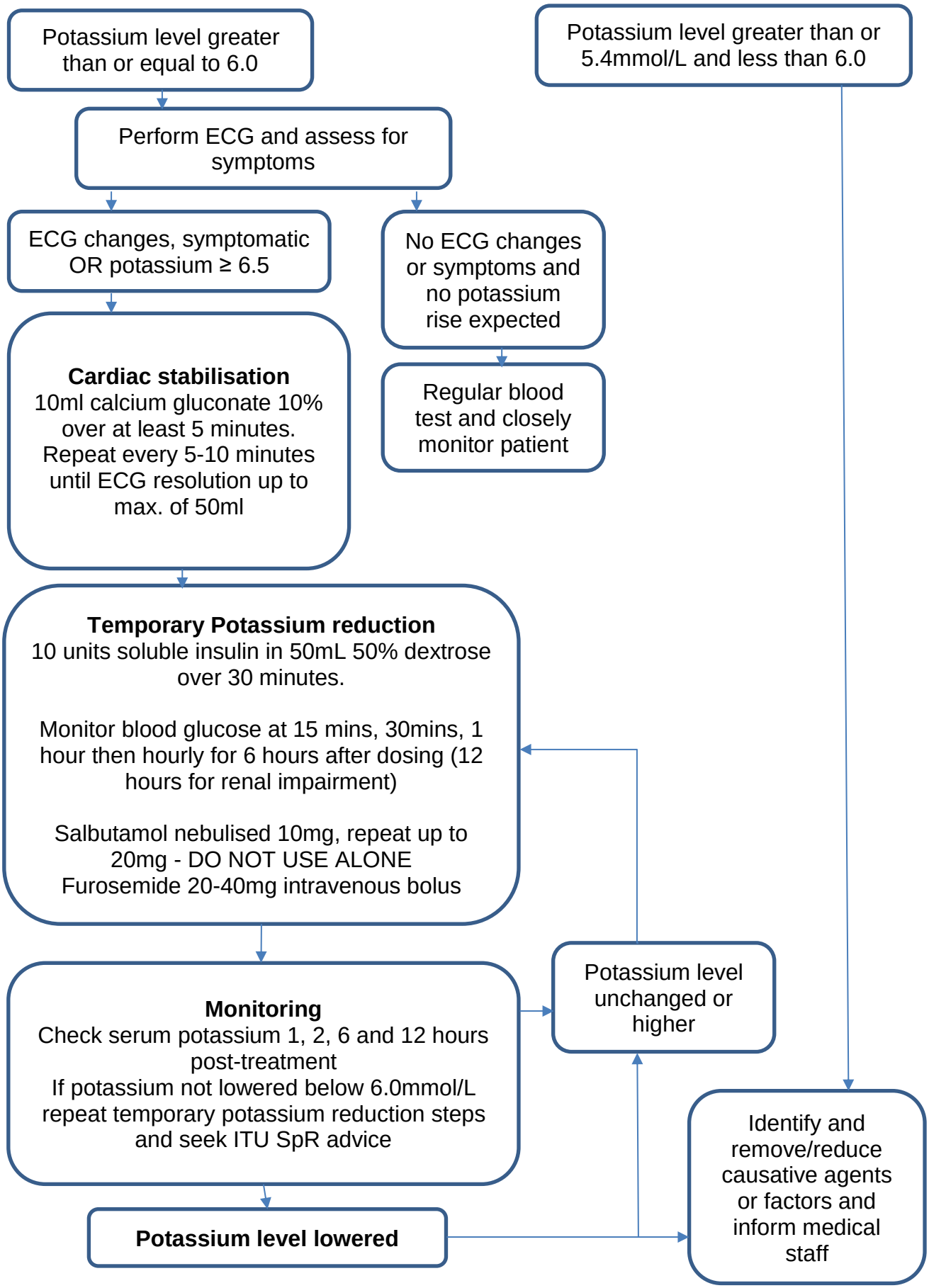
Access Exclusions
Potassium must not be administered via a pulmonary artery catheter introducer or via a peripheral line or any other large gauge IV cannula. If administered via a wide bore port there is a risk the drug could be administered as a bolus rather than over a prescribed length of time.

Administration or "giving" set

Potassium will only be administered using the Baxter rmco334w fine bore solution administration set.

3.2 Treatment of Hyperkalaemia

Emergency Management of Hyperkalaemia for Adult Patients. Notes for use in conjunction with this flow chart are found in section 3.2.1.



3.2.1Reference Notes for Hyperkalaemia Flowchart

3.2.1.1 Assess Severity

Firstly perform an airway, breathing and circulation based assessment taking special note of the patient's volume status. Discontinue any intravenous potassium-containing solutions immediately.
Secondly perform a 12 lead ECG, if there are any changes suspicious of raised serum potassium (Table 1) these require immediate action. Obtain IV access, and urgently repeat serum electrolytes (U&Es) including serum glucose, creatinine kinase & bicarbonate, also check the patient's arterial blood gas. Assess if the patient is symptomatic (Table 2). Review the potassium level and determine if it fits with the clinical picture? (see causes Table 3).
If the patient is asymptomatic with no ECG changes and there is unlikely to be a further potassium rise, review repeat electrolytes. There is no immediate treatment, however monitor the patient closely.

3.2.1.2 Cardiac Stabilisation

If there are ECG changes, administer 10mL 10% calcium gluconate IV over at least 5 minutes.
The onset of action of calcium gluconate is 1-3 minutes and lasts 30-60 minutes. ECG changes should resolve (if secondary to hyperkalaemia). Repeat the ECG after 5 minutes. If there is no resolution, repeat calcium gluconate administration **and** begin temporary potassium reduction measures. If the ECG does not resolve, repeat the administration of calcium gluconate every 5-10 minutes until a maximum of 50mL has been administered.
Ensure continuous ECG monitoring (via lead II would suffice).
Call for senior advice.
If ECG changes remain unresolved alternative causes must be considered.

3.2.1.3 Temporary Serum Potassium Reduction Measures

1. Administer 10 units IV soluble insulin in 50mL 50% dextrose over 30 minutes
This has an onset of action of 10–20 minutes, duration of 4-6 hours. Serum potassium should be lowered by 0.5-1.2 mmol/L
If the blood glucose is greater than 15 mmol/L then 10% dextrose solution will be adequate.
Monitor the blood glucose after 15 minutes, 30 minutes, 1 hour and then hourly for 6 hours after dosing (continue for 12 hours in patients with renal impairment).
2. Administer nebulised salbutamol 10-20mg, 1st dose in 4mL sodium chloride 0.9%.
This has an onset of action of 15–30 minutes, duration 2-6 hours. The serum potassium should be lowered by 0.9-1.4 mmol/L
There is an additive potassium lowering effect with intravenous insulin/glucose. Monitor for tachycardia/tremor.
Never use as sole treatment for patients already taking beta-blockers. (NB 20-40% of dialysis patients may be resistant to the effects of β agonists)
3. Administer furosemide IV bolus 20-40mg. Give in 500mL sodium chloride 0.9% if concerns exist regarding volume status.

Check the serum potassium at 1 hour, 2 hours, 6 hours and 12 hours following treatment.

Repeat temporary reduction measures if the potassium level is not lowered ***and*** **SEEK EXPERT ADVICE** (on-call Intensive Care SpR).

Compare laboratory venous glucose to ward blood glucose meter result to ensure that there is no discrepancy.

There is usually no role for IV sodium bicarbonate unless expert advice suggests otherwise.

4. Oral potassium binders may be used following the above initial treatments.

	1st line	2nd Line	3rd Line
	Sodium zirconium cyclosilicate	**Patiromer**	**Calcium polystyrene sulfonate**
Mechanism	Exchanges sodium and hydrogen for potassium	Exchanges calcium for potassium	Exchanges calcium for potassium
Onset	1 hour	4-7 hours	
Significant side effects	Hypokalaemia Oedema	Hypomagnesaemia Hypercalcaemia Diarrhoea Constipation	Hypomagnesaemia Hypercalcaemia Constipation - administer with regular laxatives
Route	Oral	Oral	Oral / rectal
Dose	10g threes times daily for up to 72 hours	8.4g once daily	15g QDS orally or 30g BD rectally
Maintenance	5g once daily. Amber initiated status on Pan Mersey formulary	8.4g once daily titrated at weekly intervals to max 25.2g daily Amber initiated status on Pan Mersey formulary	15g once or twice daily Not assess by Pan Mersey

Table 4: Oral potassium binders

- Oral potassium binders should be discontinued when serum potassium drops below 5mmols/Litre.
- Patiromer and sodium zirconium cyclosilicate are also recommended by NICE in outpatient care for patients with persistent hyperkalaemia and CKD 3b - 5 or heart failure, if they:
    - have a confirmed serum potassium level of at least 6.0 mmol/litre
    - are not taking an optimised dosage of renin-angiotensin-aldosterone system (RAAS) inhibitor because of hyperkalaemia, and
    - are not on dialysis.
- See Pan Mersey formulary and SPCs for further information.

3.2.1.4 Identifying and Removing/Reducing Causative Agents or Factors

After emergency treatment, **this is the most important step** as at this stage total body potassium is unchanged and serum potassium will return to previous values or higher.
Identify and remove cause if possible – see **Table 3**
Stop potassium supplements and drugs that promote hyperkalaemia – see **Table 3**

If these measures fail to remedy hyperkalaemia, seek advice from ITU SpR on-call

3.2.1.5 Expert Advice

Doctors caring for patients with hyperkalaemia should, when in doubt, seek advice from their senior colleagues and or from the intensive care team. Specific issues may require specific help e.g. Consultant surgical advice may be necessary in cases of tissue necrosis/compartment syndrome (see guideline).

Table 1: ECG changes associated with hyperkalaemia

Tented T waves (use judgement; various descriptions: greater than 50% QRS, 'hurt to sit on').
Prolonged PR interval
Flattened/Absent P waves, Abnormal/prolonged QRS interval.
Any dysrhythmia possible – especially if history of ischaemic heart disease
Deep S waves, sine waves, ventricular fibrillation.

Table 2: Symptoms associated with hyperkalaemia

Often none; cardiac disturbances often occur before neuromuscular manifestations.
Muscle weakness, beginning in lower limbs progressing to trunk and upper limbs.
Rarely progresses to flaccid paralysis.
Respiratory muscle involvement rare.

Table 3: Causes of hyperkalaemia

Often multifactorial but usually only problematic when body's main route of excretion is impaired. This is normally due to new or pre-existing renal impairment or when effective circulating volume is low. This is not an exhaustive list but covers common or important causes in an in-patient setting.
Excess intake
STOP intravenous or oral potassium supplements. Be alert to low sodium foods.
Check enteral feeding solutions and inform dietician of potassium concerns.
Check dietary intake; particularly if patient suffers from chronic kidney disease and no other cause identified. Again involve dietician.
Some antibiotics may contain significant potassium loads; especially if administered QDS. Consider this if cause for hyperkalaemia not evident from this table.
Excess potassium release
Tissue necrosis – burns, trauma, rhabdomyolysis (consider compartment syndrome in certain in-patient settings), tumour lysis syndrome.
Increased catabolism – sepsis, exercise.
Large volume red cell transfusions.

Metabolic Disturbances (leading to redistribution of potassium into serum)
Hyperglycaemia, hyperosmolality, acidosis. Intravenous contrast in chronic kidney disease patients. Addison's/other hypoadrenal states. Ureterojejunostomy (urinary diversion leading to gastrointestinal potassium absorption).
Drugs
Always give consideration to balancing the severity of hyperkalaemia and need for continued drug use. These steps may only be temporary and will not affect acute potassium management. Discuss with seniors as necessary.
Stop ACE inhibitors (*prils), angiotensin receptor blockers (*sartans), renin inhibitors (Aliskeren).
Stop spironolactone, eplerenone, amiloride, and other potassium sparing diuretics.
Stop NSAIDS, COX-2 inhibitors. Stop Digoxin if levels raised.
Consider stopping or exchanging trimethoprim; likewise for pentamidine.
Consider stopping beta-blockers, both selective + non-selective can cause hyperkalaemia.
Consider stopping nicorandil (anti-anginal).
Consider stopping heparin – unfractionated and low molecular weight heparins both cause hyperkalaemia; not before 48 hours use however - again in consultation with senior.
Consider reducing cyclosporine or tacrolimus ***only*** in consultation with senior.
Examine for pseudohyperkalaemia
CONSIDER THIS IF NO CAUSE APPARENT, RATHER THAN ASSUMING PSEUDOHYPERKALAEMIA EARLIER. Movement of potassium outside of cells during or after venepuncture. Forearm contracture, clenching or prolonged tourniquet use. Thrombocytosis, leukocytosis – can demonstrate by sending heparinised sample to lab. Prolonged sample storage/transport times.

3.3 Treatment of Hypokalaemia

3.3.1 Causes

Causes of hypokalaemia can be classified as relating to intake, transcellular shifts, gut and renal losses.

The most common causes in our population are likely to be inadequate intravenous potassium administration in patients who are nil by mouth and overzealous diuretic administration. Serum magnesium should also be checked as a low level can aggravate hypokalaemia and render it resistant to treatment.

Administration of feed following a period of low nutritional intake may lead to refeeding syndrome and movement of potassium intracellularly. Hypokalaemia should be treated prior to the recommencement of feed. Further advice regarding this can be sought from the dietician.

The treatment of hypokalaemia in immediate postoperative cardiac patients has been covered earlier in this policy.

Once hypokalaemia has been recognised prompt treatment should be initiated and a medical review undertaken to ascertain the cause.

3.3.2 Treatment

Protocol for the Administration of IV Potassium According to Urgency and Degree of Hypokalaemia

Serum Potassium level (mmol/L)	**Patients with NORMAL Renal Function and NO fluid restriction (Where renal function and/ or fluid intake is compromised, obtain senior input and consider critical care advice)**
Normal = 3.5 – 5.0 *Prophylaxis against Hypokalaemia*	**Oral** or n/g replacement therapy, e.g. Sando K. If nil by mouth: 20mmol in 1000mL of 0.9% sodium chloride or 5% glucose infusion administered peripherally (or centrally) over at least 8 hours as part of a normal fluids regimen
Potassium 3.0 – 3.4 or non-urgent replacement	**INFORM DOCTOR** 40mmol in 1000mL of 0.9% sodium chloride or 5% glucose infusion administered peripherally (or centrally) over at least 4 hours.
Potassium less than 3.0 *or urgent replacement*	**INFORM DOCTOR** 40mmol in 500mL 0.9% sodium chloride infusion administered centrally (peripheral administration has been known to cause tissue damage if extravasation occurs) over *at least* 2 hours. Patients require ECG monitoring. *OR* Consider transfer to critical care and central administration of potassium.

3.3.3 Ward Areas

In order to minimise the risks associated with the prescribing of intravenous potassium the following must be adhered to at all times:-

Use the oral route where possible

Intravenous treatment of hypokalaemia must only be instigated when the oral/enteral route is unavailable or will not achieve the required elevation of serum potassium within a clinically acceptable time

All prescribing of potassium must be expressed in terms of **millimoles** of potassium. The **volume** of diluent and **rate of infusion** must also be specified.

A maximum of 40mmol per infusion can be prescribed. The minimum volume per infusion is normally 1000mL.

N.B. Concentrations greater than 40mmol in 1000mL must be administered via a central line

All infusions containing potassium must be administered via a suitable infusion pump to control the infusion rate and volume. **Users should also be aware that infusion pumps can fail**

All patients being treated with intravenous potassium are to have at least once daily measurement of serum potassium until levels are shown to be satisfactory. Serum magnesium levels should be checked and corrected in patients with severe hypokalaemia

4. Policy Implementation Plan

The Drugs and Therapeutics Committee will be responsible for approving the protocol. Clinical leads and (in the case of POCCU / ITU) the critical care manager, are responsible for implementation of this policy.

The Guideline will be publicised at directorate meetings and the guideline will also be available on the Trust Intranet.

5. Monitoring of Compliance

The effectiveness of the guideline will be reviewed by the clinical divisions and by the Drug and Therapeutics Committee, taking account of any information gathered in reports via incident reports, Risk Management or from within the Divisional structure.

6. References

1. Clinical Practice Guidelines: Treatment of acute Hyperkalaemia in Adults. June **2020**. UK Renal Association. https://ukkidney.org/sites/renal.org/files/RENAL%20ASSOCIATION%20HYPERKALAEMIA%20GUIDELINE%202020.pdf
2. NICE Technology Appraisal. Patiromer for treating Hyperkalaemia. TA 623. 13th February **2020**
3. NICE Technology Appraisal. Sodium Zirconium Cyclosilicate for Treating Hyperkalaemia. TA 599. 4th September **2019**
4. Summary of Product Characteristics. Patiromer. https://www.medicines.org.uk/emc/product/10416/smpc accessed
5. Summary of Product Characteristics. Sodium zirconium cyclosilicate. https://www.medicines.org.uk/emc/product/10059/smpc accessed
6. Medusa Injectable Medicines Guide (Go to Pharmacy Green Cross intranet site, click 'Intravenous Drug Administration' and follow the link)

6. Endorsed By:

Name of Lead Clinician / Manager or Committee Chair	Position of Endorser or Name of Endorsing Committee	Date
Dr Watt	Drug & Therapeutics Committee	18.05.2022

9. Record of Changes

Section No	Version No	Date of Change	Description of Amendment	Description of Deletion	Description of Addition	Reason
6	5	12/5/2022			Addition of references	Omitted previously
3.2.1.2	5	12/5/2022		Adjustment of rate of calcium administration in those on digoxin		Guidance changed
3.2.1.3	5	12/5/2022	Insulin 1st line for hyperkalaemia			Other options are adjunctive
Hyperkalaemia Algorithm	5	12/5/2022	Calcium gluconate to be given if K≥6.5 irrespective of symptoms / ECG changes			Critical care advice (NC)
4	5	12/5/2022	Prioritise binders in line with onset of action			Avoid delayed response to treatment
4	5.1	29/8/2023	Naem change calcium reosnium to Calcium polystyrene sulfonate			