<table>
<thead>
<tr>
<th>Title of Guideline (must include the word “Guideline” (not protocol, policy, procedure etc))</th>
<th>Guideline for the Treatment of Hypomagnesaemia in Adults</th>
</tr>
</thead>
</table>
| Contact Name and Job Title (author) | Dr Peter Prinsloo - Consultant Clinical Chemistry  
Azma Malik - Senior Pharmacist |
| Directorate & Speciality | Diagnostics and Clinical Support |
| Date of submission | October 2015 |
| Date on which guideline must be reviewed (this should be one to three years) | October 2019 |
| Explicit definition of patient group to which it applies (e.g. inclusion and exclusion criteria, diagnosis) | Guideline for Adult patients excluding critical care and renal. |
| Version | 2 |
| Abstract | This guideline describes the management of hypomagnesaemia in adult inpatients |
| Key Words | Hypomagnesaemia, Hypomagnesemia, magnesium |
| Statement of the evidence base of the guideline – has the guideline been peer reviewed by colleagues? | 5 expert committee reports or opinions and / or clinical experiences of respected authorities  
Plus national advice in BNF |
| Evidence base: (1-6) | 1 NICE Guidance, Royal College Guideline, SIGN (please state which source).  
2a meta analysis of randomised controlled trials  
2b at least one randomised controlled trial  
3a at least one well-designed controlled study without randomisation  
3b at least one other type of well-designed quasi-experimental study  
4 well –designed non-experimental descriptive studies (i.e. comparative / correlation and case studies)  
5 expert committee reports or opinions and / or clinical experiences of respected authorities  
6 recommended best practise based on the clinical experience of the guideline developer |
| Consultation Process | Drugs & Therapeutics Committee  
Renal  
Consultant Clinical Chemistry  
Consultant Gastroenterologist |
| Target audience | Nursing, pharmacy and medical staff |

This guideline has been registered with the trust. However, clinical guidelines are guidelines only. The interpretation and application of clinical guidelines will remain the responsibility of the individual clinician. If in doubt contact a senior colleague or expert. Caution is advised when using guidelines after the review date.
GUIDELINE FOR THE TREATMENT OF HYPOMAGNESAEMA IN ADULTS

Clinical guidelines are guidelines only. These guidelines are not intended to cover all factors relating to hypomagnesaemia in critical care or the renal unit where specialist advice should be sought.

The interpretation and application of these guidelines remain the responsibility of the clinician. If in doubt, a senior colleague should be contacted.

The plasma contains only approximately 0.5% of total body magnesium and the relationship between serum magnesium levels and total magnesium stores has not been clearly defined. Magnesium is mainly an intracellular ion and the serum level may be normal despite significant deficiency.

Due to albumin binding, hypoalbuninaemic states may lead to spuriously low magnesium values, however, levels are not adjusted in practice.

| Normal adult magnesium range | 0.7-1.0 mmol/l |
| Mild hypomagnesaemia          | 0.5-0.7 mmol/l |
| Moderate to Severe hypomagnesaemia | <0.5 mmol/l |

Symptoms usually occur when serum magnesium falls below 0.5 mmol/l

Hypomagnesaemia often causes secondary hypocalcaemia, and also hypokalaemia and hyponatraemia. Therefore correction of magnesium may aid the correction of other electrolytes.

**Signs, symptoms and consequences of hypomagnesaemia**

- muscle weakness, ataxia, tremor, seizures, carpopedal spasm
- ventricular arrhythmias, ECG abnormalities such as prolonged QT interval and tachycardia
- depression, psychosis
- vertigo
- hyperinsulinism

Symptomatic hypomagnesaemia is usually associated with additional electrolyte abnormalities.
Causes of hypomagnesaemia

Magnesium deficiency has been associated with the following conditions:

- Gastrointestinal loss; diarrhoea
- Malnutrition
- Renal tubular reabsorption defects
- Hyperaldosteronism
- Long-term IV nutrition or fluid therapy
- Diabetic ketoacidosis
- Malabsorption
- Acute pancreatitis
- Chronic alcoholism
- Lactation
- Re-feeding Syndrome*

*For re-feeding syndrome patients please see re-feeding guideline http://nuhnet/nuh_documents/Guidelines/Trust%20Wide/Nutrition/1881.pdf

Drugs which may induce hypomagnesaemia

This is not an exhaustive list. Please contact Medicines Information (x64185) for more details.

- Proton Pump Inhibitors e.g. lansoprazole, omeprazole
- Antimicrobials (foscarnet, amphotericin B, aminoglycosides)
- Cancer chemotherapy particularly cisplatin
- Diuretics e.g. thiazides, loop diuretics
- Immunosuppressants e.g. ciclosporin, tacrolimus
- EGF-receptor antagonists (such as cetuximab)

NB: potassium sparing diuretics may lower magnesium excretion by increasing reabsorption.

Treatment

- Review patient for underlying cause of the low magnesium and review medication, where appropriate stopping drugs which may cause hypomagnesaemia.
- Supplementation: The dose of magnesium to correct hypomagnesaemia should be determined on an individual patient basis.
- Magnesium salts are not well absorbed from the gastrointestinal tract.
Summary of treatment

Magnesium Level

0.5 - 0.7 mmol/L

<0.5 mmol/L

Is the patient symptomatic?

Yes

No

Treatment may not be required but should be considered following a clinical risk/benefit decision.

Oral Treatment:
Magnesium –L-aspartate Magnaspartate® (10mmol/sachet) 1-2 sachets daily
Duration will be dependent on the serum magnesium concentration. (see monitoring below)

Intravenous Treatment:

Day 1
Magnesium Sulphate 50% 40mmol in 500ml glucose 5% over 12hours (No more than 40mmol daily)

Days 2-5
Magnesium Sulphate 50% 20mmol in 500mL glucose 5% over 6hours (No more than 20mmol daily)

*Compatible fluids – Glucose 5% is preferred but Sodium Chloride 0.9% or Glucose 4% Sodium Chloride 0.18% may also be used

Treatment (oral and IV) over 5 days is usually required as plasma magnesium levels may be artificially high whilst magnesium equilibrates with the intracellular compartment.
Oral replacement therapy:

- The standard dose of oral magnesium for hypomagnesaemia is 24mmol daily in divided doses
- If one oral magnesium preparation is not effective in raising magnesium levels or causes adverse effects in a patient it is reasonable to try an alternative oral preparation, if the patient’s condition allows.
- Preferred licensed product: Magnesium-L-aspartate Magnaspartate® 10mmol/sachet 1-2 sachets daily
- Each sachet can be dissolved in 50-200mL water, tea or orange juice. Stir until the solution in water is cloudy to transparent. In orange juice or tea inactive particles will be visible. The solution should be taken immediately after being prepared.
- Magnaspartate can be given enterally. The bioavailability may be reduced if jejunal route is used due to the gastric acid required to convert the salt aspartate to chloride before absorption in the stomach.
- Alternative may include:
  - Magnesium citrate 150mg tablets – containing 6.2mmol Mg / tablet

Magnesium glycerophosphate 4mmol/tab is an unlicensed preparation restricted to consultant gastroenterology use only. It should only be used for patients with short bowel syndrome where the licensed preparation may be unsuitable. Unlicensed medication policy must be followed if you are using this.

For IV replacement therapy:
Available as:
- Magnesium Sulphate Injection 50% (requires dilution before administration).
  - 2ml ampoule containing 4mmol magnesium (1g magnesium sulphate)
  - 20ml ampoule containing 40mmol magnesium (10g magnesium sulphate)

Administration:
- Preferably administer via a large peripheral vein (or central venous catheter).
- Compatible fluids – Glucose 5% is preferred but Sodium Chloride 0.9% or Glucose 4% Sodium Chloride 0.18% may also be used
- Administer magnesium sulphate 20-40mmol via a volumetric pump over 6-12 hours.
**Rate**
- Do not exceed a rate of 36mmol per hour (0.6mmol per minute), ideally in magnesium supplementation the rate should be no greater than 4mmol per hour.
- If necessary magnesium 20mmol may be given over 3 hours.

**Fluid restricted patients** - the maximum concentration is 20% (20mmol in 25ml = 0.8mmol/ml) via a peripheral vein. A practical regimen is 20mmol magnesium diluted to 50ml.

Patients may require up to 160mmol of magnesium sulphate over 5 days (up to 50% of the infused dose is excreted in the urine)

**Monitoring and side effects**

Diarrhoea tends to limit the amount of magnesium that can be given orally – if diarrhoea develops this may be reduced by administration with or after food or by reducing the dose.

During intravenous magnesium administration monitor BP, heart rate, respiratory rate, urine output, and also monitor for signs of hypermagnesaemia. Hypocalcaemia, hypotension can occur with rapid administration and phlebitis.

Magnesium levels should be checked daily.

Treatment (oral and IV) over 5 days is usually required as plasma magnesium levels may be artificially high whilst magnesium equilibrates with the intracellular compartment.

Calcium and potassium levels should also be checked regularly.

Frequent and long-term use of Magnaspartate® may be harmful to the teeth (caries).

**Symptoms and signs of hypermagnesaemia:**

These include flushing, thirst, hypotension, drowsiness, nausea and vomiting, double vision, slurred speech, confusion, loss of tendon reflexes due to neuromuscular blockade, muscle weakness, respiratory depression, cardiac arrhythmias ie bradycardia and AV block, coma and cardiac arrest.
Magnesium level at which clinical features may present:

<table>
<thead>
<tr>
<th>Magnesium Level (mmol/L)</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 – 3.5</td>
<td>Flushing, ECG changes</td>
</tr>
<tr>
<td>4 – 5</td>
<td>Drowsiness, slurred speech, absent deep tendon reflexes</td>
</tr>
<tr>
<td>&gt;6</td>
<td>Muscle paralysis, respiratory depression</td>
</tr>
<tr>
<td>&gt;8</td>
<td>Cardiac Arrest.</td>
</tr>
</tbody>
</table>

Special Precautions and Warnings for Use

- **Patients with renal impairment**: Magnesium is renally excreted and should be used with caution in patients with renal impairment as they are at a higher risk of adverse effects.

- **Myasthenia gravis / Hepatic impairment**: Magnesium salts should be used with caution in patients with myasthenia gravis, patients with hepatic impairment at risk of developing renal impairment, and respiratory insufficiency.

- **Cardiac patients**: Parenteral/Oral magnesium should be avoided in patients with heart block, myocardial damage, disorders of cardiac conduction (bradycardia).

- **Older patients**: Caution should be exercised with replacement in the elderly.

- **Concurrent medications**: Administer with caution to patients receiving digitalis glycosides (digoxin), iv magnesium sulphate should not be administered concurrently with high doses of barbiturates, opioids or hypnotics due to the risk of respiratory depression. Profound hypotension has been reported with concomitant use of nifedipine. As oral magnesium and other medicinal products may mutually influence each other's absorption, a time interval of 2 to 3 hours should generally be respected if possible. This specifically applies to:
  - *Fluorides and tetracycline*: if they must be used, the doses must be separated by 2 to 3 hours or more to prevent their admixture in the gut.
  - *Aminoquinolines, quinidine and quinidine derivatives nitrofurantoin, penicillamine, iron,*
<table>
<thead>
<tr>
<th><strong>bisphosphonates, eltrombopag, nitroxoline:</strong> to avoid impairment of absorption, magnesium preparations should be taken 3 to 4 hours before or after the administration of those drugs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnasparte® contains sucrose. Patients with rare hereditary problems of fructose intolerance, glucose galactose malabsorption or sucrase-isomaltase insufficiency should not take this medicine.</td>
</tr>
</tbody>
</table>

**Further advice**

Further advice on magnesium replacement can be obtained from clinical chemistry.
References:


5. UKMI Q&A 111.2 What oral magnesium preparations are available in the UK and which preparation is preferred for the treatment and prevention of hypomagnesaemia? April 2015 Accessed via www.evidence.nhs.uk on 15/09/15


Equality Impact Assessment Report

1. **Name of Policy or Service**
   Trust wide clinical guidance

2. **Responsible Manager**
   Owen Bennett (Clinical Quality, Risk and Safety Manager)

3. **Name of person Completing EIA**
   Azma Malik

4. **Date EIA Completed**
   15/09/15

5. **Description and Aims of Policy/Service**
   This clinical guideline has been written to assist hospital staff in the management of adult patients with hypomagnesaemia

6. **Brief Summary of Research and Relevant Data**
   Full references provided on document which include British National Formulary

7. **Methods and Outcome of Consultation**
   Drugs and Therapeutics Committee

8. **Results** of Initial Screening or Full Equality Impact Assessment:

<table>
<thead>
<tr>
<th>Equality Group</th>
<th>Assessment of Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>No Impact Identified</td>
</tr>
<tr>
<td>Gender</td>
<td>No Impact Identified</td>
</tr>
<tr>
<td>Race</td>
<td>No Impact Identified</td>
</tr>
<tr>
<td>Sexual Orientation</td>
<td>No Impact Identified</td>
</tr>
<tr>
<td>Religion or belief</td>
<td>No Impact Identified</td>
</tr>
<tr>
<td>Disability</td>
<td>No Impact Identified</td>
</tr>
<tr>
<td>Dignity and Human Rights</td>
<td>No Impact Identified</td>
</tr>
<tr>
<td>Working Patterns</td>
<td>No Impact Identified</td>
</tr>
<tr>
<td>Social Deprivation</td>
<td>No Impact Identified</td>
</tr>
</tbody>
</table>
9. **Decisions and/or Recommendations (including supporting rationale)**
   From the information contained in the procedure, and following the initial screening, it is my decision that a full assessment is not required at the present time.

10. **Equality Action Plan (if required)**
    N/A

11. **Monitoring and Review Arrangements**
    Review May 2015