

Project: Ghana Emergency Medicine Collaborative

Document Title: Fluid & Electrolyte Imbalances in Emergency Nursing

Author(s): Chauntel Henry (University of Michigan), RN 2012

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Electrolytes

- elements or minerals found in bodily fluids that become electrically charged particles (cations or anions)
- responsible for many activities of the body including heart automaticity, nerve impulses, movement of water and fluids, and chemical reactions
- allow cells to generate energy and maintain cell wall stability
- hormones produced by the kidneys and adrenal glands control most electrolyte levels

Reasons for Electrolyte Imbalances

Abnormalities occur when electrolyte concentrations are imbalanced between intercellular and extracellular fluids

- Kidney Dysfunction
- Lack of Water: Dehydration or Diarrhea
- Medication Side Effects

SODIUM

SODIUM, Basic Info

- An electrolyte and a mineral
- Most often found in the plasma outside the cell
- Transmit electrical impulses in heart and nervous system
- Regulates water distribution and fluid balance through entire body
- Help regulate acid/base balance

Normal Levels

- Extracellular level: 135-145 mEq/L
- Intracellular level: 10-12 mEq/L

SODIUM, Basic Info

Sodium imbalances normally related to changes in total body water, not changes in sodium.

Sodium imbalances can lead to hypovolemia or hypervolemia.

Foods High in Sodium

1. Cheese
2. Celery
3. Dried fruits
4. Ketchup
5. Mustard
6. Olives
7. Pickles
8. Preserved meats
9. Sauerkraut
10. Soy sauce
11. All prepared foods (canned and packaged) and fast foods are **very** high in sodium

HYPONATREMIA

LOW SODIUM

Signs/Symptoms Low Sodium

- Headache, lethargy, confusion
- Mild anorexia, nausea, abdominal discomfort
- Muscle cramps, weakness
- Mental status changes, decreased level of consciousness
- Seizures, tremors
- Orthostatic vital signs

Causes of Hyponatremia

- Most common electrolyte disorder
- More common in very young or very old

MANY CAUSES:

1. Sometimes caused by water intoxication (too much water intake causes sodium dilution in the blood—will overwhelm the kidney's compensation mechanism).
2. Can be caused by a syndrome of inappropriate anti-diuretic hormone secretion (SIADH).
3. Often caused by increases in Antidiuretic Hormone (ADH).
4. Other causes: profuse diaphoresis, vomiting, diarrhea, draining wounds (burns), excessive blood loss (trauma, GI bleeding), some medication side effects, renal disease

Antidiuretic Hormone (ADH)

Sodium levels are affected by ADH

- Affects water absorption in kidneys
- Increased ADH causes kidneys to reabsorb more water—can lead to hypervolemia
- Decreased ADH leads to less water reabsorption which leads to more excretion—can lead to hypovolemia

Aldosterone

Sodium levels affected by aldosterone

- Mineral/corticoid produced in adrenal cortex
- Affects water absorption in kidneys
- High aldosterone causes kidneys to reabsorb more water—can lead to hypervolemia
- Low aldosterone causes less water absorption which leads to more excretion—can lead to hypovolemia

Three Main Types Hyponatremia

Hypovolemic

Total body water decreases

Total body sodium decreases

Extracellular fluid volume decreases

Euvolemic

Total body water increases

Total body sodium remains normal

Extracellular fluid increases minimally (no edema)

Hypervolemic

Total body sodium increases

Total body water increases

Extracellular fluid increases markedly (with edema)

Most Common

S/S Hypovolemic Hyponatremia (low volume and low sodium)

****MOST COMMON****

- Dry mucous membranes
- Tachycardia
- Decreased skin turgor
- Orthostatic vital signs

S/S Hypervolemic Hyponatremia (high volume & low sodium)

- Rales
- S3 gallop
- Jugular Venous Distention
- Peripheral edema
- Ascites

Interventions/Treatments for Low Sodium

- Need to determine and treat underlying cause
- Get good IV access
- Send blood work to lab
- Start .9NS IV fluid or lactated Ringer's
- Check capillary blood glucose—hyperglycemia can cause false hyponatremia lab results
- Pad side rails if seizure activity present
- If levels below 120mEq/L, pt may need to be prepared for intubation

IV Fluid to Correct Hyponatremia

- Correct Sodium at rate of $.5\text{mEq/L}$ per hour if no symptoms present
- Elevate Sodium by $4\text{-}6\text{mEq/L}$ in first 2 hours if symptoms are present
- No more than $10\text{-}12\text{mEq/L}$ in first 24 hours and no more than 18mEq/L in first 48 hours

Nursing Plan of Care Possibilities

- Deficient Fluid Volume

[http://www.med.umich.edu/i/nursing/Clinical/documentation/NursingPlansOfCare/FluidVolume Deficient 0027.pdf](http://www.med.umich.edu/i/nursing/Clinical/documentation/NursingPlansOfCare/FluidVolume%20Deficient%200027.pdf)

- Excess Fluid Volume

[http://www.med.umich.edu/i/nursing/Clinical/documentation/NursingPlansOfCare/FluidVolume Excess 0025.pdf](http://www.med.umich.edu/i/nursing/Clinical/documentation/NursingPlansOfCare/FluidVolume%20Excess%200025.pdf)

HYPERNATERMIA

HIGH SODIUM

High Sodium: Hypernatremia

- Very rare to see over 145mEq/L, 50% of cases are fatal at that level
- Leads to intercellular dehydration because water follows sodium into extracellular spaces
- More common in very young
- Women who have poor nutrition have poor milk production for their newborns

Signs/Symptoms High Sodium

- Restlessness, change in mental status, irritability, seizure activity
- Nausea, vomiting, increased thirst
- Ataxia, tremors, hyper-reflexia
- Flushed skin, increased capillary refill time
- Decreased cardiac output related to decreased myocardial contractility

Causes of Hypernatremia

- Usually associated with dehydration--there is too little water.
- Water loss can occur from vomiting and/or diarrhea, excessive sweating, or from drinking fluid with high salt concentrations.
- Decreased thirst drive: elderly, dementia patients, newborns
- Decreased water intake--leads to free water deficit--leads to high sodium
- Diabetes Insipidus

Diabetes Insipidus

- An uncommon condition when the kidneys are unable to concentrate urine or conserve water. The amount of water conserved is controlled by antidiuretic hormone, also called vasopressin.
- **Symptoms:** polyuria, excessive thirst, inappropriately dilute urine (*urine osmolality < serum osmolality*)
- **Lab Tests:** urinalysis and strict I&O measurement
- **Treatment:** The cause of the underlying condition should be treated when possible. May be controlled with vasopressin pills or nasal spray.

Interventions/Treatments for High Sodium

- Need to determine and treat underlying cause
- Get good IV access
- Send blood work to lab
- Increase sodium intake orally or correct with hypotonic sodium IV fluids
 - .45%NS allows slower reduction of sodium levels than D5

Nursing Plan of Care Possibilities

- Impaired Urinary Elimination

http://www.med.umich.edu/i/nursing/Clinical/documentation/NursingPlansOfCare/Elimination_Urinary_Impaired_0062.pdf

- Diarrhea

http://www.med.umich.edu/i/nursing/Clinical/documentation/NursingPlansOfCare/Diarrhea_0026.pdf

POTASSIUM

POTASSIUM, Basic Info

- Most concentrated inside the cells
- Regulates muscle tissue contractility, including heart muscle
- Helps control cellular metabolism: converts glucose to glucagon for muscle fuel
- Regulated by kidneys; excess levels removed by feces and sweat
- Serum potassium levels controlled by Sodium-Potassium Pump (pumps sodium out of cells and allows potassium back into cells)

Normal Levels

- Serum level: 3.5-5.0 mEq/L

Foods Rich in Potassium

1. Artichokes
2. Apricots
3. Avocado
4. Banana
5. Beans
6. Chocolate
7. Carrots
8. Cantaloupe
9. Green Leafy Veggies
10. Mushrooms
11. Melons
12. Nuts
13. Oranges
14. Prunes
15. Potatoes
16. Pumpkins
17. Spinach
18. Tomatoes

HYPOKALEMIA

LOW

POTASSIUM

Signs and Symptoms of Low Potassium

- Muscle weakness, aches, cramping, paresthesias
- Confusion, fatigue, syncope, hallucinations
- Low blood pressure
- Palpitations
- N/V/D (can lead to low potassium and can be a sign of low potassium)
- Polyuria and UA with low specific gravity
- EKG CHANGES: U waves, increased QT interval, flat T wave, depressed ST segment

EKG chart needed here

Causes of Hypokalemia

- Nausea/Vomiting/Diarrhea
- Diabetic ketoacidosis
- Laxative abuse
- Diuretic medications
- High corticosteroid levels
- Insulin use (*can cause shift of K⁺ out of blood and into cells*)
- Magnesium deficiency
- Medicines used for asthma or COPD (*beta-adrenergic agonist drugs*)
- Acute kidney failure
- High aldosterone levels

Cushing's Disease

- A condition where the pituitary gland releases too much adrenocorticotrophic hormone (ACTH), usually due to a tumor. ACTH stimulates the production and release of cortisol, a stress hormone. Too much ACTH = too much cortisol.
- **Symptoms:** upper body obesity with thin arms and legs, round full face (moon face), collection of fat between the shoulders (buffalo hump), excess hair growth on the face or neck or chest, irregular menstrual cycle, decreased sexual desire, depression, anxiety, fatigue, frequent headaches, hypertension.
- **Lab Tests** to confirm elevated cortisol levels. Testing is then done to determine the cause.
- **Treatment:** Radiation treatment or surgery to remove the pituitary gland tumor. If the tumor does not respond to surgery or radiation, medications can be used to slow cortisol production but will need to be taken for life.

Interventions/Treatments for Low Potassium

- Need to determine and treat underlying cause
- Get good IV access--send blood work and UA to lab
- Increase potassium intake orally or correct with IV fluid
- NEVER give K+ by IV push!!

Mild or Moderately Low Potassium Level (2.5-3.5 mEq/L)

no symptoms, or only minor complaints

treat with liquid or pill potassium--
preferred because it is easy to
administer, safe, inexpensive, and readily
absorbed from the gastrointestinal tract.

Low Potassium Level (less than 2.5 mEq/L)

if cardiac arrhythmias or significant
symptoms are present

IV potassium should be given--admission
or observation in the hospital is indicated.
Replacing potassium takes several hours
as it must be administered very slowly
intravenously to avoid problems.

Severely Low Potassium Level (less than 2.0 mEq/L)

both IV potassium and oral medication
are necessary

IV Treatment of Low Potassium

per UofM CVC ICU Protocol Guidelines

Serum potassium concentration	Intravenous potassium dose[†]	Recheck serum potassium concentration
3.8 – 3.9 mEq/L	20 mEq potassium intravenously	2 hours after completing dose
3.5 – 3.7 mEq/L	40 mEq potassium intravenously	2 hours after completing dose
3.2 – 3.4 mEq/L	50 mEq potassium intravenously	2 hours after completing dose
2.9 – 3.1 mEq/L	60 mEq potassium intravenously	Immediately after completing dose
< 2.9 mEq/L	80 mEq potassium intravenously and notify MD	Immediately after completing dose

**† Rate of
Intravenous
Potassium
Infusion**

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
Potassium
Concentration**

**80 mEq/L via a peripheral vein;
up to 120 mEq/L via a central
vein (admixed in NS or ½ NS)**

Nursing Plan of Care Possibilities

- Confusion

[http://www.med.umich.edu/i/nursing/Clinical/documentation/NursingPlansOfCare/Confusion AcuteRiskCombined 0080.pdf](http://www.med.umich.edu/i/nursing/Clinical/documentation/NursingPlansOfCare/Confusion%20AcuteRiskCombined%200080.pdf)

- Nausea

[http://www.med.umich.edu/i/nursing/Clinical/documentation/NursingPlansOfCare/Nausea 0015.pdf](http://www.med.umich.edu/i/nursing/Clinical/documentation/NursingPlansOfCare/Nausea%200015.pdf)

HYPERKALEMIA

HIGH

POTASSIUM

Signs and Symptoms High Potassium

- Can be life threatening if high K⁺ causes a potentially life-threatening heart rhythm
- EKG changes: peaked T waves, prolonged PR interval, wide QRS complex
- Nausea
- Fatigue
- Muscle weakness, tingling sensation
- Bradycardia
- Weak pulses

EKG chart needed here

Causes of Hyperkalemia

- Often related to renal issues (*acute failure, stones, inflammation, transplant rejection, etc*). K⁺ levels build up because it can't be excreted in the urine.
- Using potassium supplements (RX or OTC)
- Medications: Steroid use, NSAID use, some diuretic use, ACE Inhibitors
- Severe burns or trauma injuries
- Overuse of salt substitutes
- Rhabdomyolysis
- Metabolic Acidosis or Ketoacidosis (*the acidosis and high glucose levels work together to cause fluid and potassium to move out of the cells into the blood circulation*)

Addison's Disease

- A disorder that occurs when the adrenal glands do not produce enough hormones. Hormones, such as aldosterone, regulate sodium and potassium balance.
- **Symptoms:** changes in blood pressure or heart rate, fatigue and weakness, nausea and vomiting and diarrhea, skin changes—darkening or paleness, loss of appetite, salt craving, unintentional weight loss.
- **Lab Tests:** increased potassium, low serum sodium levels, hypotension, low cortisol level.
- **Treatment:** replacement corticosteroids will control the symptoms; patients often receive a combination of glucocorticoids (cortisone or hydrocortisone) and mineralocorticoids (fludrocortisone).

Interventions/Treatments for High Potassium

- Restrict medication use
- IV diuretics, such as Lasix: to decrease the total K⁺ stores by increasing K⁺ excretion in the urine
- Kayexalate: binds K⁺ and leads to its excretion via the gastrointestinal tract.
- With high levels, a special IV cocktail is often used: calcium gluconate (*to protect the heart*), sodium bicarbonate (*to alkalinize the plasma and help move potassium into the cells*), IV dextrose (*to attract the potassium*), IV insulin (*to force the glucose into the cells and the potassium will follow*)
- Continuous cardiac monitoring and frequent vital signs

Nursing Plan of Care Possibilities

- Fatigue

http://www.med.umich.edu/i/nursing/Clinical/documentation/NursingPlansOfCare/Fatigue_0024.pdf

- Risk for Imbalance Fluid Volume

http://www.med.umich.edu/i/nursing/Clinical/documentation/NursingPlansOfCare/FulidVolume-RiskForImbalance_0011.pdf

CALCIUM

CALCIUM, Basic Info

- About 99% of the body's calcium is stored in the bones, but cells (especially muscle cells) and blood also contain calcium.
- Essential for: formation of bone and teeth, muscle contraction, nerve signaling, blood clotting, normal heart rhythm
- Calcium levels are regulated primarily by two hormones: parathyroid hormone and calcitonin

Normal Levels

- Serum level: 8.6-10.4 mg/dL

Foods High in Calcium

1. Cheese
2. Milk
3. Broccoli
4. Yogurt
5. Sardines
6. Mustard
7. Dark Greens (spinach, kale, collards, etc.)
8. Soybeans
9. Okra
10. Rhubarb
11. Calcium fortified foods (such as some orange juice, oatmeal, and breakfast cereals)
12. White beans
13. Almonds
14. Sesame Seeds

HYPOCALCEMIA

LOW CALCIUM

Signs and Symptoms Low Calcium

- Increased neuromuscular irritation:
 1. Chvostek's Sign (*tapping on the facial nerve causes twitching of facial muscles*)
 2. Trousseau's Sign (*inflating the BP cuff for several minutes causes muscular contractions, including flexion of the wrist and metacarpophalangeal joints*)
- EKG Changes: prolonged QT interval, heart block, V Tach
- Depression, dementia, anxiety, mental status changes
- Hypotension
- Diaphoresis
- Bronchospasm, Stridor
- Bone Pain, Fractures, Osteomalacia, Rickets

EKG chart needed here

Causes of Hypocalcemia

- Hypoparathyroidism
- Hyperphosphatemia
- Chronic Renal Failure
- Pancreatitis
- Sepsis
- Liver disease (*decreased albumin production*)
- Osteomalacia
- Malabsorption (*inadequate absorption of nutrients from the intestinal tract*)
- Vitamin D deficiency or Magnesium deficiency

Hypoparathyroidism

- An endocrine disorder where the parathyroid glands do not produce enough parathyroid hormone (PTH).
- PTH helps control calcium, phosphorus, magnesium, and vitamin D levels within the blood and bone.
- Blood calcium levels fall, and phosphorus levels rise.
- The most common cause is injury to the glands.
- Sometimes can be caused as a side effect of radioactive iodine treatment for hyperthyroidism.
- May lead to stunted growth, malformed teeth, and slow mental development in children.

Hyperphosphatemia

- Phosphorous is critical for bone mineralization, cellular structure, and energy metabolism.
- Causes hypocalcemia by precipitating calcium, decreasing vitamin D production, and interfering with parathyroid hormone-mediated bone reabsorption.
- Considered significant when levels are greater than 5 mg/dL in adults or 7 mg/dL in children.
- Patients commonly complain of muscle cramping that may lead to tetany, delirium, and seizures.

Intervention/Treatments for Low Calcium

- Seizure Precautions
- IV Calcium Gluconate (1-2 grams over 20 minutes) with Vitamin D (calcitriol). *(Precautions are taken to prevent seizures or laryngospasms. The heart is monitored for abnormal rhythms until the patient is stable.)*
- 1 GM Calcium Gluconate = 90mg elemental Calcium = 4.5 mEq Ca⁺⁺
- Oral Calcium (1-3 grams per day) with oral Vitamin D
- Sunlight Therapy

IV Treatment of Low Calcium

per UofM CVC ICU Protocol Guidelines

Serum calcium concentration	Preferred calcium salt*	Calcium dose	Recheck serum calcium concentration
Ionized calcium = 1.05 – 1.11 mmol/L (or corrected calcium ~ 8 – 8.4 mg/dL)	Gluconate	1 g calcium gluconate over 30 – 60 minutes	With next AM lab draw
Ionized calcium = 0.99 – 1.04 mmol/L (or corrected calcium ~ 7.5 – 7.9 mg/dL)	Gluconate	2 g calcium gluconate over 60 minutes	4 – 6 hours after completing dose
Ionized calcium = 0.93 – 0.98 mmol/L (or corrected calcium ~ 7 – 7.4 mg/dL)	Gluconate	3 g calcium gluconate over 60 minutes	4 – 6 hours after completing dose
Ionized calcium < 0.93 mmol/L (or corrected calcium < 7 mg/dL)	Gluconate	4 g calcium gluconate over 60 minutes and notify MD	4 – 6 hours after completing dose

Nursing Plan of Care Possibilities

- Risk for Fall

http://www.med.umich.edu/i/nursing/Clinical/documentation/NursingPlansOfCare/Fall_RiskFor_Adult_0005.pdf

- Activity Intolerance

http://www.med.umich.edu/i/nursing/Clinical/documentation/NursingPlansOfCare/ActivityIntolerance_0035.pdf

HYPERCALCEMIA

HIGH CALCIUM

Signs and Symptoms High Calcium

- Fatigue, lethargy
- EKG Changes: increased PR interval, short QT interval
- Depression, paranoia, hallucinations, coma
- Polyuria, flank pain, kidney stone formation
- Decreased neuromuscular excitability: (hyporeflexia, weakness, poor coordination)
- Decreased GI Motility: nausea, vomiting, constipation, hypoactive bowel sounds

Causes of Hypercalcemia

- 90% of cases caused by Hyperparathyroidism or Malignancy
- Addison's disease
- Paget's disease
- Vitamin D intoxication
- Excessive calcium intake (dairy foods), also called Milk-Alkali Syndrome
- Hyperthyroidism or too much thyroid hormone replacement medication
- Prolonged immobilization
- Sarcoidosis
- Use of certain medications such as lithium, tamoxifen, and thiazide diuretics

Hyperparathyroidism

- Most common cause of high calcium
- Due to excess PTH release by the parathyroid.
(PTH raises serum calcium levels while lowering the serum phosphorus concentration.)
- Serum calcium is elevated and bones lose calcium.
- Surgical removal of the affected gland(s) is the most common cure.

Addison's Disease

- A disorder that occurs when the adrenal glands do not produce enough hormones. Hormones, such as aldosterone, regulate sodium and potassium balance.
- **Symptoms:** changes in blood pressure or heart rate, fatigue and weakness, nausea and vomiting and diarrhea, skin changes—darkening or paleness, loss of appetite, salt craving, unintentional weight loss.
- **Lab Tests:** increased potassium, low serum sodium levels, hypotension, low cortisol level.
- **Treatment:** replacement corticosteroids will control the symptoms; patients often receive a combination of glucocorticoids (cortisone or hydrocortisone) and mineralocorticoids (fludrocortisone).

Paget's Disease

- A chronic skeletal disorder which may result in enlarged or deformed bones in one or more regions of the skeleton.
- Involves abnormal bone destruction followed by irregular bone regrowth--results in deformities and weakness.
- The new bone is bigger, but weakened and filled with blood vessels.

Intervention/Treatments for High Calcium

- Bisphosphonates--first line treatment--prevent bone breakdown and increase bone density. It may take 3 months or longer before bone density begins to increase. (*ex: Fosamax, Actonel*)
- .9NS IV leads to natriuresis which leads to increased Calcium excretion
- Calcitonin--when taken by shot or nasal spray, will slow the rate of bone thinning. (*ex: Miacalcin, Calcimar*)
- Lasix--promotes fluid and Calcium excretion

Nursing Plan of Care Possibilities

- Risk for Injury
- http://www.med.umich.edu/i/nursing/Clinical/documentation/NursingPlansOfCare/Injury_RiskFor_0017.pdf
- Confusion
- http://www.med.umich.edu/i/nursing/Clinical/documentation/NursingPlansOfCare/Confusion_AcuteRiskCombined_0080.pdf

MAGNESIUM

Magnesium, Basic Info

- Magnesium is the fourth most abundant mineral in the body.
- 50% of total body magnesium is found in bone. 50% is found inside cells of body tissues and organs.
- Only 1% of magnesium is found in blood.
- Magnesium helps maintain normal muscle and nerve function, supports healthy immune system, promotes normal blood pressure, involved in energy metabolism, and is needed to move other electrolytes (potassium and sodium) in and out of cells.
- Stimulates the parathyroid glands to secrete parathyroid hormone. If these glands don't produce sufficient hormones, the level of calcium in the blood will fall

Normal Levels

- Serum level: 1.7-2.6 mEq/L

Foods High in Magnesium

1. Wheat Bran
2. Almonds
3. Spinach
4. Oatmeal
5. Peanuts
6. Coconuts
7. Grapefruit
8. Chocolate
9. Molasses
10. Oranges
11. Seafood
12. Soy Milk
13. Raisins
14. Lentils

HYPOMAGNESEMIA

LOW MAGNESIUM

Signs/Symptoms Low Magnesium

- Causes neuromuscular irritability and irregular heartbeats
- Laryngospasm, hyperventilation
- Apathy, mood changes, agitation, confusion
- Insomnia, anxiety
- Anorexia, nausea, vomiting
- Tremors, hyper-reflexia, leg cramps, muscle weakness
- Seizures
- Magnesium deficiency has been associated with hypokalemia, hypocalcemia, and cardiac arrhythmias

Causes of Hypomagnesemia

- Magnesium deficiency is often associated with low blood calcium and/or low potassium
- Irritable Bowel Syndrome, Ulcerative Colitis—because magnesium is absorbed in the intestines and then transported through the blood to cells and tissues
- Alcoholism, withdrawal from alcohol
- Hypoparathyroidism
- Malnutrition, Inadequate intake of mineral
- Kidney disease
- Pancreatitis
- Medications--Diuretics (increases loss of magnesium through urine), Digitalis, Cisplatin, Cyclosporine
- Large amounts of magnesium can be lost by prolonged exercise, excessive sweating, or chronic diarrhea

Hypoparathyroidism

- An endocrine disorder where the parathyroid glands do not produce enough parathyroid hormone (PTH).
- PTH helps control calcium, phosphorus, magnesium, and vitamin D levels within the blood and bone.
- Blood calcium levels fall, and phosphorus levels rise.
- The most common cause is injury to the glands.
- Sometimes can be caused as a side effect of radioactive iodine treatment for hyperthyroidism.
- May lead to stunted growth, malformed teeth, and slow mental development in children.

Intervention/Treatment for Low Magnesium

- Seizure Precautions
- Magnesium Sulfate
 1. 25-50mg/kg/dose for replacement
 2. 30-60mg/kg/day for maintenance
 3. IV dose exceeding 2 grams must be given over 120 minutes via pump
- 500mg Mg Sulfate = 49.3 mg elemental Mg = 4.06 mEq Mg⁺⁺
- Doses exceeding 2 grams must be infused over 60-120 minutes!

IV Treatment of Low Magnesium

per UofM CVC ICU Protocol Guidelines

Serum magnesium concentration	Intravenous magnesium sulfate dose [†]	Recheck serum magnesium concentration
1.9 – 2 mg/dL	1 g magnesium sulfate	With next AM lab draw
1.7 – 1.8 mg/dL	2 g magnesium sulfate	With next AM lab draw
1.6 – 1.7 mg/dL	3 g magnesium sulfate otherwise use sodium phosphate (1 mmol potassium phosphate = 1).	4 – 6 hours after completion of dose if symptomatic, otherwise with next AM lab draw
< 1.5 mg/dL	Notify MD	
Rate of intravenous infusion of magnesium	Recommend infusing 1 g magnesium sulfate/hour (~8 mEq magnesium/hour), up to maximum of 2 g magnesium sulfate/hour	

HYPERMAGNESEMIA

HIGH MAGNESIUM

Signs and Symptoms High Magnesium

- Too much magnesium depresses the nervous system and breathing and produces neuromuscular and heart effects.
- Hypotension, bradycardia
- Diaphoresis, flushing
- Drowsiness, decreased mental status
- Decreased heart rate, tall T wave, ventricular dysrhythmias
- Hyporeflexia, weakness, paralysis

Causes Hypermagnesemia

- Dehydration
- Addison's Disease or other adrenal gland disease
- Hyperparathyroidism
- Hypothyroidism
- Kidney Failure
- Acute Acidosis

Intervention/Treatment for High Magnesium

- Circulatory and respiratory support
- 1 gram Calcium Gluconate (*to reverse s/s including respiratory depression*)
- Administration of IV Lasix to increase magnesium excretion (*only when renal function is adequate*)
- Hemodialysis may be used in severe hypermagnesemia because approx 70% of serum magnesium is not protein bound and can be removed through dialysis.

Nursing Care Plan Possibilities

- Ineffective Breathing Pattern

<http://www.med.umich.edu/i/nursing/Clinical/documentation/NursingPlansOfCare/GasExchange-Impaired AirwayClearance BreathingPatterns-Ineffective 0078.pdf>

- Decreased Cardiac Output

<http://www.med.umich.edu/i/nursing/Clinical/documentation/NursingPlansOfCare/CardiacOutput Decreased 0056.pdf>