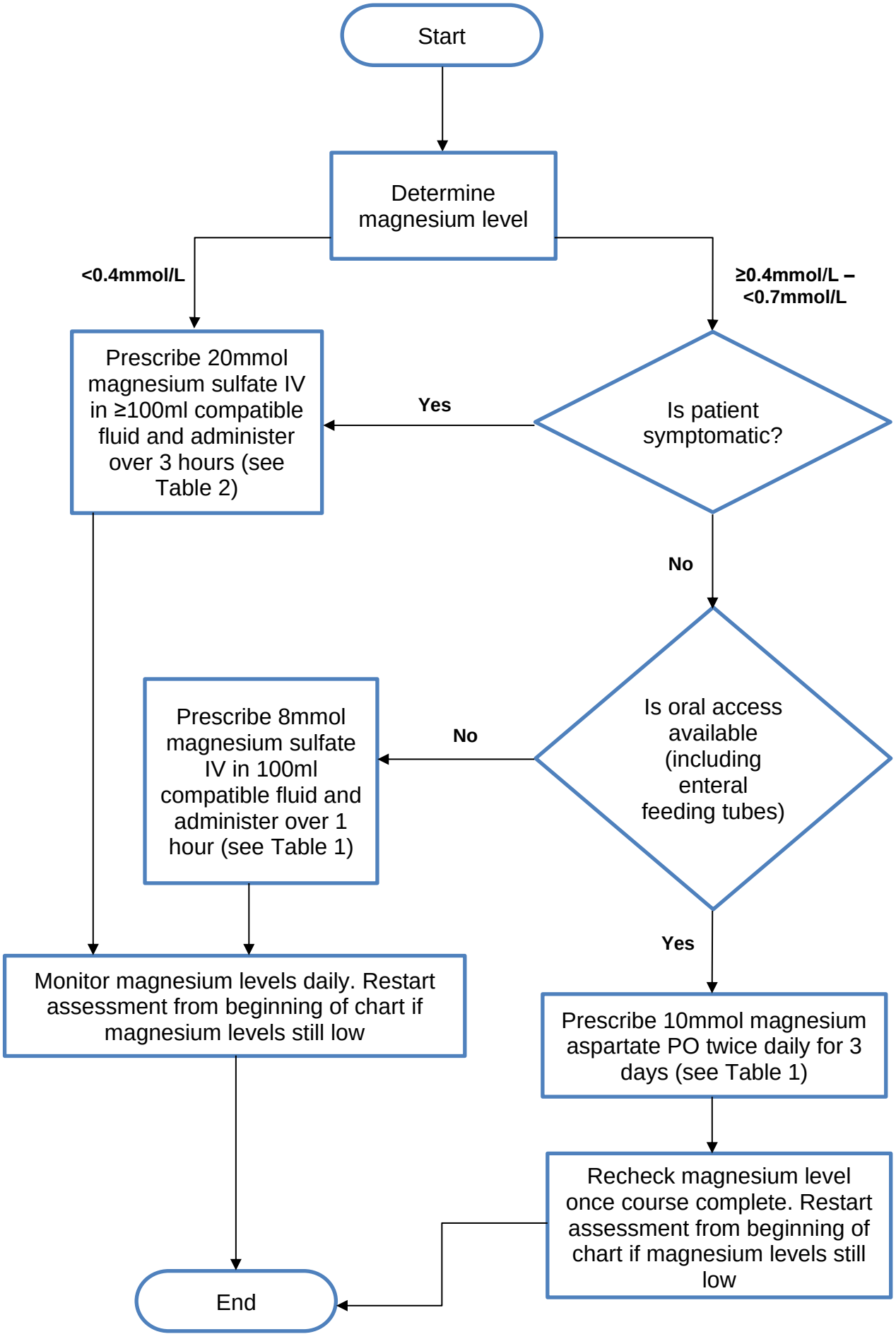
Royal Cornwall Hospitals
NHS Trust

Treatment of Hypomagnesaemia in Adults Clinical Guideline

V4.0

August 2024

Summary


Start
Determine magnesium level
<0.4mmol/L
≥0.4mmol/L – <0.7mmol/L
Prescribe 20mmol magnesium sulfate IV in ≥100ml compatible fluid and administer over 3 hours (see Table 2)
Yes
Is patient symptomatic?
No
Is oral access available (including enteral feeding tubes)
No
Prescribe 8mmol magnesium sulfate IV in 100ml compatible fluid and administer over 1 hour (see Table 1)
Yes
Monitor magnesium levels daily. Restart assessment from beginning of chart if magnesium levels still low
Prescribe 10mmol magnesium aspartate PO twice daily for 3 days (see Table 1)
Recheck magnesium level once course complete. Restart assessment from beginning of chart if magnesium levels still low
End

1. Aim/Purpose of this Guideline

1.1. This guideline is intended to guide medical, nursing and pharmacy staff in the treatment of hypomagnesaemia in adult patients. It does not cover use of magnesium for management of acute asthma exacerbation, torsade de pointes or pre-eclampsia.

1.2. This version supersedes any previous versions of this document.

Data Protection Act 2018 (UK General Data Protection Regulation – GDPR) Legislation.

The Trust has a duty under the Data Protection Act 2018 and UK General Data Protection Regulations 2016/679 to ensure that there is a valid legal basis to process personal and sensitive data. The legal basis for processing must be identified and documented before the processing begins. In many cases we may need consent; this must be explicit, informed, and documented. We cannot rely on opt out, it must be opt in.

Data Protection Act 2018 and UK General Data Protection Regulations 2016/679 is applicable to all staff; this includes those working as contractors and providers of services.

For more information about your obligations under the Data Protection Act 2018 and UK General Data Protection Regulations 2016/679 please see the Information Use Framework Policy or contact the Information Governance Team.

Royal Cornwall Hospital Trust rch-tr.infogov@nhs.net

2. The Guidance

2.1. Background

Magnesium (Mg) is the second most abundant intracellular cation. It is an essential body electrolyte and a cofactor in numerous enzyme systems. The average daily magnesium intake is 15mmol. One-third of this magnesium is absorbed, mainly in the small bowel; however, this fraction may be increased in patients with low magnesium levels. The kidney is the principal organ for magnesium regulation, the major site being the distal tubule.

2.2. Definition of hypomagnesaemia

2.2.1. The reference range for serum magnesium used in the Royal Cornwall Hospitals Trust is 0.7 – 1.0 mmol/L.

2.2.2. For the purposes of this guideline, hypomagnesaemia is defined as a serum blood magnesium concentration of less than 0.7 mmol/L.

2.3. Causes of hypomagnesaemia

2.3.1. Decreased magnesium absorption

Severe malabsorption, malnutrition, excess alcohol intake.
Drugs: proton pump inhibitors.

2.3.2. Increased renal excretion/loss

Drugs: loop and thiazide diuretics, digoxin, alcohol.
Conditions: SIADH.
Drug toxicity: aminoglycosides, ciclosporin, amphotericin.

2.3.3. Endocrine

Hyperthyroidism, hyperaldosteronism, diabetes mellitus, diabetic ketoacidosis, vitamin D deficiency.

2.3.4. Gut losses

Acute and chronic diarrhoea, excessive purgation, GI/biliary fistula, extensive bowel resection, prolonged nasogastric suction.

2.3.5. Miscellaneous

Acute pancreatitis, excessive lactation.

2.4. Signs and symptoms

2.4.1. Many of the symptoms of moderate to severe hypomagnesaemia are non-specific. Symptomatic magnesium depletion is often associated with multiple biochemical abnormalities such as hypokalaemia and hypocalcaemia. Correction of magnesium may aid the correction of other electrolytes.

2.4.2. Symptoms may include:

- Neuromuscular: ataxia, carpopedal syndrome, confusion, depression, hallucination, muscle weakness, psychosis, seizures, tremor.
- Metabolic: altered glucose homeostasis (carbohydrate intolerance, hyperinsulinism), atherosclerosis.
- Cardiovascular: ECG abnormalities (widening of QRS complex, prolongation of PR interval), severe ventricular arrhythmias, sensitivity to cardiac glycosides.
- Bone: osteoporosis, osteomalacia.
- Calcium and potassium: refractory or unexplained hypocalcaemia, refractory hypokalaemia.
- Gastrointestinal: anorexia, nausea.

2.5. Treatment

2.5.1. Points for consideration

2.5.1.1. The specific regime for magnesium replacement is dependent on the clinical presentation of the patient. Although this document offers guidance, the dose of magnesium to correct hypomagnesaemia should be determined on an individual patient basis.

2.5.1.2. Precipitating agents should be withdrawn if possible, and the underlying cause treated.

2.5.1.3. Serum magnesium concentrations do not reflect the total body store. A clinical assessment is therefore more useful in guiding treatment approach.

2.5.1.4. Serum magnesium concentration may return to within a normal range within the first 24-hour period of replacement. However, total replenishment of body stores may take several days, and as approximately 50% of the administered IV dose of magnesium will be excreted in the urine, replacement must be done slowly. In resistant cases, please seek advice of a senior clinician.

2.5.1.5. Magnesium is also administered for therapeutic reasons in the absence of hypomagnesaemia such as acute asthma, which are not the subject of this guideline.

2.5.1.6. Magnesium supplementation may be administered via the oral, intravenous, or intramuscular route, depending on the severity of magnesium depletion, presence of symptoms, and patient tolerance.

2.5.2. Treatment of mild hypomagnesaemia (0.4 – 0.7 mmol/L) and in asymptomatic patients

2.5.2.1. Magnesium supplements should be given orally whenever possible (see Table 1).

2.5.2.2. Intravenous (IV) administration of magnesium may be required in patients who cannot tolerate, or are unlikely to absorb, oral magnesium (see Table 1).

Table 1: Treatment options for mild or asymptomatic hypomagnesaemia

Preparation	Route	Dose	Other instructions
Magnesium aspartate 10mmol (243mg) sachet	Oral	1 sachet once or twice daily	Dissolve in 50-200mL water, tea, or orange juice
Magnesium sulfate 50% injection (8mmol, or 2g, in 4mL)	IV	8mmol magnesium (4mL)	Dilute in 100ml sodium chloride 0.9% or glucose 5% and give over 1 hour

2.5.2.3. Diarrhoea tends to limit the amount of magnesium that can be given orally; if diarrhoea develops, the dose should be reduced. Administering with or after food may help to reduce the incidence of diarrhoea.

2.5.2.4. Magnesium aspartate in 200mL water is licensed for administration via gastric, duodenal, and nasal enteral feeding tubes.

2.5.2.5. Oral magnesium should be initially prescribed initially for three days only. This is usually sufficient to correct mild hypomagnesaemia. The need to continue oral supplementation beyond this should be reviewed on completion of the three-day course.

2.5.3. Treatment of severe hypomagnesaemia (<0.4mmol/L) and in symptomatic patients

2.5.3.1. Intravenous (IV) administration magnesium for symptomatic patients or those with severe hypomagnesaemia should be given as outlined in Table 2.

2.5.3.2. Patients who have mild hypomagnesaemia and cannot tolerate oral administration should be treated as per section 3.5.2.

Table 2: Treatment options for severe or symptomatic hypomagnesaemia

Preparation	Route	Dose	Diluent	Rate
Magnesium sulfate 50% (20mmol, or 5g, per 10mL)	IV	20mmol magnesium (10mL)	≥100mL sodium chloride 0.9% or glucose 5%	Give over at least 3 hours. Do not exceed 8mmol/hour

2.5.3.3. The magnesium infusion should not be mixed with any other drugs, and no other drugs should be added to the infusion bag. For information on y-site compatibility, where there is a strict clinical necessity, please contact your ward pharmacist or Medicines Information department for advice.

2.5.3.4. A total of up to 160mmol intravenous may be required over 5 days to correct the deficiency.

2.5.3.5. A longer infusion period may be more suitable for non-emergency situations, for example, a rate of 4mmol/hour. The maximum recommended rate is 8mmol/hour.

2.5.3.6. A longer infusion period may be required for patients with renal impairment. Consider seeking renal team input in patients with severe renal impairment (GFR <30ml/min).

2.5.3.7. Magnesium sulfate 50% injections must be diluted to a maximum concentration of 5% (20mmol/100mL) for peripheral administration (see Table 2 for dilution instructions).

- A greater volume of fluid is preferred for peripheral administration if the patient can tolerate this to reduce the risk of irritation and tissue damage.

2.5.4. Intramuscular magnesium administration

Undiluted magnesium sulfate 50% injections may be given intramuscularly in alternate buttocks at a dose of 1 or 2g (4 or 8mmol) every 6 hours for 24 hours (4 doses in total). However, the injections are painful, potentially sclerosing and require multiple administrations. There is no therapeutic advantage over the IV route, and intramuscular administration should thus be reserved for patients in whom peripheral venous access is not readily available.

2.6. Monitoring

The following should be monitored daily when replacing magnesium:

2.6.1. Urea and electrolytes, with special attention to the following:

2.6.1.1. Magnesium – monitor for therapeutic outcome as well as magnesium toxicity (see section 2.8), especially if given parenterally.

- Monitor levels daily for patients receiving IV magnesium supplementation.
- Levels should be taken at least 12 hours post infusion to allow time for magnesium to be redistributed.
- Blood samples should be taken from the opposite arm to which the infusion has been administered.

2.6.1.2. Potassium and calcium – magnesium levels are closely linked to potassium and calcium; replacing one may affect levels of the others.

2.6.2. Renal function

2.6.2.1. Magnesium is renally cleared and can therefore accumulate in renal impairment, causing hypermagnesaemia. It has been suggested that approximately 50% of the normal dose or less should be administered, depending on the extent of renal impairment and whether the patient is symptomatic. Seek renal team input, especially in severe renal impairment (GFR <30mL/min).

2.6.2.2. Administer single doses of magnesium only and use resulting serum magnesium levels to reassess further treatment.

2.6.3. Cardiovascular

2.6.3.1. During intravenous infusion, blood pressure, respiratory rate and heart rate should be monitored. Rapid administration may cause flushing and hypotension.

2.6.3.2. In patients with underlying cardiac issues, ECG monitoring should also be in place.

2.6.3.3. If intravenous treatment is for symptomatic hypomagnesaemia with cardiovascular symptoms, continuous cardiac monitoring must be ensured.

2.7. Cautions and contraindications

2.7.1. Avoid use in patients with heart block or bradycardia.

2.7.2. Caution in patients with myasthenia gravis.

2.7.3. Caution in patients with severe renal impairment (higher risk of adverse effects).

2.7.4. Caution in patients with hepatic impairment at risk of developing renal impairment.

2.8. Adverse effects of magnesium replacement

2.8.1. Oral magnesium can cause gastrointestinal irritation and watery diarrhoea. The latter may be avoided by administering with or after food.

2.8.2. Intravenous magnesium replacement can cause hypermagnesaemia (particularly in patients with renal failure), hypocalcaemia, hypotension (due to peripheral vasodilatation) and injection site reactions, such as phlebitis.

2.8.3. Symptoms of hypermagnesaemia include respiratory depression, loss of deep tendon reflexes due to neuromuscular blockade, nausea, vomiting, flushing of the skin, thirst, muscle weakness, ECG changes/arrhythmias (e.g. bradycardia), double vision, slurred speech, confusion, coma, and cardiac arrest.

2.9. Miscellaneous

2.9.1. Magnesium sulphate has a high osmolarity and may cause tissue damage if it extravasates into the surrounding tissue following IV administration.

2.9.2. Refeeding syndrome

2.9.2.1. When initiating patients on enteral or parenteral nutrition, it is important to check electrolyte levels prior to commencing feed.

2.9.2.2. Low magnesium levels must be corrected before feeding is initiated to minimise the risk of refeeding syndrome.

3. Monitoring compliance and effectiveness

Information Category	Detail of process and methodology for monitoring compliance
Element to be monitored	Compliance with prescribing and administration in accordance with this guideline (or other safe practice).
Lead	Ann Cardell, Medicines Safety Pharmacist.
Tool	No specific tool. Datix will be used to identify clinical incidents.
Frequency	As required according to clinical incident reports.
Reporting arrangements	Via Medicines Practice Committee. Clinical incidents on Datix will be reported to the senior nurse/manager in that area and will also be reported to the Medication Safety Group.
Acting on recommendations and Lead(s)	Actions from incident reports will be at a local level and may also result in broader actions, coordinated by the Medication Safety Group. Matrons/ward managers.
Change in practice and lessons to be shared	Required changes to practice will be identified and actioned within the time frame specified in the action plan. A lead member of the team will be identified to take each change forward where appropriate. Lessons will be shared with all the relevant stakeholders.

4. Equality and Diversity

4.1. This document complies with the Royal Cornwall Hospitals NHS Trust service Equality and Diversity statement which can be found in the Equality Diversity And Inclusion Policy or the Equality and Diversity website.

4.2. Equality Impact Assessment

The Initial Equality Impact Assessment Screening Form is at Appendix 2.

Appendix 1. Governance Information

Information Category	Detailed Information
Document Title:	Treatment of Hypomagnesaemia in Adults Clinical Guideline V4.0
This document replaces (exact title of previous version):	Treatment of Hypomagnesaemia in Adults Clinical Guideline V3.0
Date Issued/Approved:	August 2024
Date Valid From:	August 2024
Date Valid To:	August 2027
Directorate / Department responsible (author/owner):	Heather Fothersgill, Medicines Information
Contact details:	01872 252587 rch-tr.medicinesinformation@nhs.net
Brief summary of contents:	Guidance on the treatment of hypomagnesaemia in adult patients.
Suggested Keywords:	Hypomagnesaemia, magnesium, electrolyte, electrolytes, replacement, refeeding.
Target Audience:	**RCHT:** Yes **CFT:** No **CIOS ICB:** No
Executive Director responsible for Policy:	Chief Medical Officer
Approval route for consultation and ratification:	Medicines Practice Committee, Pharmacy, Biochemistry.
Manager confirming approval processes:	Ian Davidson, Chief Pharmacist
Name of Governance Lead confirming consultation and ratification:	Kevin Wright
Links to key external standards:	None required.
Related Documents:	1) Joint Formulary Committee. British National Formulary (online) London: BMJ Group and Pharmaceutical Press. Accessed via:

Information Category	Detailed Information
	http://www.medicinescomplete.com/ on 04 Apr 2024. 2) Kora Healthcare. Summary of Product Characteristics for Magnaspartate 243mg Powder for Oral Solution. Last updated on the eMC 08 Nov 2023. Accessed online via: http://www.medicines.org.uk/emc/ on 04 Apr 2024. 3) Martindale Pharma. Summary of Product Characteristics for Magnesium Sulfate 50% w/v Solution for Injection. Last updated on the eMC 21 Oct 2019. Accessed online via: http://www.medicines.org.uk/emc/ on 04 Apr 2024. 4) Specialist Pharmacy Service. How is Acute Hypomagnesaemia Treated in Adults. Published 12 Jan 2021. Accessed online via: www.sps.nhs.uk on 04 Apr 2024. *5)* Injectable Medicines Guide. Version 13: Jan 2024. Magnesium Sulfate. Accessed online at: https://www.medusaimg.nhs.uk/Home.asp on 04 Apr 2024.
Training Need Identified?	No
Publication Location (refer to Policy on Policies – Approvals and Ratification):	Internet and Intranet
Document Library Folder/Sub Folder:	Clinical / Pharmacy

Version Control Table

Date	Version Number	Summary of Changes	Changes Made by
December 2017	V2.0	Update	Maggie Fitzgerald, Pharmacist, Medicines Information
January 2021	V3.0	Clinical update. Deletion of mention of giving doses up to 50mmol daily off license, if tolerated.	Lisa Thomas, Medicines Information Pharmacist

Date	Version Number	Summary of Changes	Changes Made by
August 2024	V4.0	Transposed onto new template. Added summary flowchart and references. Added statement that guideline is not to be used in the context of administration of magnesium in acute asthma exacerbation, torsade de points or pre-eclampsia. Added low dose IV option for treating mild hypomagnesaemia in patients who cannot tolerate oral supplementation. Added instructions for initial course length of oral supplementation and reviewing need for further treatment. Removed recommendation for maximum daily dose of 50mmol. Added caution surrounding use in patients with renal impairment. Removed section on subcutaneous administration as would only be considered in exceptional circumstances. Highlighted risk of irritation and tissue damage with peripheral administration and recommendation for use of larger fluid volumes. Clarified time scale for taking magnesium levels post infusion.	Heather Fothersgill, Lead Medicines Information Pharmacist

Appendix 2. Equality Impact Assessment

Section 1: Equality Impact Assessment (EIA) Form

The EIA process allows the Trust to identify where a policy or service may have a negative impact on an individual or particular group of people.

For guidance please refer to the Equality Impact Assessment Policy (available from the document library) or contact the Equality, Diversity, and Inclusion Team rcht.inclusion@nhs.net

Information Category	Detailed Information
Name of the strategy / policy / proposal / service function to be assessed:	Treatment of Hypomagnesaemia in Adults Clinical Guideline V4.0
Directorate and service area:	All clinical areas.
Is this a new or existing Policy?	Existing
Name of individual completing EIA (Should be completed by an individual with a good understanding of the Service/Policy):	Heather Fothersgill, Lead Medicines Information Pharmacist
Contact details:	01872 252587

Information Category	Detailed Information
1. Policy Aim - Who is the Policy aimed at? (The Policy is the Strategy, Policy, Proposal or Service Change to be assessed)	To provide guidance on management of hypomagnesaemia in adult patients.
2. Policy Objectives	To ensure safe treatment of hypomagnesaemia.
3. Policy Intended Outcomes	Treatment of hypomagnesaemia complies with the guidance set out in this document.
4. How will you measure each outcome?	Review of Clinical Incident Reports.
5. Who is intended to benefit from the policy?	Hypomagnesaemia patients and the clinical staff treating them.
6a. Who did you consult with? (Please select Yes or No for each category)	• Workforce: Yes • Patients/ visitors: No • Local groups/ system partners: No • External organisations: No • Other: No

Information Category	Detailed Information
6b. Please list the individuals/groups who have been consulted about this policy.	Medicines Safety Group. Medicines Practice Committee. Biochemistry.
6c. What was the outcome of the consultation?	Approved
6d. Have you used any of the following to assist your assessment?	**National or local statistics, audits, activity reports, process maps, complaints, staff, or patient surveys:** None required.

7. The Impact
Following consultation with key groups, has a negative impact been identified for any protected characteristic? Please note that a rationale is required for each one.

Where a negative impact is identified without rationale, the key groups will need to be consulted again.

Protected Characteristic	(Yes or No)	Rationale
Age	No	Guideline for all patients.
Sex (male or female)	No	Guideline for all patients.
Gender reassignment (Transgender, non-binary, gender fluid etc.)	No	Guideline for all patients.
Race	No	Guideline for all patients.
Disability (e.g. physical or cognitive impairment, mental health, long term conditions etc.)	No	Guideline for all patients.
Religion or belief	No	Guideline for all patients.
Marriage and civil partnership	No	Guideline for all patients.
Pregnancy and maternity	No	Guideline for all patients.
Sexual orientation (e.g. gay, straight, bisexual, lesbian etc.)	No	Guideline for all patients.

A robust rationale must be in place for all protected characteristics. If a negative impact has been identified, please complete section 2. If no negative impact has been identified and if this is not a major service change, you can end the assessment here.

I am confident that section 2 of this EIA does not need completing as there are no highlighted risks of negative impact occurring because of this policy.

Name of person confirming result of initial impact assessment: Heather Fothersgill, Lead Medicines Information Pharmacist.

If a negative impact has been identified above OR this is a major service change, you will need to complete section 2 of the EIA form available here:
Section 2. Full Equality Analysis