NHS Grampian

# NHS Grampian Staff Guideline For The Management Of Acute Hyperkalaemia In Adults

| Co-ordinators: | Consultation Group: | Approver: |
|---|---|---|
| Lead Medicines Information Pharmacist | See Page 10 | Medicine Guidelines and Policies Group |

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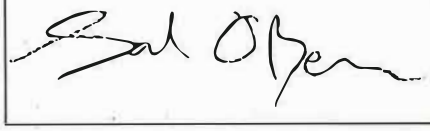
|  | |  |

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**Executive Sign-Off**

***This* document has been endorsed by the Director of Pharmacy and Medicines Management**

**Signature:** 

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**Responsibilities for implementation:**

| | |
|---|---|
| **Organisational:** | Chief Executive and Management Teams |
| **Corporate:** | Senior Managers |
| **Departmental:** | Heads of Service/Clinical Leads |
| **Area:** | Line Managers |
| **Hospital/Interface services:** | Assistant General Managers and Group Clinical Directors |
| **Operational Management Unit:** | Unit Operational Managers |
| **Policy statement:** | It is the responsibility of all staff to ensure that they are working to the most up to date and relevant policies, protocols procedures. |
| **Review:** | This policy will be reviewed in three years or sooner if current treatment recommendations change |

**Responsibilities for review of this document:** Lead Medicines Information Pharmacist

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| **Responsibilities for ensuring registration of this document on the NHS Grampian Information/ Document Silo:** | Pharmacy and Medicines Directorate |
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| **Job/group title of those who have control over this document:** | Lead Medicines Information Pharmacist |
| **Responsibilities for disseminating document as per distribution list:** | Lead Medicines Information Pharmacist |

**Revision History:**

| Revision Date | Previous Revision Date | Summary of Changes (Descriptive summary of the changes made) | Changes Marked* (Identify page numbers and section heading ) |
|---|---|---|---|
| May 2022 | Dec 2018 | Added table of contents | P1, table of contents |
| May 2022 | Dec 2018 | Ranges amended in line with national guidance | P2, Table 1 |
| May 2022 | Dec 2018 | Grouped causes of hyperkalaemia | P3, Causes of hyperkalaemia |
| May 2022 | Dec 2018 | Simplified signs and symptoms based on up to date resources | P3, Signs and Symptoms |
| May 2022 | Dec 2018 | Added comment that normal ECG does not exclude treatment if severe hyperkalaemia confirmed, and a note about peaked T waves. Added bradycardia and heart block | P4, ECG abnormalities |
| May 2022 | Dec 2018 | Added note about frequency of pseudohyperkalaemia | P4, Exclude pseudohyperkalaemia |
| May 2022 | Dec 2018 | Added a cause to pseudohyperkalaemia and a definition | P4, Exclude pseudohyperkalaemia |
| May 2022 | Dec 2018 | Increased monitoring guidance in line with national guidance, added renal team referral guidance, added guidance specific to primary care | P5, Monitoring |
| May 2022 | Dec 2018 | Added instruction to record NEWS score, amended ranges, increased glucose monitoring to 12 hours per national guidance, added additional renal referral criteria, updated monitoring, added dose instructions, added option for fluid restriction | P6, flowchart |

| Revision Date | Previous Revision Date | Summary of Changes (Descriptive summary of the changes made) | Changes Marked* (Identify page numbers and section heading ) |
|---|---|---|---|
| May 2022 | Dec 2018 | Removed glucose as flush as per Medusa, amended wording of diluent per Medusa | P7, Calcium gluconate |
| May 2022 | Dec 2018 | Changed to 10% glucose | P7, soluble insulin-glucose IV infusion |
| May 2022 | Dec 2018 | Added instruction to use insulin syringe, added information about running glucose infusion, rephrased onset of action per national guidance, added caution about frequency and risk of hypoglycaemia, reduced duration of action, added treatment of hypoglycaemia, added option for fluid restriction | P7, soluble insulin-glucose IV infusion |
| May 2022 | Dec 2018 | Minor edit to section on reduced response, added statement not to use as monotherapy | P8, salbutamol |
| May 2022 | Dec 2018 | Added statement to avoid Laxido/Movicol, changed instruction for administration from paste to suspension per SPC | P8, calcium resonium |
| May 2022 | Dec 2018 | New section | P8, Sodium zirconium cyclosilicate |
| Aug 2022 | Dec 2018 | Inserted ECG example | P3 ECG |
| Oct 2022 | Aug 2022 | Flowchart and section 6.2 edited to reflect products that are available | P6 and P7 |
| July 2023 | Oct 2022 | Calcium gluconate advice changed following MHRA National Patient Safety Alert | Flowchart, p6 treatment flowchart and p7 calcium gluconate |
| July 2023 | Oct 2022 | Flowchart amended to make it clear that calcium gluconate can be given alongside insulin-glucose infusion. | Flowchart p6 |

* Changes marked should detail the section(s) of the document that have been amended, i.e. page number and section heading.

# NHS Grampian Staff Guideline for the Management of Acute Hyperkalaemia in Adults

Please note: Treatment Flowchart is on Page 6 and Summary Document Appendix 1

**Contents** **Page No**

# NHS Grampian Staff Guideline for the Management of Acute Hyperkalaemia in Adults

## 1. Definition[1-5]

This guideline is for use by healthcare professionals within primary or secondary care in NHS Grampian. Intravenous treatment should only occur in an acute setting.

The NHS Grampian reference range for serum potassium in patients over 16 years of age is 3.5 – 5.3mmol/L.

**Table 1 – Serum Potassium Classification**

| **Mild hyperkalaemia**: | **Moderate hyperkalaemia**: | **Severe hyperkalaemia**: |
|---|---|---|
| 5.4-5.9mmol/L<br><br>(Routine review required) | 6.0-6.4mmol/L<br><br>(Urgent review or treatment required) | ≥6.5mmol/L<br>**or**<br>≥6.0mmol/L **and** ECG changes present<br><br>(Potentially life threatening. Emergency treatment required) |

## 2. Causes of Hyperkalaemia[1-2,5-7]

The following list is not exhaustive:

### 2.1. Renal causes

- Acute kidney injury (AKI)
- Chronic kidney disease
- Medication that interferes with renal potassium excretion (e.g. potassium sparing diuretics (spironolactone, eplerenone), trimethoprim, co-trimoxazole)
- Medication that interferes with the renin-angiotensin-aldosterone system (e.g. Angiotensin Converting Enzyme inhibitors or Angiotensin II Receptor Antagonists (including combined products containing either of these), Non-Steroidal Anti-inflammatory Drugs, heparins)
- Mineralocorticoid deficiency (hypoaldosteronism states), including hyperkalaemic renal tubular acidosis (type IV), Addison's disease

## 2.2. Transcellular shift (intracellular to extracellular)

- Acidosis, including diabetic ketoacidosis (DKA) - Caution, during treatment of DKA life threatening hypokalaemia may develop
- Medication (e.g. digoxin poisoning, suxamethonium, beta blockers)
- Acute tumour lysis
- Burns
- Rhabdomyolysis

## 2.3. Other causes

- Heart failure
- Massive blood transfusion
- Use of salt substitutes/diet
- Medication (e.g. potassium supplementation)

Many patients, particularly those who are elderly, may have more than one risk factor for the development of hyperkalaemia.

## 3. Signs and Symptoms of Hyperkalaemia[1,2,5]

May be asymptomatic.

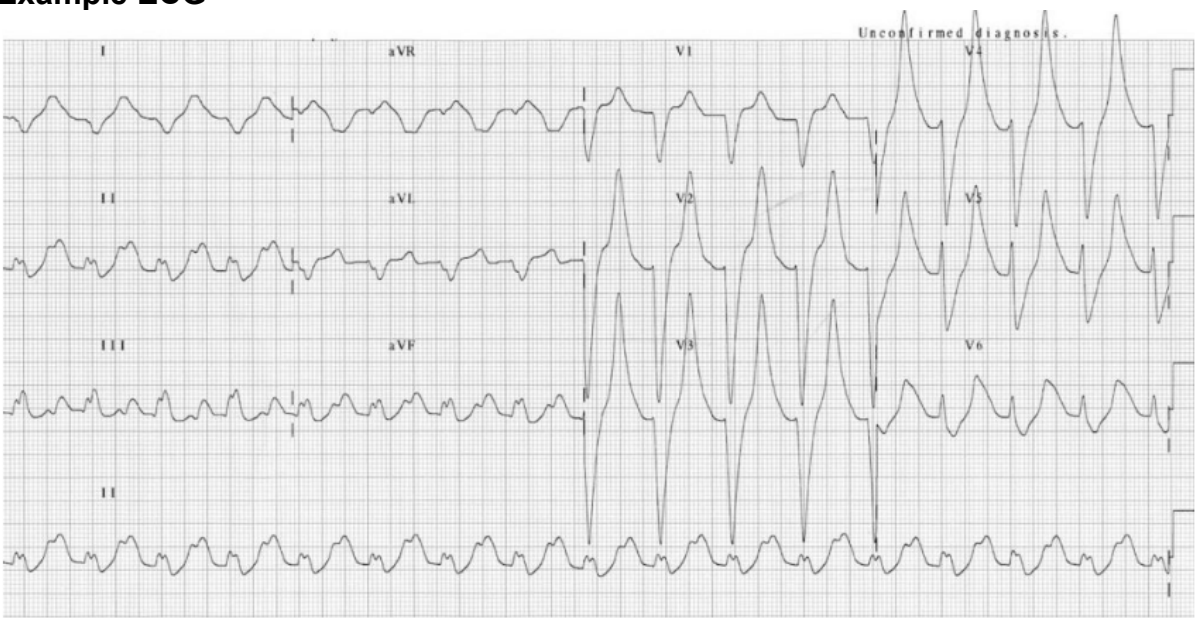
- ECG abnormalities (see below) ***requires emergency treatment***
- Muscle weakness
- Ascending paralysis (in severe hyperkalaemia)
- Paraesthesia
- Muscle cramps
- Hyperreflexia
- Cardiac arrest
- Nausea/vomiting
- Diarrhoea

## 4. ECG abnormalities[1-3,5,6]

A normal ECG does not exclude the need for treatment if severe hyperkalaemia (≥6.5mmol/L) has been confirmed.

- Peaked T waves (this alone is not an automatic indication for urgent treatment)
- Prolongation of PR interval (>200ms)
- Loss of (or small) P waves
- QRS widening (>120ms)
- Eventual merger of QRS complex with the T wave
- Ventricular arrhythmias
- Asystole
- Bradycardia
- Heart block

**Example ECG**[15]




This ECG displays many of the features of hyperkalaemia:
Prolonged PR interval, broad QRS complexes (these merge with both the preceding P wave and subsequent T wave), and peaked T waves.

## 5. Management and Monitoring

See flowchart on Page 6, information below and information on individual medications on Page 7 and 8.

### 5.1. Exclude pseudohyperkalaemia[2,5,6]

Relatively uncommon in hospitalised patients. Refers to falsely raised serum potassium which does not reflect the patient's true level.

If the patient is well, and has none of the above signs and symptoms, repeat the test urgently as it may not be a true level.

Possible causes of pseudohyperkalaemia:

- Test tube haemolysis
- Delayed analysis
- Issues during venepuncture (prolonged tourniquet use, small needle calibre, excessive fist clenching, excessive plunger force to draw blood into syringe)
- Thrombocytosis
- Leukocytosis
- Sample drawn from limb infused with IV fluids containing potassium

## 5.2. Medication

Discontinue or reduce the dose of medications known to cause hyperkalaemia (see Causes, Page 2).

## 5.3. Monitoring[2-3]

If ECG changes have been identified, or if serum potassium ≥6.5mmol/L irrespective of ECG changes, begin continuous ECG monitoring. Consider transfer to high dependency environment.

Visible bedside ECG and blood pressure monitoring should be in place before administration of intravenous calcium gluconate.

Monitor urea and electrolytes one hour post treatment. Once serum potassium is <6mmol/L, then monitor urea and electrolytes at a minimum of 2, 4, 6, and 24 hours in patients who have been treated for moderate or severe hyperkalaemia to ensure adequate treatment and detect any 'rebound' rise in potassium requiring further treatment.

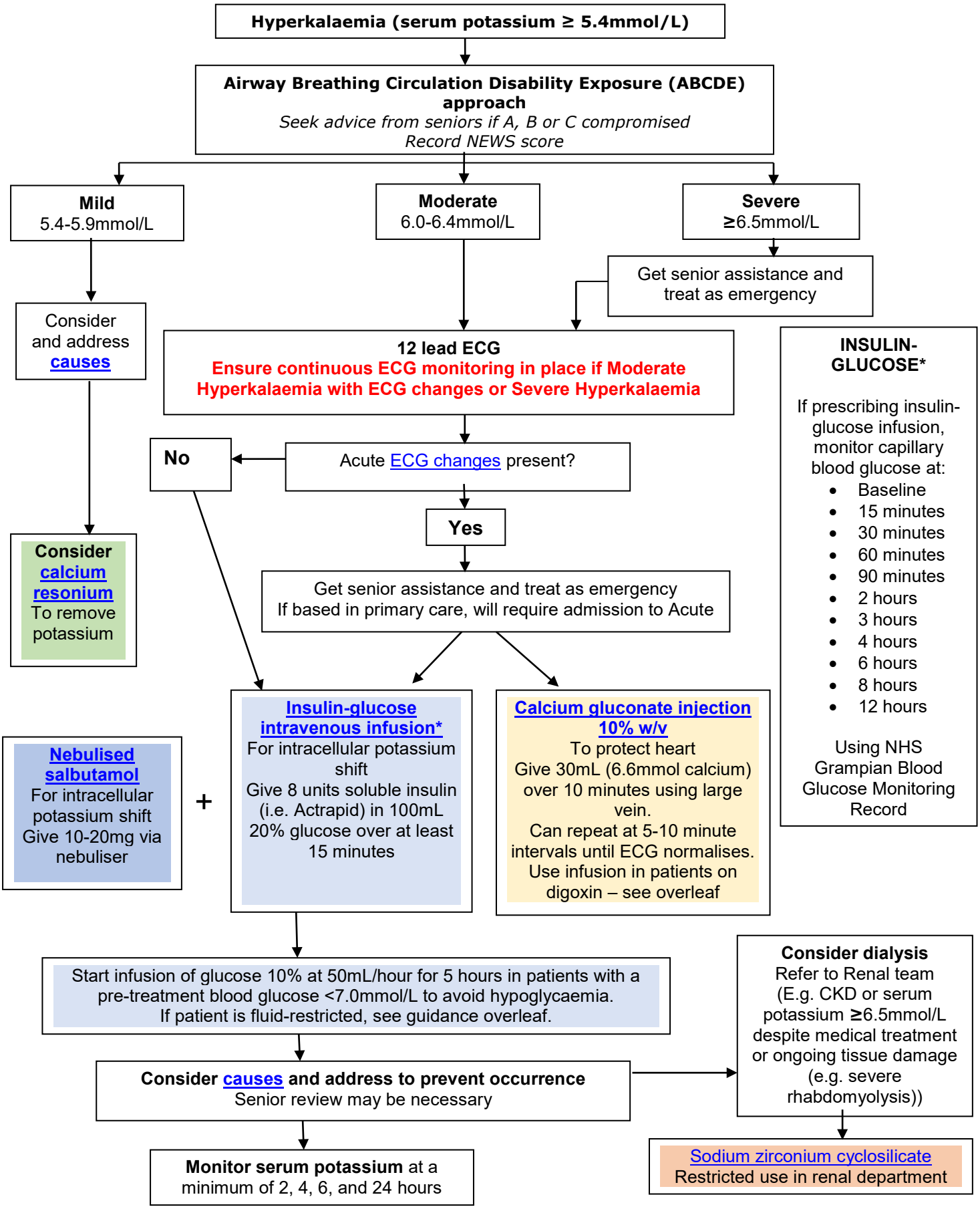
If, following treatment, a potassium level ≥ 6.5mmol/L recurs or remains persistent, discuss with the renal team.

In primary care, if mild hyperkalaemia is detected unexpectedly and patient is stable, serum potassium should be repeated within 3 days, or as soon as feasible. If moderate hyperkalaemia (without ECG changes) is detected, serum potassium should be repeated within 1 day. Consider referral to hospital if clinically unwell or AKI present.

## 5.4. Hyperkalaemia Treatment Flowchart

**For each medication, please see detailed information on next page**

**[senior = registrar, consultant or GP, as appropriate]**



## 6. Dosage and Administration

### 6.1. Calcium gluconate injection 10% w/v

- Function: protect the heart
- NB: does not lower potassium
- Ensure visible bedside ECG and blood pressure monitoring are in place
- **Dose**: Administer 30mL calcium gluconate 10% w/v injection (6.6mmol calcium) intravenously over 10 minutes
    - NB: For patients on **digoxin**, give as an infusion over 20-30 minutes (e.g. dilute 30mL 10% calcium gluconate injection (6.6mmol calcium) in 100mL sodium chloride 0.9% or glucose 5%)
- Use a large vein. Central administration is preferred if immediately available.
- Flush with sodium chloride 0.9%
- Onset of action: 1-3 minutes
- Can repeat dose at 5-10 minute intervals until ECG features of hyperkalaemia have normalised. This should not delay further management of hyperkalaemia so treatment to reduce the potassium levels can be initiated in the meantime.
- Duration of action: 30-60 minutes
- Contraindications: hypercalcaemia
- Caution: May potentiate arrhythmias in digoxin toxicity
- Extravasation can cause tissue necrosis

### 6.2. Soluble insulin-glucose intravenous infusion

- Function: move potassium into cells
- **Dose**: 8 units soluble insulin (i.e. Actrapid) in 100mL 20% glucose over at least 15 minutes
- Use an insulin syringe to measure the insulin
- Use a large vein. Central administration is preferred if immediately available.
- Risk of hypoglycaemia for up to 12 hours after treatment. Patients with End Stage Renal Disease (ESRD) are more susceptible due to decreased excretion of insulin. Monitor patient for hypoglycaemia as per the instruction box in the flowchart on page 6. Must be highlighted in medical and nursing notes, and at handover.
- The risk of hypoglycaemia in patients with low pre-treatment glucose concentration (<7mmol/L) may be reduced by providing additional glucose (as 10% glucose 250mL infusion at 50mL/hour for 5 hours)
- **Fluid restriction**: for patients where fluid load is a concern, treat with soluble insulin and glucose, ensure blood glucose monitoring is undertaken at the specified intervals, and only start glucose infusion if blood glucose concentration falls below <7mmol/L post treatment.
- Onset of action: within 15 minutes
- Duration of action: 2-4 hours
- Peak action: 30-60 minutes
- Serum potassium may fall by up to 1mmol/L
- Increased effectiveness if given with nebulised salbutamol
- If hypoglycaemia occurs, give dextrose tablets (e.g. Dextrose Energy) or glucose 40% gel (e.g. GlucoBoost). Avoid fruit juice given high potassium content.

### 6.3. Nebulised salbutamol

- Function: move potassium into cells
- **Dose**: 10-20mg via nebuliser.
- Caution: cardiovascular disease. High doses can precipitate arrhythmias, use 10mg if history of Ischaemic Heart Disease
- Onset of action: within 30 minutes
- Duration of action: up to 2 hours
- Avoid if tachyarrhythmia present
- Some patients may have limited response to nebulised salbutamol treatment (e.g. patients on non-selective beta-blockers and patients with End Stage Renal Disease)
- Serum potassium may fall by 0.5-1mmol/L
- Do not use as monotherapy, unless in exceptional circumstance where there is no intravenous access to administer insulin and glucose

### 6.4. Calcium resonium powder

- Function: remove potassium from body
- **Dose:** 15g made into a suspension using a small amount of water and given orally four times daily **OR** 30g resin in 150mL of water or 10% glucose given rectally as a retention enema twice daily
- Oral route is preferable
- Not appropriate for emergency treatment
- Onset: slow and variable, hours to days
- Contraindications: bowel obstruction
- Administer calcium resonium at least 3 hours before or 3 hours after other oral medications. For patients with gastroparesis, a 6-hour separation should be considered
- Consider risk of bowel obstruction and perforation
- **Oral use:** consider co-prescribing a laxative (avoid Laxido/Movicol due to potassium content)
- **Rectal use**: enema should be retained for at least 9 hours then colon irrigated with water by medical staff to remove resin as per SmPC.

### 6.5. Sodium zirconium cyclosilicate

- Function: increase gastrointestinal loss of potassium
- **Dose**: 10g three times daily for up to 72 hours
- Mix the contents of each 10g sachet of powder with approximately 45 mL of water and stir well. The powder will not dissolve and the suspension should be taken while it is cloudy; if the powder settles it should be stirred again.
- Onset of action: within 1 hour
- Lowers potassium by up to 1.1mmol/L within 48 hours. In patients with serum potassium >6.0mmol/L, it can lower serum potassium by 1.5mmol/L within 48 hours.
- Restricted to correction phase use within the renal department, as emergency bridging use for adults where dialysis is unavailable but urgently needed, and potassium is dangerously elevated
- Caution: with abdominal x-rays. Sodium zirconium cyclosilicate may be opaque to x-rays.

## 7. References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## 8. Consultation Group

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| Dr Gavin Tunnard | Emergency Medicine Consultant |
| Dr Innes Young | Consultant Acute Medicine |
| Dr Jamie Smith | Consultant Nephrologist |
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**Consultation Group for July 2023 amendment:**

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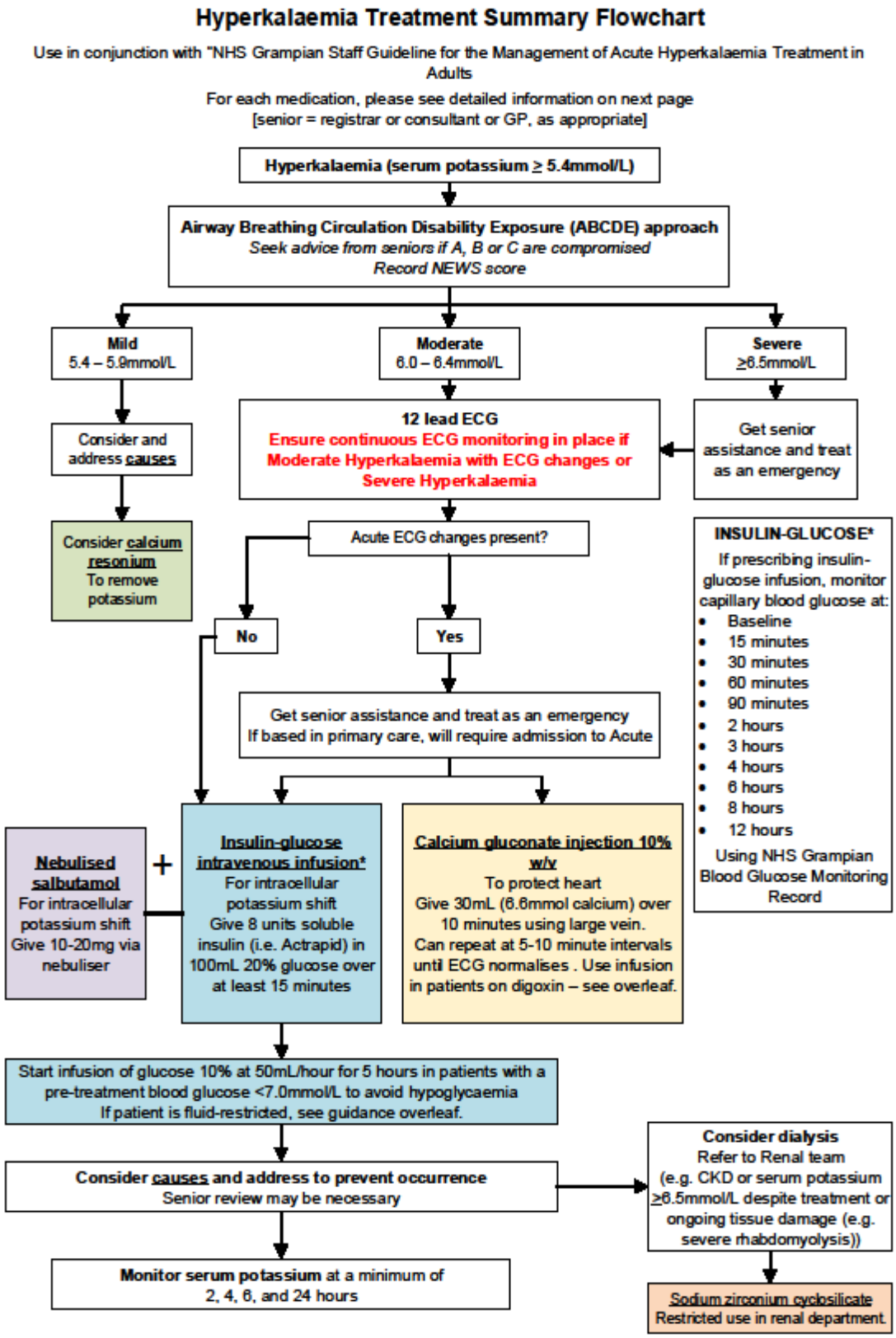
## Appendix 1 - Hyperkalaemia Treatment Summary Flowchart



**Calcium gluconate injection 10% W/V**

- Function: Protect the heart
- NB: does not lower potassium
- Ensure visible bedside ECG and blood pressure monitoring are in place
- **Dose:** administer 30mL (6.6mmol calcium) calcium gluconate 10%w/v injection intravenously
- Use a large vein. Central administration is preferred if immediately available.
- Give over 10 minutes.
- Give as infusion over 20-30 minutes in patients on **digoxin** (e.g. dilute 30mL 10% calcium gluconate injection in 100mL sodium chloride 0.9% or glucose 5%)
- Flush with sodium chloride 0.9%
- Onset of action: 1-3 minutes
- Can repeat dose at 5-10 minute intervals until ECG features of hyperkalaemia have normalised.
- Duration of action: 30-60 minutes
- Contraindications: hypercalcaemia
- Caution: May potentiate arrhythmias in digoxin toxicity
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**Soluble insulin-glucose intravenous infusion**

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- **Dose:** 8 units soluble insulin (i.e. Actrapid) in 100mL 20% glucose over at least 15 minutes
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- The risk of hypoglycaemia in patients with low pre-treatment glucose concentration (<7mmol/L) may be reduced by providing additional glucose (as 10% glucose infusion at 50mL/hour for 5 hours)
- **Fluid restriction:** for patients where fluid load is a concern, treat with soluble insulin and glucose, ensure blood glucose monitoring is undertaken at the specified intervals, and only start glucose infusion if blood glucose concentration fall below <7mmol/L post treatment.
- Onset of action: within 45 minutes
- Duration of action: 2-4 hours
- Peak action: 30-60 minutes
- Serum potassium may fall by up to 1mmol/L
- Increased effectiveness if given with nebulised salbutamol
- If hypoglycaemia occurs, give dextrose tablets (e.g. Dextrose Energy) or glucose 40% gel (e.g. GlucoBoost). Avoid fruit juice given high potassium content.

**Nebulised salbutamol**

- Function: move potassium into cells
- **Dose:** 10-20mg via nebuliser
- Caution: cardiovascular disease. High doses can precipitate arrhythmias, use 10mg if history of Ischaemic Heart Disease.
- Onset of action: within 30 minutes
- Duration of action: up to 2 hours
- Avoid if tachyarrhythmia present
- Some patients may have limited response to nebulised salbutamol treatment (e.g. patients on non-selective beta-blockers and patients with End Stage Renal Disease)
- Serum Potassium may fall by 0.5-1mmol/L
- Do not use as monotherapy, unless in exceptional circumstances where there is no intravenous access to administer insulin and glucose

**Sodium zirconium cyclosilicate**

- Function: increase gastrointestinal loss of potassium
- **Dose:** 10g three times daily for up to 72 hours
- Mix the content of each 10g sachet of powder with approximately 45 mL of water and stir well. The powder will not dissolve and the suspension should be taken while it is cloudy; if the powder settles it should be stirred again.
- Onset of action: within 1 hour
- Lowers potassium by up to 1.1mmol/L within 48 hours. In patients with serum potassium >6.0mmol/L, it can lower serum potassium by 1.5mmol/L within 48 hours.
- Restricted to correction phase use within the renal department, as emergency bridging use for adults where dialysis is unavailable but urgently needed, and potassium is dangerously elevated.
- Caution: with abdominal x-rays. Sodium zirconium cyclosilicate may be opaque to x-rays.

**Calcium resonium powder**

- Function: remove potassium from body
- **Dose:** 15g made into a suspension using a small amount of water and given orally four times daily **OR** 30g resin in 150mL of water or 10% glucose given rectally as a retention enema twice daily.
- Oral route is preferable
- Not appropriate for emergency treatment
- Onset: slow and variable, hours to days
- Contraindications: bowel obstruction
- Administer calcium resonium at least 3 hours before or 3 hours after other oral medications. For patients with gastroparesis, a 6-hour separation should be considered.
- Consider risk of bowel obstruction and perforation
- **Oral use:** consider co-prescribing a laxative (avoid Laxido/ Movicol due to potassium content)
- **Rectal use:** Enema should be retained for at least 9 hours then colon irrigated with water by medical staff to remove resin as per SmPC.

**Monitoring**

If ECG changes have been identified, or if serum potassium is greater than or equal to 6.5mmol/L irrespective of ECG changes, begin continuous ECG monitoring. Consider transfer to high dependency environment.

Visible bedside monitoring should be in place before administration of intravenous calcium gluconate.

Monitor urea and electrolytes one hour post treatment. Once serum potassium is <6mmol/L, then monitor urea and electrolytes at a minimum of 2, 4, 6, and 24 hours in patients who have been treated for moderate or severe hyperkalaemia to ensure adequate treatment and detect any "rebound" rise in potassium requiring further treatment.

If, following treatment, a potassium level > 6.5mmol/L recurs, discuss with the renal team due to resistant or recurrent hyperkalaemia.

In primary care, if mild hyperkalaemia is detected unexpectedly and patient is stable, serum potassium should be repeated within 3 days, or as soon as feasible. If moderate hyperkalaemia (without ECG changes) is detected, serum potassium should be repeated within 1 day. Consider referral to hospital if clinically unwell or AKI present.