

## **Appendix**

### **Table 1. Page 2.**

**Multivariable analysis of risk factors and protective factors identifying the strongest predictors of hypoglycemia**

### **Figure 1. Page 3**

**Orderset 1.1: Revised Hyperkalemia Orderset – January 1, 2016 to March 19, 2017**

### **Figure 3: Page 4**

**Orderset 1.2: Newly Revised Hyperkalemia Orderset – March 20, 2017 to September 30, 2017**

Table 1. Multivariable analysis of risk factors and protective factors for hypoglycemia

Factor	Odds Ratio	95% Confidence Interval	p-value*
Female <sup>(r)</sup>	0.6	0.289 – 1.421	0.274
>0.14 Units/kg Insulin <sup>(r)</sup>	2.8	1.318 – 5.806	<b>0.007</b>
Pre-Insulin Blood Glucose <140 mg/dL <sup>(r)</sup>	5.8	2.219 – 14.97	<b>&lt;0.0001</b>
Serum Creatinine >2.5 mg/dL <sup>(r)</sup>	1.6	0.777 – 3.265	0.204
Diagnosed with Type 2 Diabetes <sup>(p)</sup>	0.7	0.290 – 1.537	0.342
Concomitant Albuterol <sup>(p)</sup>	1.9	0.936 – 3.908	0.075

Risk Factors(r); Protective Factors(p)

**Figure 1. Orderset 1.1: Revised Hyperkalemia Orderset – January 1, 2016 to March 19, 2017**

Order Sets

**Orders** Clear All Orders

Order Sets

▼ **IP Adult Hyperkalemia Treatment Orders** Add Order

Protocol for management of acute hyperkalemia.

Please note that this order set provides guidelines to which there will always be exceptions, so please use your clinical judgment in treating patients. Call nephrology if you have questions or if dialysis is indicated.

AHA/CPR 2005 guideline for treatment of hyperkalemia  
Treatment & prevention of hyperkalemia

▼ **General**

▼ **Vital Signs and Monitoring**

Continuous Cardiac Telemetry Orders

▶ **Diet/Nutrition**

Renal Diet 2-3 gm Sodium; 2-3 gm Potassium

▶ Diet Effective Now starting Today at 1206 Until Specified

Sodium Restriction: 2-3 gm Sodium

Potassium Restriction: 2-3 gm Potassium

▼ **Labs**

▶ **Chemistry - Hyperkalemia**

Basic Metabolic Panel (Na, K, Cl, CO2, BUN, Cr, Glu, Ca)

▶ STAT, Every 8 Hours(Lab) First occurrence Today at 1206 Last occurrence Today at 1600 for 2 occurrences

Container details: Gold top or Light Green top

▼ **Other Tests**

▼ **Cardiac Studies**

Please note that EKG findings are not sensitive for life-threatening hyperkalemia, but any findings warrant immediate treatment – if you don't have one, order it here

ECG 12 Lead

STAT, Once

▼ **Mild Hyperkalemia (K<6) Medications**

▶ Remove Potassium from the Body (onset at least several hours)

▼ **Moderate Hyperkalemia (K 6.0-6.4) Medications**

▶ Shift Potassium Intracellularly (onset <1 hr, duration several hours)

▶ Remove Potassium from the Body (onset at least several hours)

▼ **EKG changes or Severe Hyperkalemia (K>=6.5) Medications**

Also consider aggressive treatment for rapidly rising K or underlying arrhythmia

▼ **Stabilize the Myocardium (onset within minutes, duration <1 hr)**

Recurrent treatment may be necessary for EKG changes

calcium gluconate 100 mg/mL injection (1st choice)

2 g, Intravenous, Once, IV push over 5 min

calcium chloride 100 mg/mL injection (2nd choice)

1 g, Intravenous, Once, IV push over 5 min. Critical care / central-line administration preferred (2nd line given high-risk)

▼ **Shift Potassium Intracellularly (onset <1 hr, duration several hours)**

**Insulin**

insulin regular (HumuLIN R, NovoLIN R) injection 100 units/mL

10 Units, Intravenous, Once, 1 dose Today at 1230

dextrose 50% injection syringe 25 g

25 g, Intravenous

Once, 1 dose Today at 1230

Give D50 prior to insulin push

POCT glucose, Fingerstick

Routine, Every Hour First occurrence Today at 1300 Last occurrence Today at 1400 for 2 occurrences

q1 hour x2, then q2 hour x 2

POCT glucose, Fingerstick

Routine, Every 2 Hours First occurrence Today at 1400 Last occurrence Today at 1600 for 2 occurrences

q1 hour x2, then q2 hour x 2

Notify Provider if BG is <70 mg/dL or >400 mg/dL

Routine, Continuous starting Today at 1208 Until Specified

Hypoglycemia Protocol (select if ordering insulin & hypoglycemia protocol is not already ordered for the patient)

albuterol (PROVENTIL) inhalation solution

10 mg, Nebulization, Once, Second dose of 10mg albuterol may be ordered if inadequate response

sodium bicarbonate IV (least effective intervention, reserved for acidotic patients)

50 mEq, Intravenous, Once, Generally least effective intervention, reserved for acidotic patients)

▼ **Remove Potassium from the Body (onset at least several hours)**

Kayexalate PO/PR

furosemide (LASIX) IV

CPMA Shift Medication Medication Messages: My Incomplete Notes - Future/Stopping Orders - Verapamil Alert

**Figure 2: Orderset 1.2: Newly Revised Hyperkalemia Orderset – March 20, 2017 to September 30, 2017**

**IP Adult Hyperkalemia Treatment Orders [3040000340]**

Protocol for management of acute hyperkalemia.

Please note that this order set provides guidelines to which there will always be exceptions, so please use your clinical judgment in treating patients. Call nephrology if you have questions or if dialysis is indicated.

[AHA/CPR 2005 guideline for treatment of hyperkalemia](http://circ.ahajournals.org/cgi/reprint/CIRCULATIONAHA.105.166563v1.pdf) **URL:** <http://circ.ahajournals.org/cgi/reprint/CIRCULATIONAHA.105.166563v1.pdf>

[Treatment & prevention of hyperkalemia](http://www.uptodate.com/contents/treatment-and-prevention-of-hyperkalemia-in-adults?source=search_result&search=hyperkalemia&selectedTitle=1~150) **URL:** [http://www.uptodate.com/contents/treatment-and-prevention-of-hyperkalemia-in-adults?source=search\\_result&search=hyperkalemia&selectedTitle=1~150](http://www.uptodate.com/contents/treatment-and-prevention-of-hyperkalemia-in-adults?source=search_result&search=hyperkalemia&selectedTitle=1~150); AHA guidelines (although cutoff here for severe is 7)

**General**

**Vital Signs and Monitoring**

Continuous Cardiac Telemetry Orders  
**Please order both the Initiate and the Continuous orders**

<input type="checkbox"/> Initiate Continuous Cardiac monitoring	Routine, Once For 1 Occurrences
<input type="checkbox"/> Continuous Cardiac monitoring	Baseline Rhythm:
	Other instructions:
	Reason for telemetry:

**Diet/Nutrition**

<input checked="" type="checkbox"/> Renal Diet	Diet Effective Now, Starting today
	Sodium Restriction: 2-3 gm Sodium
	Potassium Restriction: 2-3 gm Potassium
	Protein:
	Other Restriction:

## Other Tests

### Cardiac Studies

- ECG 12 Lead

STAT, Once For 1 Occurrences  
Describe Clinical Scenario: Nonspecific abnormal electrocardiogram (ECG) (EKG)  
Device:

## Labs

### Last Glucose:

No results found for: GLU, POCTGLU, GLB, GLUPC, GUA, FBS, POCTGLUCUR, GLFP2H, FBSEXT, GT60EXT, GT120EXT, GLU3HREXL, GLC, GLT1EXT, GT60, GT120, NP120

### Last Potassium:

No results found for: K, KSB, POTTAS24EXT

### Chemistry - Hyperkalemia

- Basic Metabolic Panel - UCSF/LabCorp/Quest (NA, K, CL, CO2, BUN, CR, GLU, CA)

STAT, Every 6 Hours(Lab), Starting today with First Occurrence Include Now For 2 Occurrences  
Container details: Light green top preferred, gold top acceptable

Specimen Site/Additional Info:

- Potassium, Serum / Plasma

STAT, Once For 1 Occurrences  
Container details: Light green top preferred, Gold top acceptable

Specimen Site/Additional Info:

- Digoxin Level

1 hour following completion of treatment (for severe hyperkalemia)

Routine, Once

Type:

Container details: Gold top or Light Green top

Specimen Site/Additional Info:

## Medications for Mild Hyperkalemia (K <6 & NO ECG Changes)

### Remove Potassium from the Body (onset at least several hours)

- Kayexalate PO/PR (Single Response)

- sodium polystyrene (KAYEXALATE) suspension

15 g, Oral, Once, Once For 1 Doses  
Contraindicated in post-op patients and patients at increased risk of bowel necrosis/perforation.

- sodium polystyrene (KAYEXALATE) suspension

Consider repeat dose if no response in 6 hours.  
30 g, Rectal, Once, Once For 1 Doses  
Contraindicated in post-op patients and patients at increased risk of bowel necrosis/perforation.

- furosemide (LASIX) IV

Consider repeat dose if no response in 6 hours.  
40 mg, Intravenous  
Once, Once For 1 Doses  
Contraindicated in acute renal failure

## Medications for Moderate Hyperkalemia (K 6.0-6.4 & NO ECG Changes)

Shift Potassium Intracellularly (onset <1 hr, duration several hours)

Please select one of the insulin panels based on patient blood sugar levels

- Insulin for Blood Sugar < 150 mg/dL

**Recommended insulin dosing is 0.1 units/kg (rounded to whole unit) up to a maximum of 10 units**

- Dextrose 50% IV Push  
 dextrose injection

**"Followed by" Linked Panel**

25 g, Intravenous  
Once, Once For 1 Doses  
Give 25 grams of IV dextrose prior to insulin push  
25 g, Intravenous  
Once, Once Starting H+1 Hours For 1 Doses  
Give 25 grams of IV dextrose 1 hour after bolus dose of insulin to prevent hypoglycemia

- dextrose injection

- insulin regular (HumuLIN R, NovoLIN R) injection 100 units/mL  
 POCT glucose, Fingerstick

0.1 Units/kg, Intravenous, Once, Once Starting H For 1 Doses

Routine, Every Hour For 2 Occurrences

Container details:

q1 hour x2, then q2 hour x 2

Routine, Every 2 Hours For 2 Occurrences

Container details:

q1 hour x2, then q2 hour x 2

STAT, Once For 1 Occurrences

Container details:

Obtain within 15 min AFTER insulin for hyperkalemia if no POCT glucose drawn with the last 2 hours

- POCT glucose, Fingerstick

- Notify Provider if BG is <70 mg/dL or >400 mg/dL

Routine, Continuous

Notify Provider for:

- Insulin for Blood Sugar 150-300 mg/dL

**Recommended insulin dosing is 0.1 units/kg (rounded to whole unit) up to a maximum of 10 units**

- dextrose injection

25 g, Intravenous  
Once, Once For 1 Doses

Give 25 grams of IV dextrose prior to insulin push

0.1 Units/kg, Intravenous, Once, Once For 1 Doses

- insulin regular (HumuLIN R, NovoLIN R) injection 100 units/mL

- POCT glucose, Fingerstick

Routine, Every Hour For 2 Occurrences

Container details:

q1 hour x2, then q2 hour x 2

Routine, Every 2 Hours, Starting today at 8:16 AM For 2 Occurrences

Container details:

q1 hour x2, then q2 hour x 2

STAT, Once For 1 Occurrences

Container details:

Obtain within 15 min AFTER insulin for hyperkalemia if no POCT glucose drawn with the last 2 hours

- POCT glucose, Fingerstick

- POCT glucose, Fingerstick

- Notify Provider if BG is <70 mg/dL or >400 mg/dL

Routine, Continuous

Notify Provider for:

<input type="checkbox"/> Insulin for Blood Sugar > 300 mg/dL	<b>Recommended insulin dosing is 0.1 units/kg (rounded to whole unit) up to a maximum of 10 units</b>
<input type="checkbox"/> insulin regular (HumuLIN R,NovoLIN R) injection 100 units/mL	0.1 Units/kg, Intravenous, Once, Once For 1 Doses
<input type="checkbox"/> POCT glucose, Fingerstick	Routine, Every Hour For 2 Occurrences Container details: q1 hour x2, then q2 hour x 2
<input type="checkbox"/> POCT glucose, Fingerstick	Routine, Every 2 Hours, Starting today at 8:17 AM For 2 Occurrences Container details: q1 hour x2, then q2 hour x 2
<input type="checkbox"/> POCT glucose, Fingerstick	STAT, Once For 1 Occurrences Container details: Obtain within 15 min AFTER insulin for hyperkalemia if no POCT glucose drawn with the last 2 hours
<input type="checkbox"/> Notify Provider if BG is <70 mg/dL or >400 mg/dL	Routine, Continuous Notify Provider for:
<input type="checkbox"/> Hypoglycemia Protocol (select if ordering insulin & hypoglycemia protocol is not already ordered for the patient)	
<input type="checkbox"/> D50W IV	25 mL, Intravenous Every 15 Min PRN, hypoglycemia , Every 15 Min PRN For 24 Hours Give if patient cannot take PO or give 6 oz. Fruit juice.  For BG<70 mg/dL, give a fast acting carbohydrate per patient preference or Dextrose IV per order if patient cannot take PO.  Every 15 minutes: Recheck blood glucose per POCT orders and repeat treatment until BG is >/= 100 mg/dL.
<input type="checkbox"/> glucose chewable tablet	20 g, Oral, Every 15 Min PRN, hypoglycemia, Every 15 Min PRN For 24 Hours For BG<70 mg/dL, give a fast acting carbohydrate per patient preference if patient is taking PO.  Every 15 minutes: Recheck blood glucose per POCT orders and repeat treatment until BG is >/= 100 mg/dL.  May substitute with 6oz fruit juice and document in appropriate nursing flowsheet.
<input type="checkbox"/> POCT glucose	Routine, PRN For 24 Hours Container details: Every 15 minutes for hypoglycemia. If BG < 70 mg/dL administer a fast-acting carbohydrate per order. Every 15 minutes: Repeat BG check and treatment until BG is >/= 100 mg/dL.
<input type="checkbox"/> albuterol (PROVENTIL) inhalation solution	10 mg, Nebulization, Once, Once For 1 Doses Second dose of 10mg albuterol may be ordered if inadequate response

### Remove Potassium from the Body (onset at least several hours)

- Kayexalate PO/PR (Single Response)
  - sodium polystyrene (KAYEXALATE) suspension 15 g, Oral, Once, Once For 1 Doses  
Contraindicated in post-op patients and patients at increased risk of bowel necrosis/perforation.
  
  - sodium polystyrene (KAYEXALATE) suspension 30 g, Rectal, Once, Once For 1 Doses  
Contraindicated in post-op patients and patients at increased risk of bowel necrosis/perforation.
  
- furosemide (LASIX) IV 40 mg, Intravenous  
Once, Once For 1 Doses  
Contraindicated in acute renal failure

### Medications for ECG Changes or Severe Hyperkalemia ( $K > 6.5$ )

Also consider aggressive treatment for rapidly rising K or underlying arrhythmia

#### Stabilize the Myocardium (onset within minutes, duration < 1 hr)

Recurrent treatment may be necessary for EKG changes

- calcium gluconate 100 mg/mL injection (1st choice) 2 g, Intravenous, Once, Once For 1 Doses  
IV push over 5 min
  - calcium chloride 100 mg/mL injection (2nd choice) 1 g, Intravenous, Once, Once For 1 Doses  
IV push over 5 min.
- Critical care / central-line administration preferred (2nd line given high-risk)

#### Shift Potassium Intracellularly (onset < 1 hr, duration several hours)

**Please select one of the insulin panels based on patient blood sugar levels**

- Insulin for Blood Sugar < 150 mg/dL  
**Recommended insulin dosing is 0.1 units/kg (rounded to whole unit) up to a maximum of 10 units**
    - Dextrose 50% IV Push  
 dextrose injection  
  
 dextrose injection
  
    - insulin regular (HumuLIN R, NovoLIN R) injection 100 units/mL  
 POCT glucose, Fingerstick
  
    - POCT glucose, Fingerstick
  
    - POCT glucose, Fingerstick
  
    - Notify Provider if BG is <70 mg/dL or >400 mg/dL
- "Followed by" Linked Panel**
- 25 g, Intravenous  
Once, Once For 1 Doses  
Give 25 grams of IV dextrose prior to insulin push
- 25 g, Intravenous  
Once, Once Starting H+1 Hours For 1 Doses  
Give 25 grams of IV dextrose 1 hour after bolus dose of insulin to prevent hypoglycemia
- 0.1 Units/kg, Intravenous, Once, Once Starting H For 1 Doses
- Routine, Every Hour For 2 Occurrences  
Container details:  
q1 hour x2, then q2 hour x 2
- Routine, Every 2 Hours For 2 Occurrences  
Container details:  
q1 hour x2, then q2 hour x 2
- STAT, Once For 1 Occurrences  
Container details:  
Obtain within 15 min AFTER insulin for hyperkalemia if no POCT glucose drawn with the last 2 hours
- Routine, Continuous  
Notify Provider for:



- Insulin for Blood Sugar 150-300 mg/dL

**Recommended insulin dosing is 0.1 units/kg (rounded to whole unit) up to a maximum of 10 units**

- dextrose injection 25 g, Intravenous  
Once, Once For 1 Doses  
Give 25 grams of IV dextrose prior to insulin push
- insulin regular (HumuLIN R,NovoLIN R) injection 100 units/mL 0.1 Units/kg, Intravenous, Once, Once For 1 Doses
- POCT glucose, Fingerstick Routine, Every Hour For 2 Occurrences  
Container details:  
q1 hour x2, then q2 hour x 2
- POCT glucose, Fingerstick Routine, Every 2 Hours, Starting today at 8:16 AM For 2 Occurrences  
Container details:  
q1 hour x2, then q2 hour x 2
- POCT glucose, Fingerstick STAT, Once For 1 Occurrences  
Container details:  
Obtain within 15 min AFTER insulin for hyperkalemia if no POCT glucose drawn with the last 2 hours
- Notify Provider if BG is <70 mg/dL or >400 mg/dL Routine, Continuous  
Notify Provider for:

- Insulin for Blood Sugar > 300 mg/dL

**Recommended insulin dosing is 0.1 units/kg (rounded to whole unit) up to a maximum of 10 units**

- insulin regular (HumuLIN R,NovoLIN R) injection 100 units/mL 0.1 Units/kg, Intravenous, Once, Once For 1 Doses
- POCT glucose, Fingerstick Routine, Every Hour For 2 Occurrences  
Container details:  
q1 hour x2, then q2 hour x 2
- POCT glucose, Fingerstick Routine, Every 2 Hours, Starting today at 8:17 AM For 2 Occurrences  
Container details:  
q1 hour x2, then q2 hour x 2
- POCT glucose, Fingerstick STAT, Once For 1 Occurrences  
Container details:  
Obtain within 15 min AFTER insulin for hyperkalemia if no POCT glucose drawn with the last 2 hours
- Notify Provider if BG is <70 mg/dL or >400 mg/dL Routine, Continuous  
Notify Provider for:

Hypoglycemia Protocol (select if ordering insulin & hypoglycemia protocol is not already ordered for the patient)

D50W IV

25 mL, Intravenous

Every 15 Min PRN, hypoglycemia , Every 15 Min PRN For 24 Hours

Give if patient cannot take PO or give 6 oz. Fruit juice.

For BG < 70 mg/dL, give a fast acting carbohydrate per patient preference or Dextrose IV per order if patient cannot take PO.

Every 15 minutes: Recheck blood glucose per POCT orders and repeat treatment until BG is  $\geq$  100 mg/dL.  
20 g, Oral, Every 15 Min PRN, hypoglycemia, Every 15 Min PRN For 24 Hours

For BG < 70 mg/dL, give a fast acting carbohydrate per patient preference if patient is taking PO.

Every 15 minutes: Recheck blood glucose per POCT orders and repeat treatment until BG is  $\geq$  100 mg/dL.

May substitute with 6oz fruit juice and document in appropriate nursing flowsheet.

Routine, PRN For 24 Hours

Container details:

Every 15 minutes for hypoglycemia.

If BG < 70 mg/dL administer a fast-acting carbohydrate per order. Every 15 minutes: Repeat BG check and treatment until BG is  $\geq$  100 mg/dL.

POCT glucose

albuterol (PROVENTIL) inhalation solution

10 mg, Nebulization, Once, Once For 1 Doses  
Second dose of 10mg albuterol may be ordered if inadequate response

**Remove Potassium from the Body (onset at least several hours)**

Kayexalate PO/PR (Single Response)

sodium polystyrene (KAYEXALATE) suspension

15 g, Oral, Once, Once For 1 Doses

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furosemide (LASIX) IV

Consider repeat dose if no response in 6 hours.

40 mg, Intravenous

Once, Once For 1 Doses

Contraindicated in acute renal failure