

# **Hypokalemia and Hypomagnesemia in Peritoneal Dialysis Patients**

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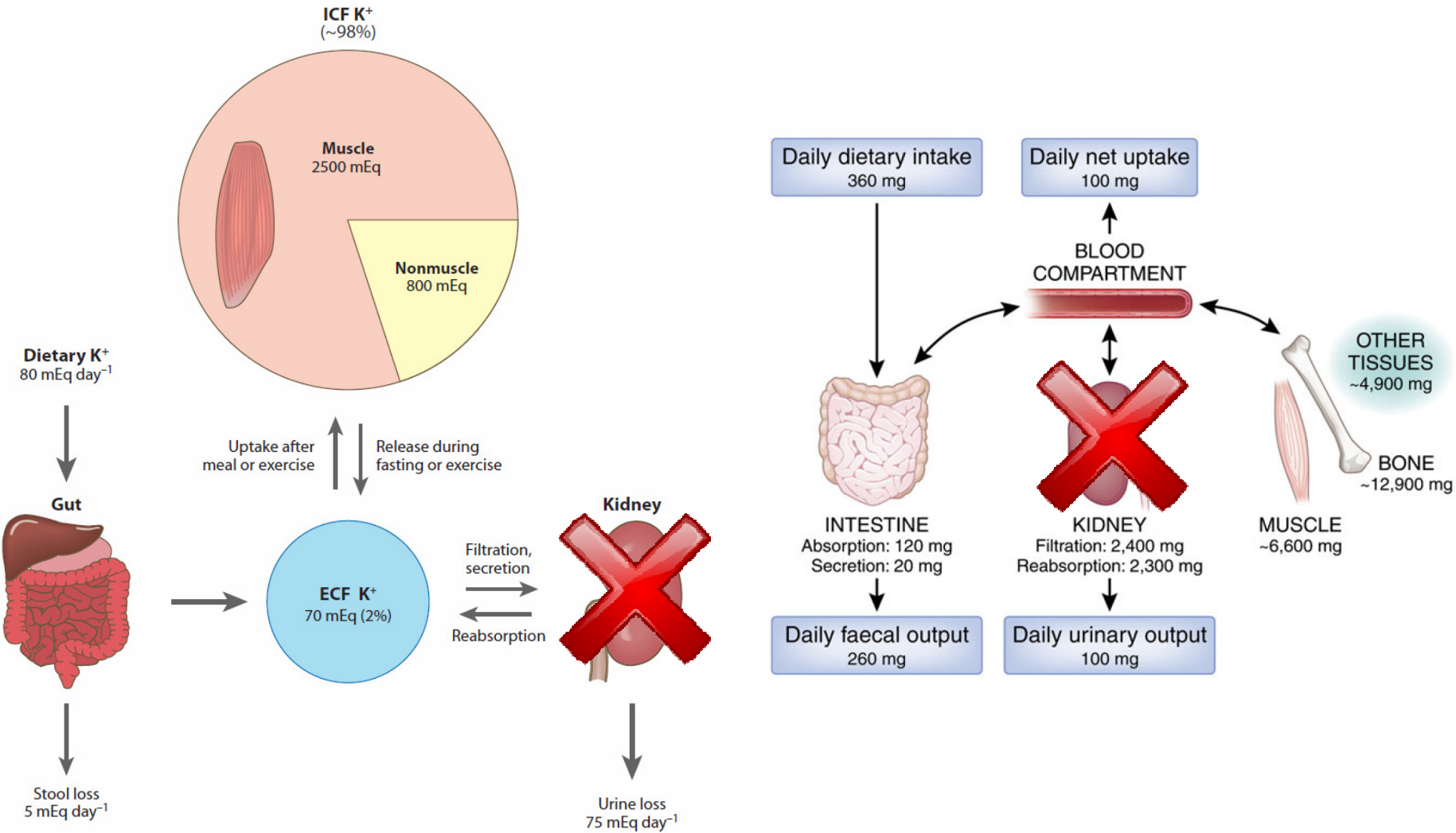
# Outline

- **Background**
  - Potassium and magnesium
  - British Columbia Renal drug funding
- **Hypokalemia and Hypomagnesemia Study in British Columbia Peritoneal Dialysis Patients**
  - Objectives, design and methods, results, discussion, limitations, conclusion

# Potassium and Magnesium

- Potassium and magnesium essential for normal cellular function and processes
- Potassium – 2<sup>nd</sup> most abundant cation in body and major intracellular cation
  - Normal serum level 3.5-5 mmol/L
- Magnesium – 4<sup>th</sup> most abundant cation and 2<sup>nd</sup> most common intracellular cation
  - Normal serum level 0.7-1.1 mmol/L

# Potassium and Magnesium Regulation



Annu Rev Physiol 2009;71:381-401  
 Clin Kidney J 2012;5(Suppl 1):i3-14

# Potassium and Magnesium in CKD

## Pre- or Hemodialysis



- Hyperkalemia
- Hypermagnesemia

## Peritoneal Dialysis



- Hypokalemia
- Hypomagnesemia

# Hypokalemia Complications

- **Neuromuscular:** weakness, tetany, cramps, paralysis (flaccid), ileus, constipation, urinary retention
- **Cardiovascular:** abnormal ECG and arrhythmias, abnormal contractility, potentiation of digitalis toxicity
- **Metabolic:** decreased insulin release, abnormal tolerance to glucose causing diabetes, impaired hepatic glycogen and protein synthesis, decreased aldosterone and growth hormone secretion, growth retardation, maintenance of metabolic alkalosis
- **Renal:** decreased renal blood flow and GFR, impaired urine concentration, increased renal ammonia genesis, precipitating encephalopathy, increased renal  $\text{HCO}_3$  reabsorption, chronic tubulointerstitial disease, cyst formation, proximal tubular vacuolization, rhabdomyolysis

# Hypomagnesemia Complications

Signs	Symptoms
Chvostek's sign	Nausea
Trousseau's sign	Vomiting
Tremors	Apathy
Muscle fasciculations	Weakness
Hyperreflexia	Anorexia
Seizures	Mental retardation
Depression	
Psychosis	
Prolonged QT interval	
Cardiac arrhythmias	
Decreased myocardial contractility	
Hypertension	
Sudden death	

# Hypokalemia and Hypomagnesemia Associated Mortality in PD Patients

- Lee S et al 2017 (Potassium):
  - Prospective, observational cohort study of 3230 patients undergoing HD (64.3%) or PD (35.7%)
  - Lower serum potassium levels (< 4.5 mmol/L) occurred more commonly in PD than in HD patients
  - Hypokalemia was independent predictor of mortality
- Cai K et al 2016 (Magnesium):
  - Single-center retrospective study of 253 incident PD patients
  - Low serum magnesium levels common among PD patients
  - Hypomagnesemia was independent predictor of all-cause and cardiovascular mortality



# BC Renal Drug Funding



## BCPRA DIALYSIS FORMULARY FOR DIALYSIS PATIENTS AND ALL PEDIATRIC PATIENTS

The following medications are funded for dialysis patients. All formulary medications are oral products and generic formulations unless otherwise indicated.

BC Renal funds

a  
n  
e  
Care and  
treatment of  
kidney disease  
patients

**Potassium and magnesium supplements not funded!**

### **ACIDOSIS**

Sodium bicarbonate

### **ANEMIA**

#### **Erythropoiesis-stimulating agents**

Darbepoetin alfa (Aranesp<sup>®</sup>) [restricted]\*Δ

Epoetin alfa (Eprex<sup>®</sup>) [restricted]\*Δ

### **Calcium channel blockers**

Amlodipine

Diltiazem

Felodipine

Nifedipine

Verapamil

### **INFECTIONS**

#### **Topical Antibacterials**

Chlorhexidine

Gentamicin cream & ointment

Mupirocin cream & ointment

#### **Antifungals**

### **ACE Inhibitors**

Ramipril

Trandolapril

### **Angiotensin II Receptor Antagonists**

Candesartan\*\*

Irbesartan\*\*

Telmisartan\*\*

Valsartan\*\*

Losartan

### **Anticoagulants**

Aspirin (enteric-coated; all strengths)

Dipyridamole

Warfarin

### **Beta-adrenergic Blockers**

Acebutolol

Atenolol

Bisoprolol

Carvedilol

Labetalol

Metoprolol

Propranolol

### **Cardiovascular**

### **Laxatives**

Docosate

Senosidose

Lactulose

PEG 3350 without electrolytes

PEG 3350 with electrolytes ❖

### **Upper Gastrointestinal Tract Agents**

Domperidone

Metoclopramide

### **Nausea and Vomiting Related to CKD**

Haloperidol

Methotrimeprazine

### **Antimitotics**

Allopurinol

Colchicine

### **Corticosteroids**

Prednisone

### **HYPERKALEMIA**

#### **Exchange Resins**

Sodium polystyrene sulfonate

Calcium polystyrene sulfonate

### **NEUROMUSCULAR DISORDERS**

#### **Leg Cramps**

Vitamin E

#### **Neuropathic Pain**

Desipramine

Nortriptyline

Gabapentin

#### **Restless Leg Syndrome**

Levodopa/carbidopa

Ropinirole

#### **Anesthetics**

Lidocaine/prilocaine 2.5% cream (EMLA<sup>®</sup>) †

Lidocaine 5% ointment †

#### **NUTRITIONAL DISORDERS**

Replavite / Renavite

Folate / folic acid

Zinc gluconate

#### **PRURITUS**

##### **Antihistamines**

Diphenhydramine

Hydroxyzine

##### **Topicals**

Glaxal base

Menthol 0.25%, Camphor 0.25% in Glaxal

Base (PRA Cream)

Urea 10% and 20% topical cream

# **Hypokalemia and Hypomagnesemia Study in British Columbia Peritoneal Dialysis Patients**

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# Objectives

- To determine one-year prevalence of hypokalemia and hypomagnesemia in BC PD patients
- To assess one-year frequency and cost of prescription of potassium and magnesium supplements in BC PD patients

# Design and Methods

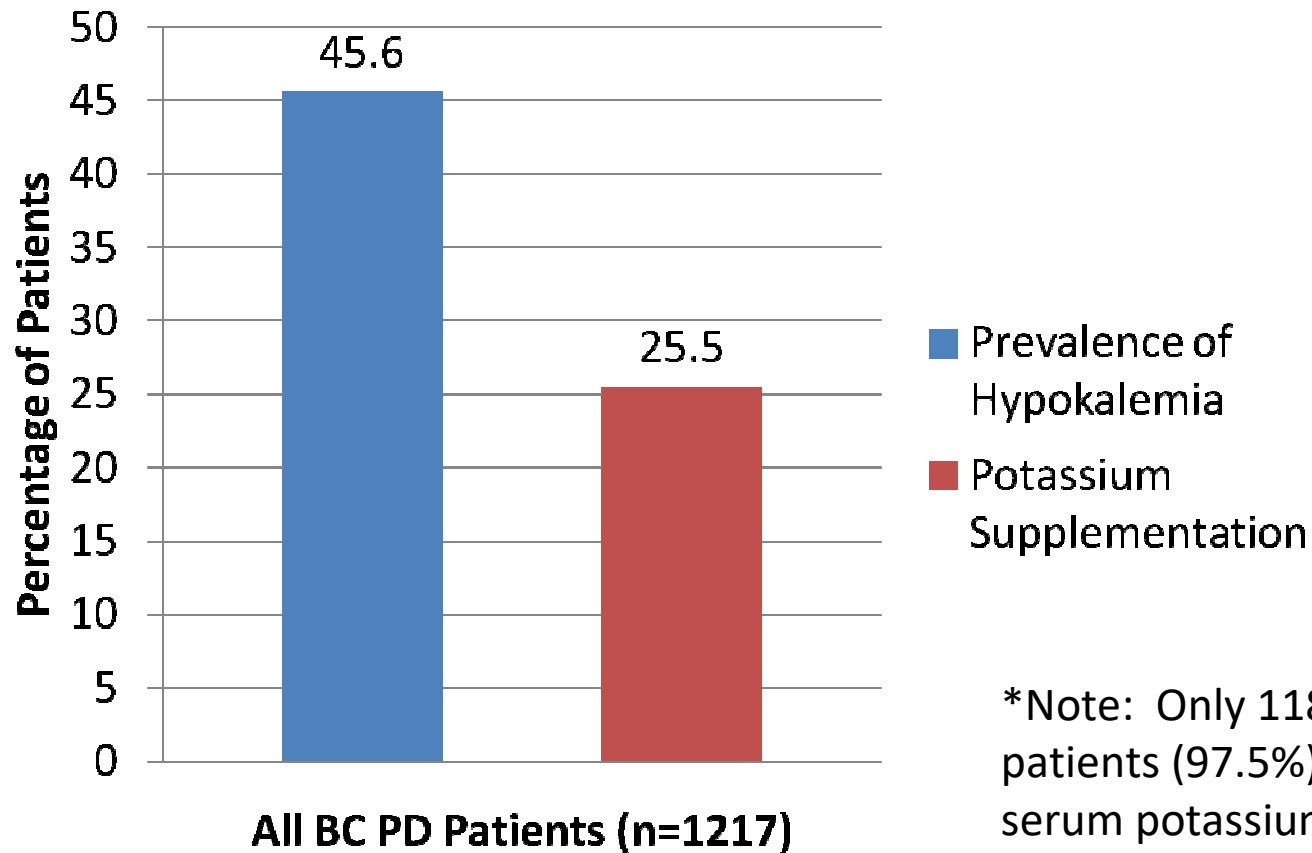
- **Design:** multicenter, retrospective review utilizing PROMIS (Patient Records and Outcome Management Information System) database
- **Study Period:** May 1, 2017 to April 30, 2018
- **Inclusion Criteria:**
  - All BC patients on PD within study period
  - Serum potassium or magnesium level checked at least every 3 months

# Design and Methods

- **Outcomes:**
  - Prevalence of hypokalemia: any serum potassium level  $< 3.5$  mmol/L during study period
  - Prevalence of hypomagnesemia: any serum magnesium level  $< 0.7$  mmol/L during study period
  - Prescription frequency of potassium and magnesium supplements
  - Yearly cost estimates of potassium and magnesium supplements based on unit costs and dispensing fees provided by BC Renal contracted community pharmacies (Macdonald's and Laurel Pharmacies)

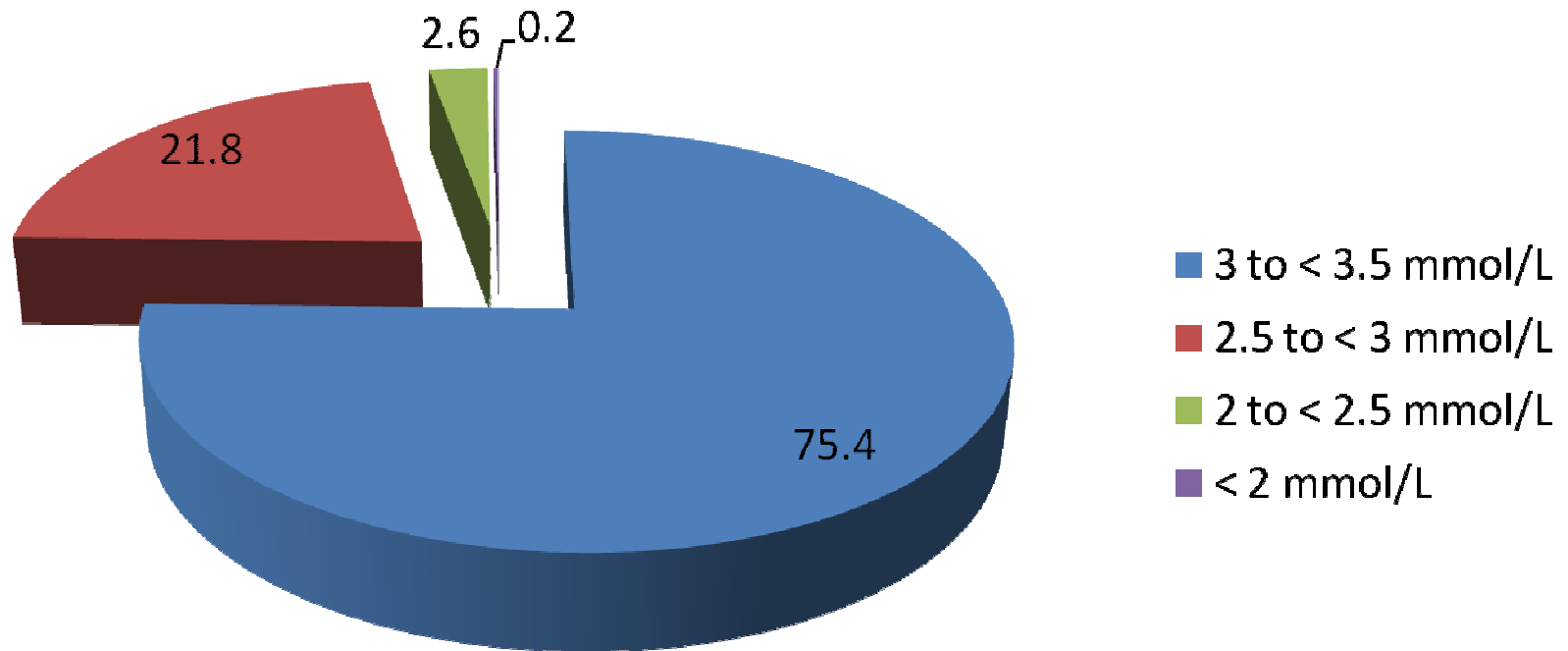
# Results

# Prevalence of Hypokalemia and Potassium Supplementation



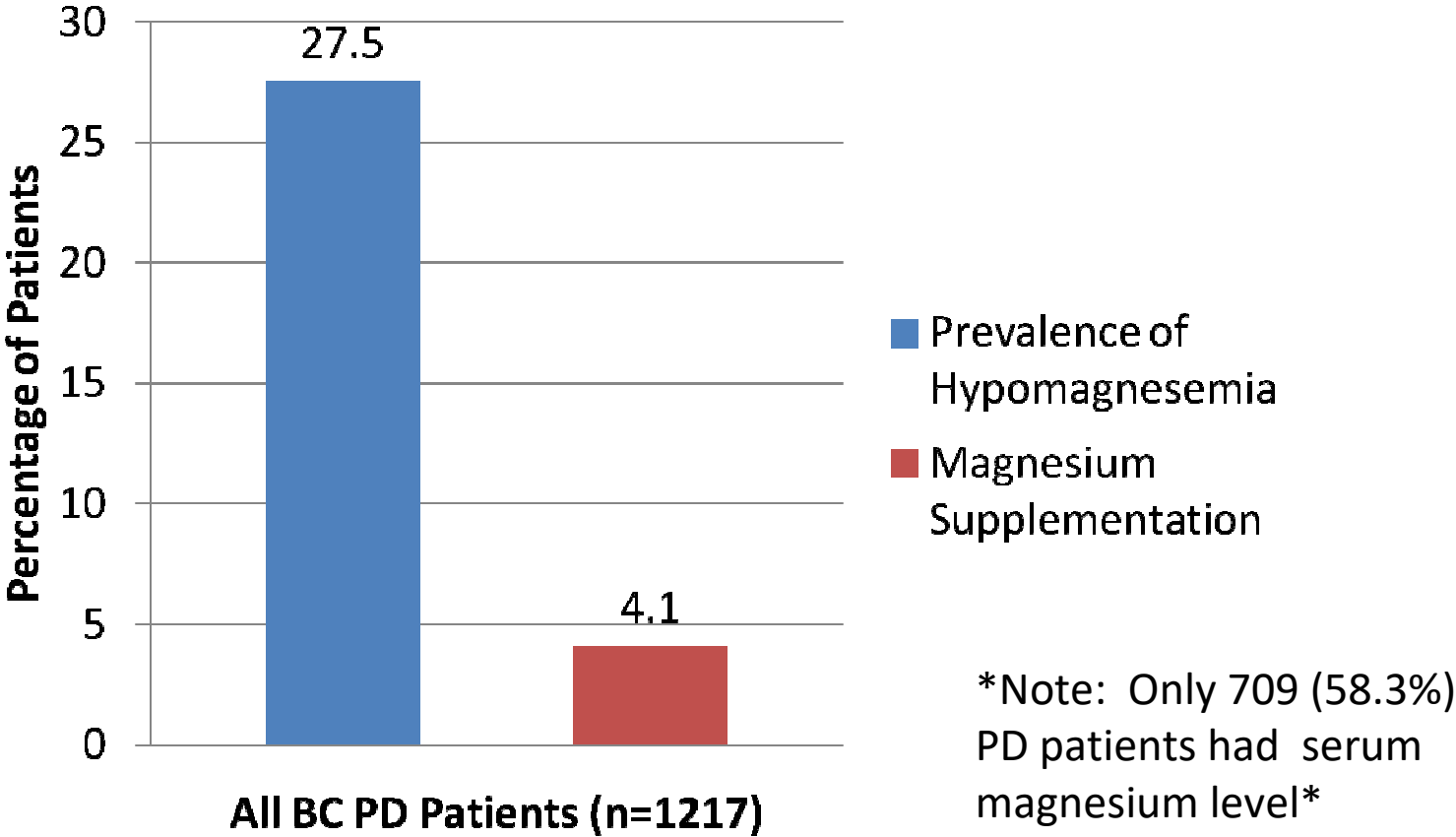
# Breakdown of Potassium Levels

Percentage of all BC PD Patients with Serum Potassium Level (n=1187)



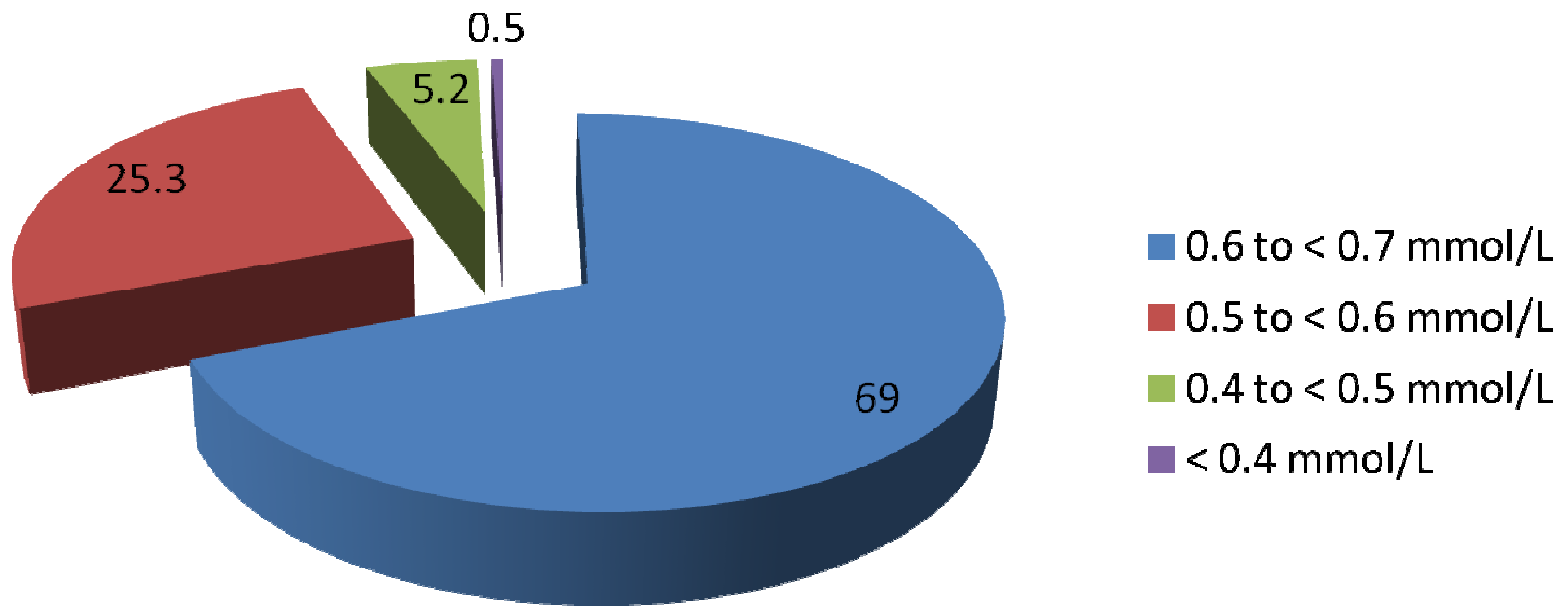


# Prevalence of Hypomagnesemia and Magnesium Supplementation



# Breakdown of Magnesium Levels

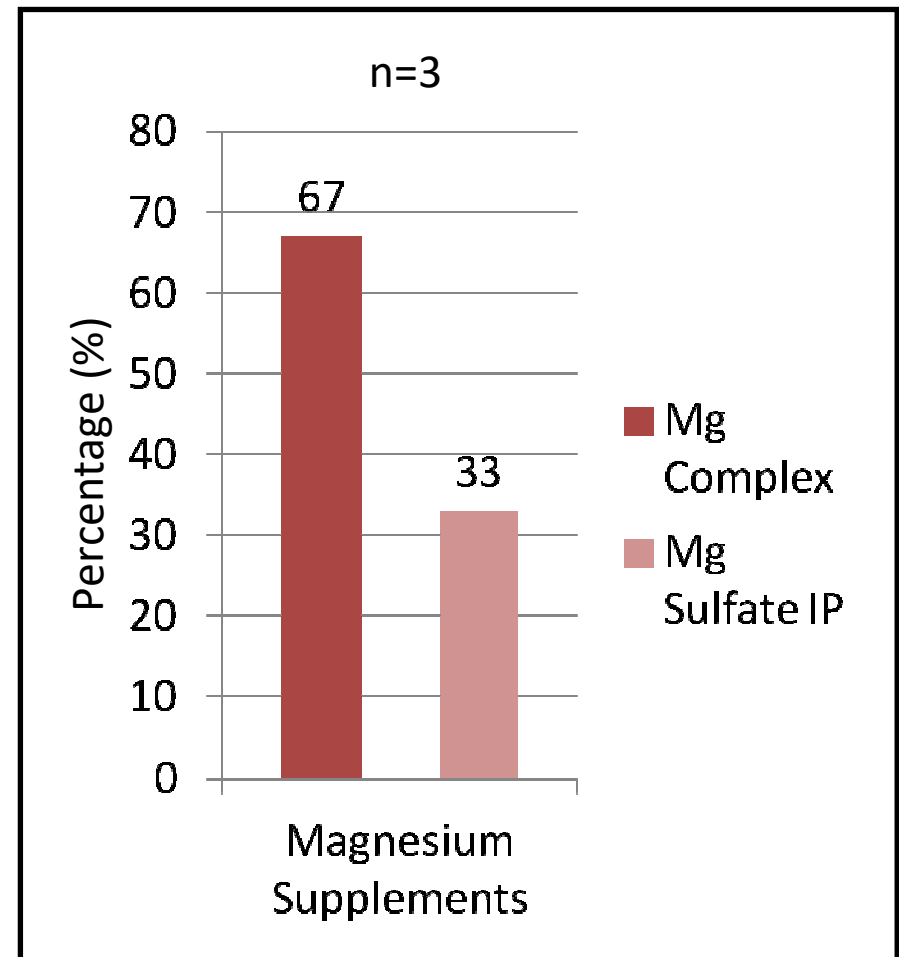
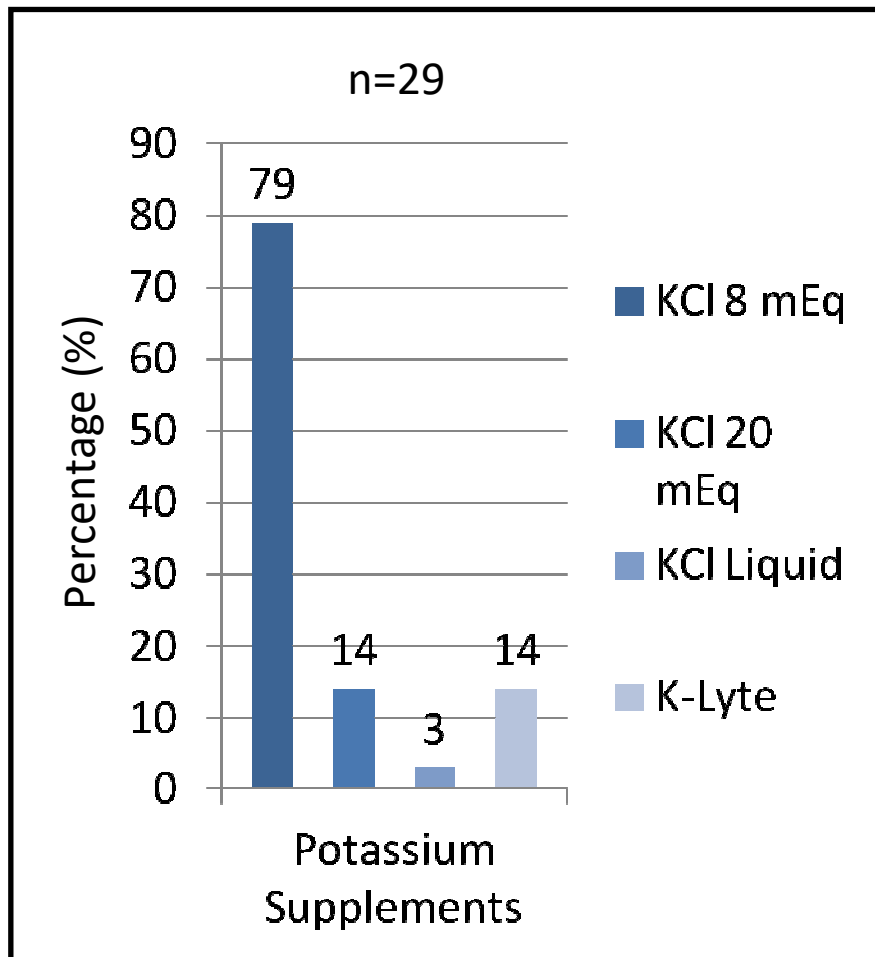
Percentage of all BC PD Patients with Serum Magnesium Level  
(n=709)



# Potassium and Magnesium Supplement Costs

- **Potassium supplements:** \$15, 110/year for all BC PD patients
  - Unit Pricing:
    - Potassium chloride 8 mEq \$0.0432/tab (generic)
    - Potassium chloride 8 mEq \$0.1079/tab (Micro K)
    - Potassium chloride 20 mEq \$0.21/tab (generic)
    - Potassium chloride liquid 20 mEq/15 mL \$0.01512/mL
    - K-Lyte 25 mEq \$0.645/tab (brand)
- **Magnesium supplements:** \$2209/year for all BC PD patients
  - Unit Pricing:
    - Magnesium complex 100 mg \$0.1099/tab
    - Magnesium glucoheptonate liquid \$0.0215/mL
    - Magnesium sulfate 5 g \$7.68/vial
- **Dispensing Fees:** \$11 for Macdonald's and \$10.80 for Laurel

# Potassium and Magnesium Supplements Prescribed at VGH



# Limitations

- Prevalence of hypokalemia and hypomagnesemia may be underreported as some sites did not monitor serum potassium and/or magnesium levels at all
  - Serum potassium level available for 97.5% of patients
  - Serum magnesium level available for 58.3% of patients
- Inaccuracy in supplement cost estimates due to:
  - Exclusion of patients from supplement cost analysis if exact dose could not be determined (n=25) or if as needed dosing regimen prescribed (n=20)
  - Use of algorithm to estimate pharmacy dispensing fee
- Individual patient charts not accessed to verify PROMIS data

# Discussion

- Prevalence of hypokalemia and hypomagnesemia higher than actual prescription of potassium and magnesium supplements
- Cost may present as barrier even to patients with extended health benefits
- Potassium and magnesium supplements cost comparable to other similar medications listed on BC Renal dialysis formulary

# Conclusion

- Nov/18: Study findings submitted to BC Renal to have potassium and magnesium supplements added to dialysis formulary for PD patients
- June/19: Potassium and magnesium supplements added to dialysis formulary
- Current: Guidance documents on management of hypokalemia and hypomagnesemia in PD patients and prescription of potassium and magnesium supplements being drafted

# Questions?

