

**UNIVERSITY OF MICHIGAN HEALTH-SYSTEM**  
**Adult Intensive Care Unit Electrolyte Dosing Guidelines**

**WARNINGS AND PRECAUTIONS**

- Patients with renal insufficiency are exempt from these guidelines (e.g., serum creatinine  $\geq$  2 mg/dL, or patients on any form of renal replacement therapy (intermittent or continuous)).
- These guidelines are meant to assist with empiric dosing of electrolytes for ICU patients; doses may need to be adjusted based on patient-specific factors and responses to initial doses.
- Goal serum concentrations may also need to be adjusted based on patient-specific factors.
- These guidelines are for routine supplementation of electrolytes; **they are not meant for treatment in urgent or emergent situations.**

**POTASSIUM**

Goal serum potassium concentration 4.0 – 5.0 mEq/L

**Treatment of Hypokalemia**

\*RN to decide route based on available access.

**Any dose above 20 mEq may be administered as a combination of oral & intravenous.**

<b>Serum potassium concentration</b>	<b>Intravenous potassium dose<sup>†</sup></b> Max IV is 20 mEq/hour	<b>Oral potassium dose</b>	<b>Recheck serum potassium concentration</b>
<b>3.8 – 3.9 mEq/L</b>	20 mEq IVPB	20 mEq (1 packet)	Within 2-4 hours of completing dose
<b>3.5 – 3.7 mEq/L</b>	40 mEq IVPB	40 mEq (2 packets)	Within 2-4 hours of completing dose
<b>3.2 – 3.4 mEq/L</b>	60 mEq IVPB	60 mEq (3 packets)	Within 2-4 hours of completing dose
<b>&lt; 3.1 mEq/L</b>	80 mEq and <b>notify MD</b>	80 mEq (4 packets) and <b>notify MD</b> Must be administered in combination with IV	Immediately after completing dose

<b>† Rate of Intravenous Potassium Infusion</b>	10 mEq potassium/hour; can increase to 20 mEq/hour, but continuous cardiac monitoring and infusion via a central venous catheter are recommended for infusion rates > 10 mEq potassium/hour. Maximum of 40 mEq potassium/hour in emergency situations.
<b>Maximum Potassium Concentration</b>	80 mEq/L via a peripheral vein; up to 120 mEq/L via a central vein (admixed in NS or ½ NS)

**\*\*Consider adding scheduled oral potassium chloride as indicated\*\***

References:

- Kruse JA, Carlson RW. Rapid correction of hypokalemia using concentrated intravenous potassium chloride infusions. *Arch Intern Med.* 1990; 150:613-617.
- Kruse JA, Clark VL, Carlson RW, et al. Concentrated potassium chloride infusions in critically ill patients with hypokalemia. *J Clin Pharmacol.* 1994; 34:1077-1082.
- Hamill RJ, Robinson LM, Wexler HR, et al. Efficacy and safety of potassium infusion therapy in hypokalemic critically ill patients. *Crit Care Med.* 1991; 9:694-699.

## CALCIUM

Goal serum ionized calcium concentration 1.12 – 1.3 mmol/L

### Treatment of Hypocalcemia

Oral treatment preferred when possible.

IV treatment preferred whenever patient is symptomatic.

Serum ionized calcium concentration	Oral Calcium Citrate dose	Intravenous Calcium Gluconate dose	Recheck serum calcium concentration
1.05 – 1.11 mmol/L	2 tablets	1 g over 30 – 60 minutes	With next AM lab draw
0.99 – 1.04 mmol/L	3 tablets	2 g over 30 – 60 minutes	Within 4 – 6 hours of completing dose
0.93 – 0.98 mmol/L	Not recommended	3 g over 60 minutes	Within 4 – 6 hours of completing dose
<0.93 mmol/L	Not recommended	4 g over 60 minutes and <b>notify MD</b>	Within 4 – 6 hours of completing dose

1 g calcium citrate = 10.5 mEq calcium.

Each tablet of calcium citrate + vitamin D contains 315 mg of calcium citrate (66 mg elemental calcium, 3.3 mEq calcium) and 250 units of vitamin D (cholecalciferol).

1 g calcium gluconate = 4.56 mEq calcium

Maximum rate of intravenous infusion = 1.5 mEq calcium/minute

Corrected serum  $[Ca^{++}]$  (mg/dL) = measured serum  $[Ca^{++}]$  (mg/dL) +  $[0.8 \times (4 - \text{serum albumin (g/dL)})]$

#### References:

Olinger ML. Disorders of calcium and magnesium metabolism. *Emerg Med Clin North Am.* 1989; 7:795-822.

Joy MS, Hladik GA. Disorders of sodium, water, calcium, and phosphorus homeostasis. In: Dipro JT, Talbert RL, Yee GC, et al, eds. *Pharmacotherapy: A Pathophysiologic Approach.* 5<sup>th</sup> ed. New York, NY: McGraw-Hill; 2002:953-979.

Lacy CH, Armstrong LL, Goldman MP, et al, eds. *Drug Information Handbook.* 11<sup>th</sup> ed. Hudson, OH: Lexi-Comp Inc; 2003.

## MAGNESIUM

Goal serum magnesium concentration 2.0 – 2.4 mg/dL

### Intravenous Treatment of Hypomagnesemia

Serum magnesium concentration	Intravenous magnesium sulfate dose <sup>†</sup>	Oral magnesium oxide dose	Recheck serum magnesium concentration
1.6 – 1.9 mg/dL	2 g	800 mg	4 to 6 hours after dose if symptomatic otherwise with next AM lab draw
1.0 – 1.5 mg/dL	4 g	Not recommended	4 to 6 hours after dose if symptomatic otherwise with next AM lab draw
< 1.0 mg/dL	6 g and <b>notify MD</b>	Not recommended	4 to 6 hours after dose if symptomatic otherwise with next AM lab draw
<b>Rate of intravenous infusion of magnesium</b>		Recommend infusing 1 g magnesium sulfate/hour (~8 mEq magnesium/hour), up to maximum of 2 g magnesium sulfate/hour (doses of up to 32 mEq magnesium can be given over 4 – 5 minutes in <b><u>severe symptomatic hypomagnesemia</u></b> (urgent or emergent situation))	

† 1 g magnesium sulfate = 8.1 mEq magnesium

**\*\*Consider adding scheduled oral magnesium oxide as indicated\*\***

#### References:

- Heaton FW. The kidney and magnesium homeostasis. *Ann NY Acad Sci.* 1969; 162:775-785.
- Martin HE. Clinical magnesium deficiency. *Ann NY Acad Sci.* 1969; 162:891-900.
- Salem M, Munoz R, Chernow B. Hypomagnesemia in critical illness: a common and clinically important problem. *Crit Care Clin.* 1991; 7:225-252.
- Dickerson RN, Brown RO. Hypomagnesemia in hospitalized patients receiving nutritional support. *Heart & Lung.* 1985; 14:561-569.
- Rasmussen HS, McNair P, Norregard P, et al. Intravenous magnesium in acute myocardial infarction. *Lancet.* 1986 Feb 1; 1(8475):234-236.
- Ceremuzynski L, Hao NV. Ventricular arrhythmias late after myocardial infarction are related to hypomagnesemia and magnesium loss: preliminary trial of corrective therapy. *Clin Cardiol.* 1993; 16:493-496.
- Flink EB. Therapy of magnesium deficiency. *Ann NY Acad Sci.* 1969; 162:901-905.
- Oster JR, Epstein M. Management of magnesium depletion. *Am J Nephrol.* 1988; 8:349-354.
- Sacks GS, Brown RO, Dickerson RN, et al. Mononuclear blood cell magnesium content and serum magnesium concentration in critically ill hypomagnesemic patients after replacement therapy. *Nutrition.* 1997; 13:303-307.
- Hebert P, Mehta N, Wang J, et al. Functional magnesium deficiency in critically ill patients identified using a magnesium-loading test. *Crit Care Med.* 1997; 25:749-755.
- Huycke MM, Naguib MT, Stroemmell MM, et al. *Antimicrob Agents Chemother.* 2000; 44:2143-2148.

## PHOSPHORUS / PHOSPHATE

Goal serum phosphorus concentration 2.7 – 4.6 mg/dL

### Intravenous Treatment of Hypophosphatemia

Serum phosphorus concentration	Intravenous phosphate dose <sup>**†</sup>	Oral phosphate dose	Recheck serum phosphorus concentration
2.0 – 2.6 mg/dL	15 mmol over 2 hours	500 mg (16 mmol, 2 packets)	With next AM lab draw
1.5 – 2.0 mg/dL	30 mmol over 4 hours	1000 mg (32 mmol, 4 packets)	Within 4 – 6 hours of completing dose
< 1.5 mg/dL	45 mmol over 6 hours	Not recommended	Within 4 – 6 hours of completing dose

\*Maximum infusion rate = 7 mmol phosphate/hour.

Per protocol all intravenous doses will be replaced as sodium phosphate. If patient is hypernatremic or hypokalemic, contact physician regarding possibly replacing as potassium phosphate instead. A separate order will be needed for potassium phosphate.

1 mMol sodium phosphate = 1.33 mEq sodium

1 mMol potassium phosphate = 1.47 mEq potassium

Each packet of oral phosphate replacement contains 8 mmol phos, 7 mEq potassium, 7 mEq sodium

#### References:

Lentz RD, Brown DM, Kjellstrand CM. Treatment of severe hypophosphatemia. *Ann Intern Med.* 1978; 89:941-944.

Vannatta JB, Whang R, Papper S. Efficacy of intravenous phosphorous therapy in the severely hypophosphatemic patient. *Arch Intern Med.* 1981; 141:885-887.

Andress DL, Vannatta JB, Whang R. Treatment of refractory hypophosphatemia. *South Med J.* 1982; 75:766-767.

Vannatta JB, Andress DL, Whang R, et al. High-dose intravenous phosphorus therapy for severe complicated hypophosphatemia. *South Med J.* 1983; 76:1424-1426.

Kingston M, Al-Siba'i MB. Treatment of severe hypophosphatemia. *Crit Care Med.* 1985; 13:16-18.

Rosen GH, Boullata JI, O'Rangers EA, et al. Intravenous phosphate repletion regimen for critically ill patients with moderate hypophosphatemia. *Crit Care Med.* 1995; 23:1204-1210.

Clark CL, Sacks GS, Dickerson RN, et al. Treatment of hypophosphatemia in patients receiving specialized nutrition support using a graduated dosing scheme: results from a prospective clinical trial. *Crit Care Med.* 1995; 23:1504-1510.

**Not in Omnicell.  
Must call pharmacy to dispense.**

Approved by: Critical Care Steering Committee, 3/2010  
Pharmacy and Therapeutics Committee, 4/2010

## **Michigan Critical Care Collaborative Network**

### Material Attribution

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### Notes/Summary