Glycemic Control Initiative: Insulin Order Set Changes Hypoglycemia Nursing Protocol

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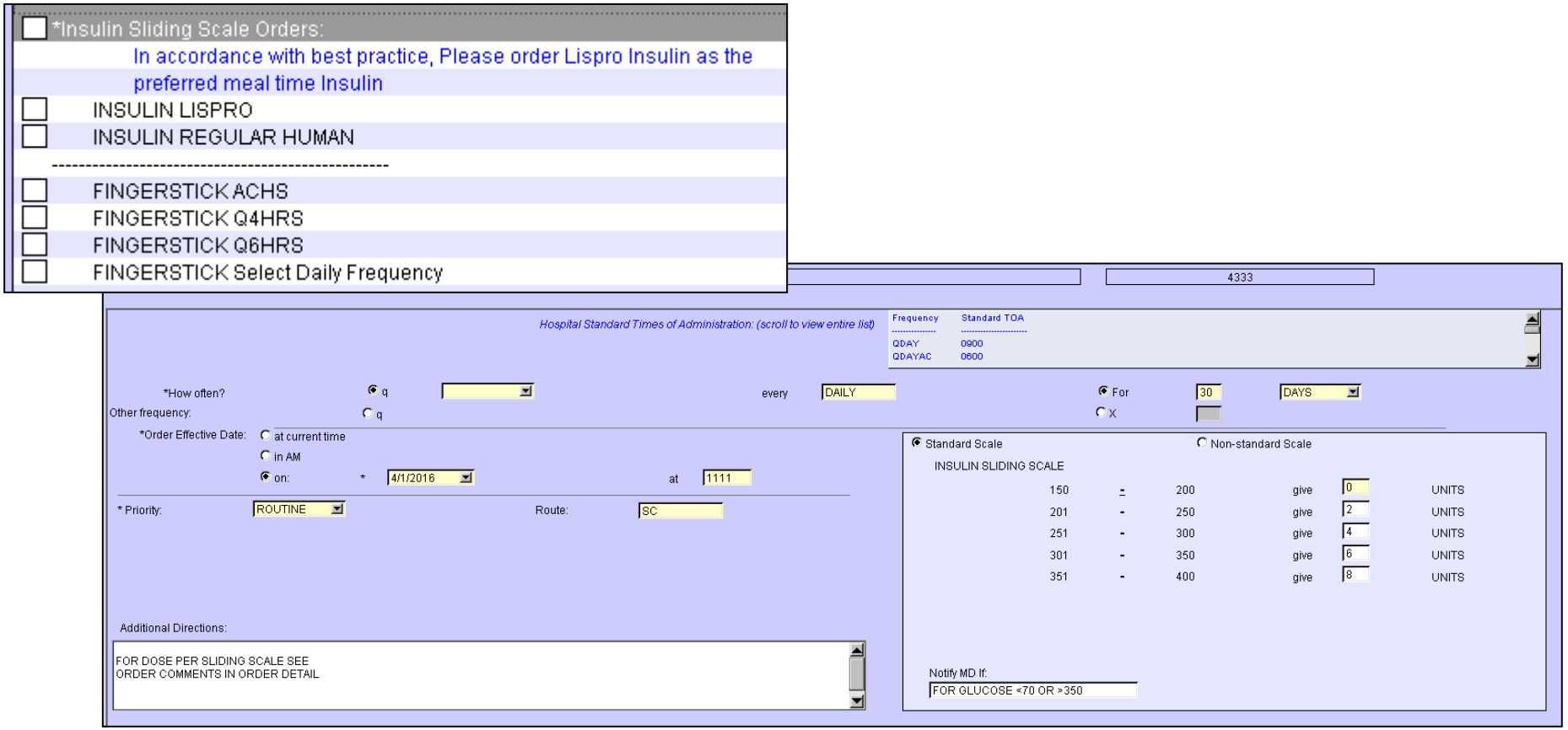
Objectives

- Review the current practice at UConn Health with sliding scale insulin.
- Illustrate the need for changes within our glycemic control practice based on a recent audit and current published literature.
- Summarize the upcoming changes within the insulin order set including pre-checked hypoglycemia orders

Current Practice at UConn Health

[Sliding Scale Insulin]



Current Practice at UConn Health
[Sliding Scale Insulin]

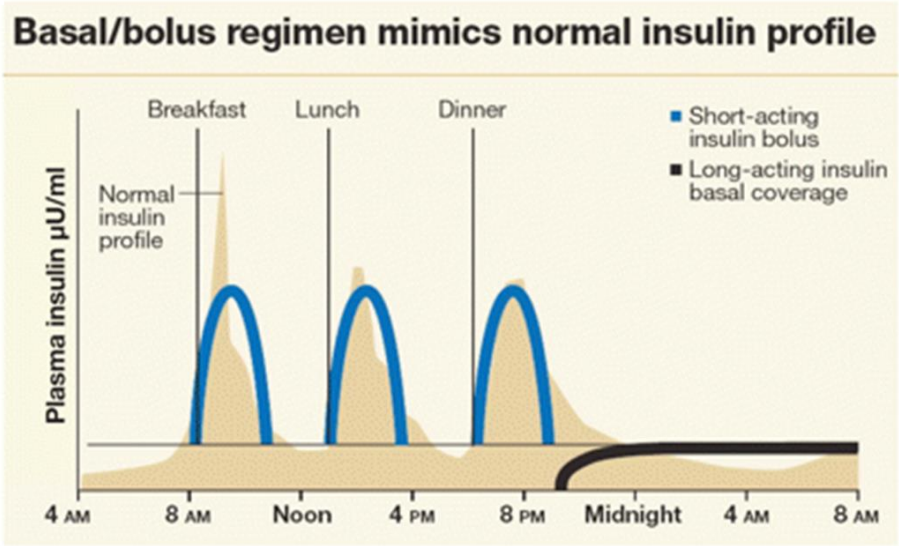
- Sliding Scale Insulin (SSI) which uses increases in insulin doses with pre-defined blood glucose ranges. Sliding scale insulin regimens approximate daily insulin requirements.

- SSI can cause fluctuations in blood glucose levels throughout the day.

- SSI insulin doses are based on the blood sugar before a meal, so they correct for the previous dose of insulin, rather than prepare for the meal.

- Unstable insulin levels are hazardous to patients, potentially making them hypoglycemic, especially in the morning after taking their nighttime dose for the prior day. Currently, there is no standardization for hypoglycemia treatment and sliding scale may not have a dosage reduction for nighttime dosing.

Primary Goals to Change Practice



- To achieve a level of glycemic control in a hospital setting that closely mimics that of nondiabetic patients in an effort to prevent long- and short-term complications and mortality associated with diabetes.
- Avoid wide fluctuations in blood glucose levels
- Have orders readily available for nursing staff to treat hypoglycemia

Becker T, Moldoveanu A, Cukierman T, et al. Clinical outcomes associated with the use of subcutaneous insulin-by-glucose sliding scales to manage hyperglycemia in hospitalized patients with pneumonia. Diabetes Res Clin Pract. 2007;78:392–397.

Primary Goals to Change Practice

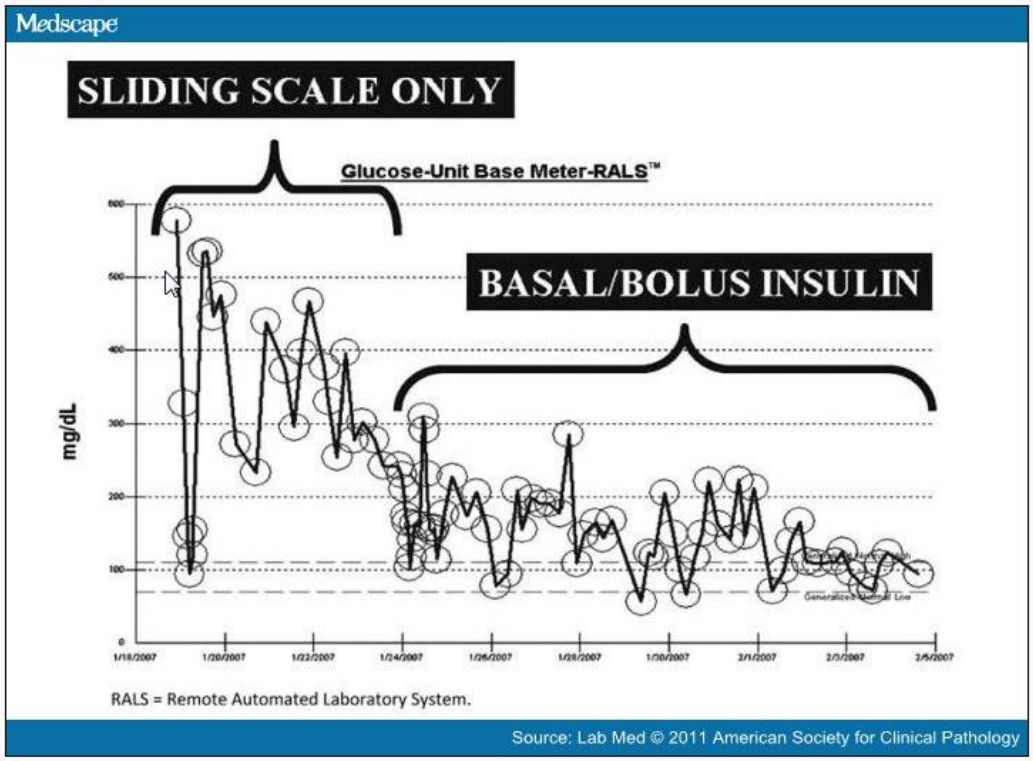


Figure 1.

Example of a patient on a sliding-scale-only insulin regimen for the first few days of hospitalization with high mean glucose with large glycemic variability. When switched to a basal/bolus insulin regimen, mean glucose gradually decreased, and glycemic variability was significantly less

SSI regimens respond to hyperglycemia after it has happened, rather than preventing it, and the sliding scale depends on the inaccurate assumption that insulin sensitivity is uniform among all patients.

http://www.medscape.com/viewarticle/744866_1

Insulin Comparison Chart

Insulin Type	Generic and Brand Names	Onset	Peak	Duration
Rapid-Acting	Insulin aspart (NovoLog) Insulin glulisine (Apidra) **Insulin lispro (Humalog)**	<15 minutes	30 to 90 minutes	3 to 5 hours
Short-Acting	**Insulin regular** (Humulin R, Novolin R)	30 to 60 minutes	2 to 4 hours	4 to 8 hours
Intermediate-Acting	**Insulin NPH human** (Humulin N, Novolin N)	1 to 2 hours	4 to 10 hours	10 to 18 hours
Long-Acting	**Insulin glargine (Lantus)** Insulin detemir (Levemir)	1 to 2 hours	No clear peak	20 to 26 hours
Combination	Insulin 70% NPH + 30% Regular (NovoLIN or HumuLIN 70/30)	30 to 60 minutes	2 to 10 hours	10 to 18 hours
Combination	Insulin 70% aspart protamine + 30% aspart (Novolog Mix 70/30)	<15 minutes	1 to 2 hours	10 to 18 hours
Combination	**Insulin lispro protamine + lispro (Humalog Mix 75/25** or 50/50)	<15 minutes	1 to 2 hours	10 to 18 hours

Bolded items are currently on JDH Formulary

AACE Position Statement: Hospital Glycemic Goals

Intensive Care Units: 110 mg/dL

Non-Critical Care Units:

- Pre-Prandial 110mg/dL
- Max. Glucose 180mg/dL

https://www.aace.com/files/inpatientglycemiccontrolconsensusstatement.pdf

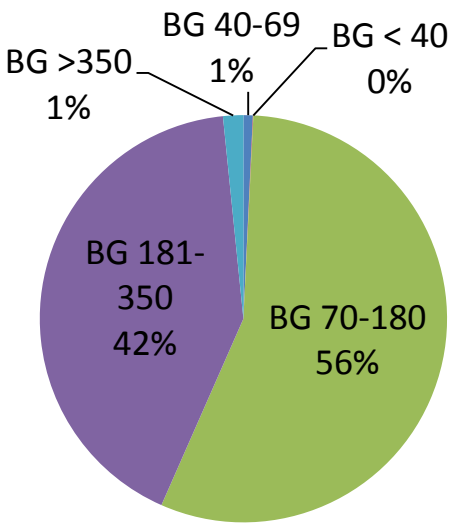
Glycemic Control Audit

[December 2015]

- Goal was to evaluate our rates of hypoglycemia and hyperglycemia pre-implementation of the new basal/bolus order set.
- Excluded Patients on TPN, DKA admission diagnosis, expired during hospital stay, OB/L&D, and regular insulin for hyperkalemia.
- Total of 114 patients evaluated and included only BG readings from December 2015.
- Hypoglycemia defined as BG <70mg/dL. Severe hypoglycemia (<40mg/dL) during critical illness should be avoided because it has been associated with increased mortality. **6.1%** (7) experienced at least one hypoglycemic event.
- Hyperglycemia defined as BG >180 mg/dL. Uncontrolled hyperglycemia is associated with increased morbidity, mortality, longer hospitalization and rehospitalization. **91.2%** (104) experienced at least one hyperglycemic event.

Glycemic Control Audit

[December 2015]



All Patients (n=2426 BG Readings)

- Another hospital with a glycemic control project (California Hospital Engagement Network) and their rates within goal were 26.1-32.4% (ours were 43%): http://www.hqinstitute.org/sites/main/files/file-attachments/p2_cshp_hypoglycemia_presentation_0.pdf
- In the largest review of hospital glucose data of more than 12 million blood sugars at 126 U.S. hospitals, 46% of all blood sugars in the ICU setting and 31.7% of all blood sugars in non-ICU patients were in the hyperglycemic range (defined as a glucose >180 mg/dL). In our audit, <10% were ICU patients.

Demographics (All Patients)	
Total Number of Patients	114
Age Mean	66.5
Age Median	68
Age Range	25-93
Male	50% (57)
Female	50% (57)
LOS Mean	5 days
LOS Median	4 days
LOS Range	1 to 30 days
Type I Diabetic	7.9% (9)
Type II Diabetic	80.7% (92)
No History of Diabetes	10.5% (12)
Pre-Diabetic	0.9% (1)
Recent AIC	50.9% (58)
Recent AIC and ULN	70.7% (38)
Basal-Bolus Patients	***11.4% (13)***
Sliding Scale Patients	88.6% (101)
Number of BG Readings (PCD)	2426
BG 40-69	**0.74% (18)**
BG <40	**0.04% (1)**
BG 70-180	55.81% (1354)
BG 181-350	**41.8% (1014)**
BG >350	**1.61% (39)**

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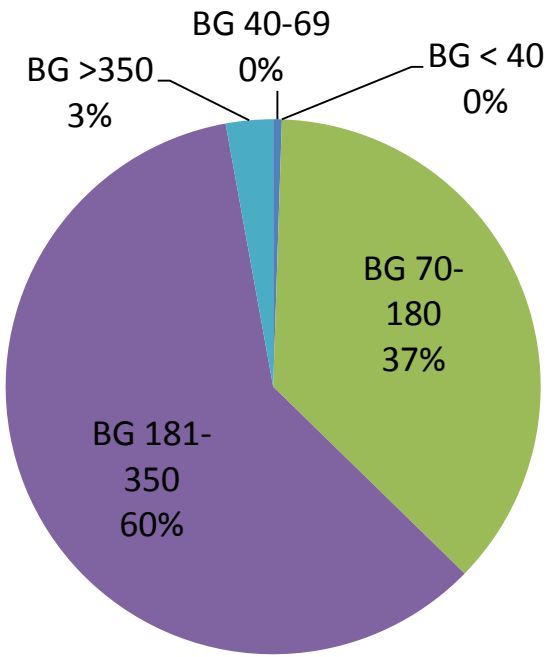
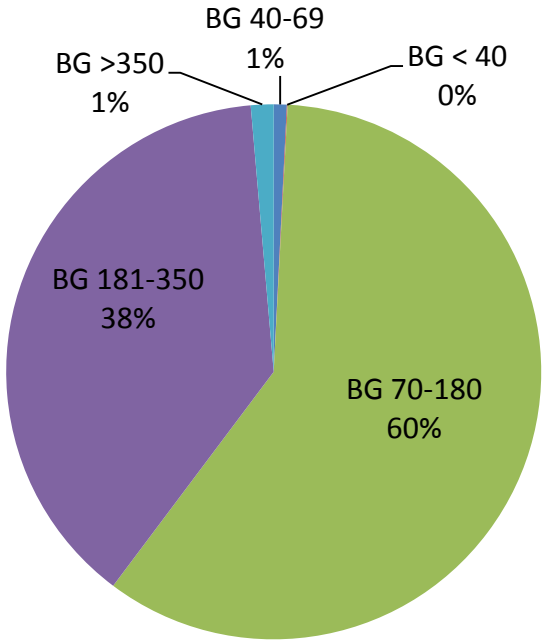
Glycemic Control Audit

[Basal/Bolus vs SSI]

Difficult to determine a true comparison between the group. Basal/Bolus group may have had more insulin control issues (87.5% [7/8] of that group if had an AIC was ULN) and small n (13).



Basal Bolus Patients



Sliding Scale Patients

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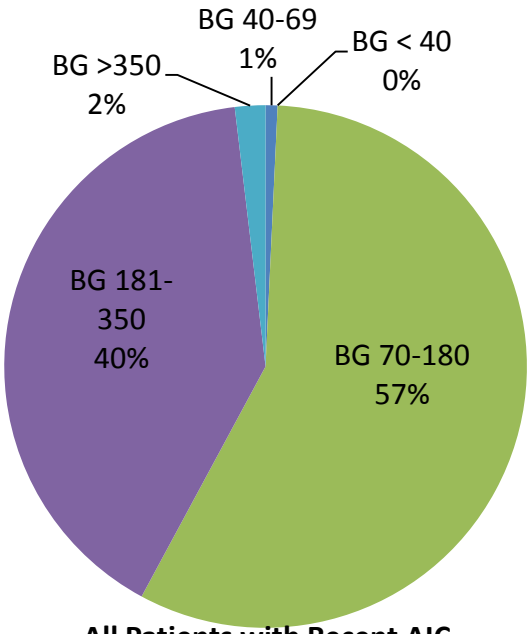
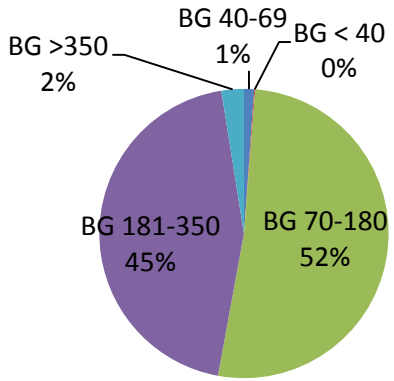
Glycemic Control Audit

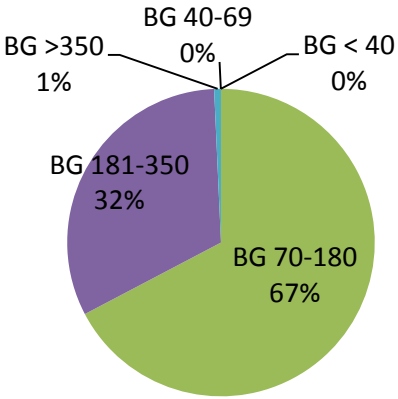
[Sliding Scale Patients with Recent AIC]



All Patients with Recent AIC [n=1220 BG, 50 patients]



Patients with ULN AIC [n=798 BG, 34 patients]



Patients with WNL AIC (n= 422 BG,16 patients)

- 86% of all patients with a recent AIC were Type II Diabetics.
- As anticipated, patients with ULN AIC are more prone to hyperglycemic events.

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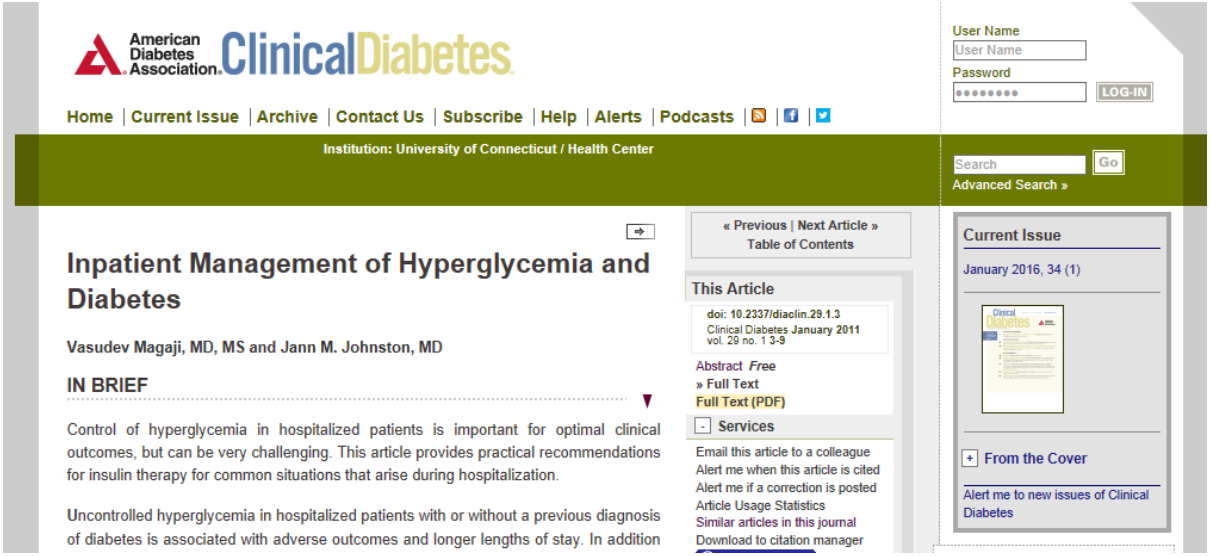
Order Set Changes [Insulin]

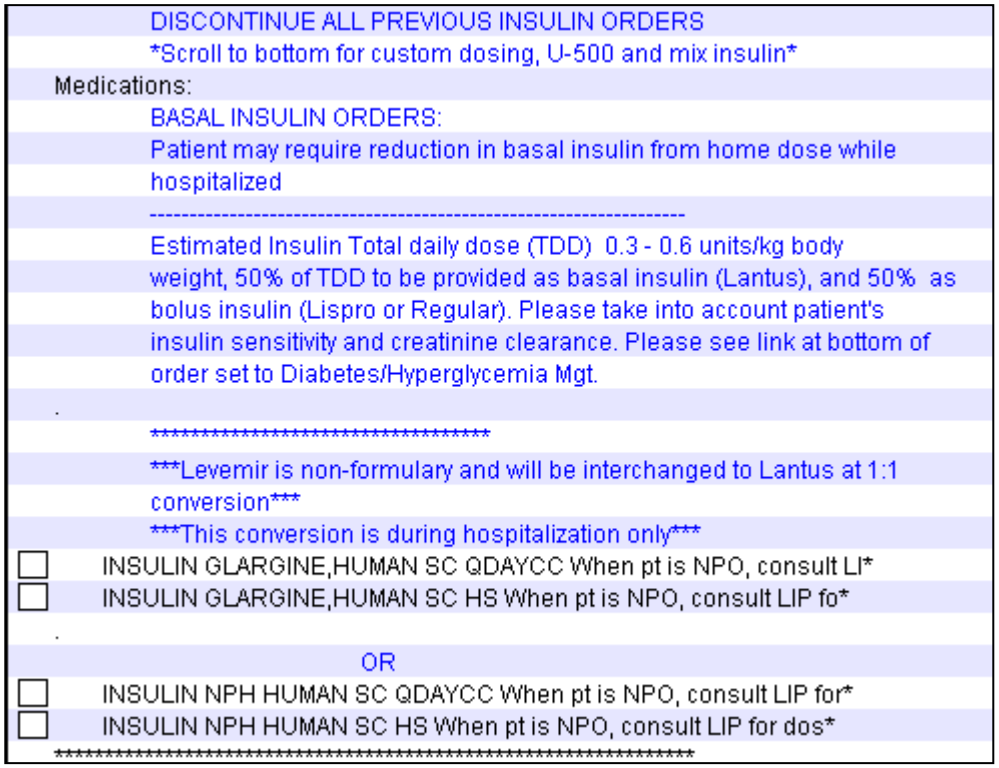
- Links at the bottom of the order set (purple boxes) that will lead to related information (e.g journal article)
- Basal Insulin Orders
- Prandial (sometimes called Bolus) Insulin Orders
- Correction Dosing Insulin (although technically a sliding scale we will refer to correction dosing)
- Misc Insulin Orders (e.g. Humalog Mix, U-500)
- Consult Area and Labs
- Hypoglycemia Protocol Medications
  - This will be pre-checked and duplicate orders may need to be discontinued.

Order Set Changes [Insulin]



The reference article for this order set will be a link within the CPOE order set. Read the article linked below: http://clinical.diabetesjournals.org/content/29/1/3.full

Order Set Changes [Basal Insulin]



DISCONTINUE ALL PREVIOUS INSULIN ORDERS
Scroll to bottom for custom dosing, U-500 and mix insulin
Medications:
BASAL INSULIN ORDERS:
Patient may require reduction in basal insulin from home dose while hospitalized
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Estimated Insulin Total daily dose (TDD) 0.3 - 0.6 units/kg body weight, 50% of TDD to be provided as basal insulin (Lantus), and 50% as bolus insulin (Lispro or Regular). Please take into account patient's insulin sensitivity and creatinine clearance. Please see link at bottom of order set to Diabetes/Hyperglycemia Mgt.
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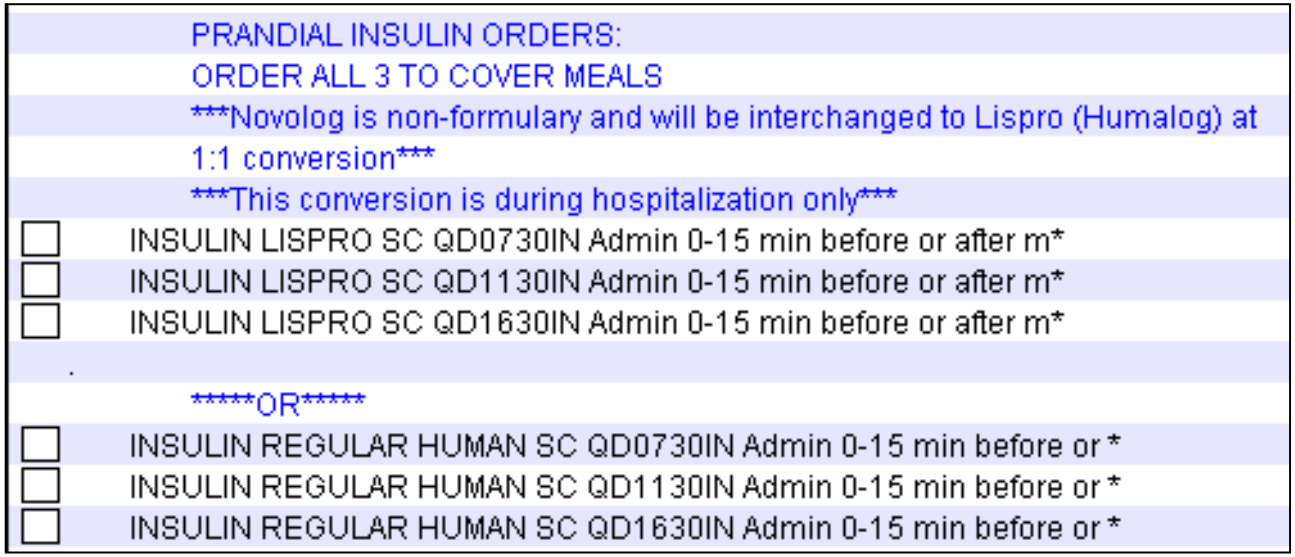
****
Levemir is non-formulary and will be interchanged to Lantus at 1:1 conversion
This conversion is during hospitalization only
☐ INSULIN GLARGINE,HUMAN SC QDAYCC When pt is NPO, consult LI*
☐ INSULIN GLARGINE,HUMAN SC HS When pt is NPO, consult LIP fo*
.
OR
☐ INSULIN NPH HUMAN SC QDAYCC When pt is NPO, consult LIP for*
☐ INSULIN NPH HUMAN SC HS When pt is NPO, consult LIP for dos*
****

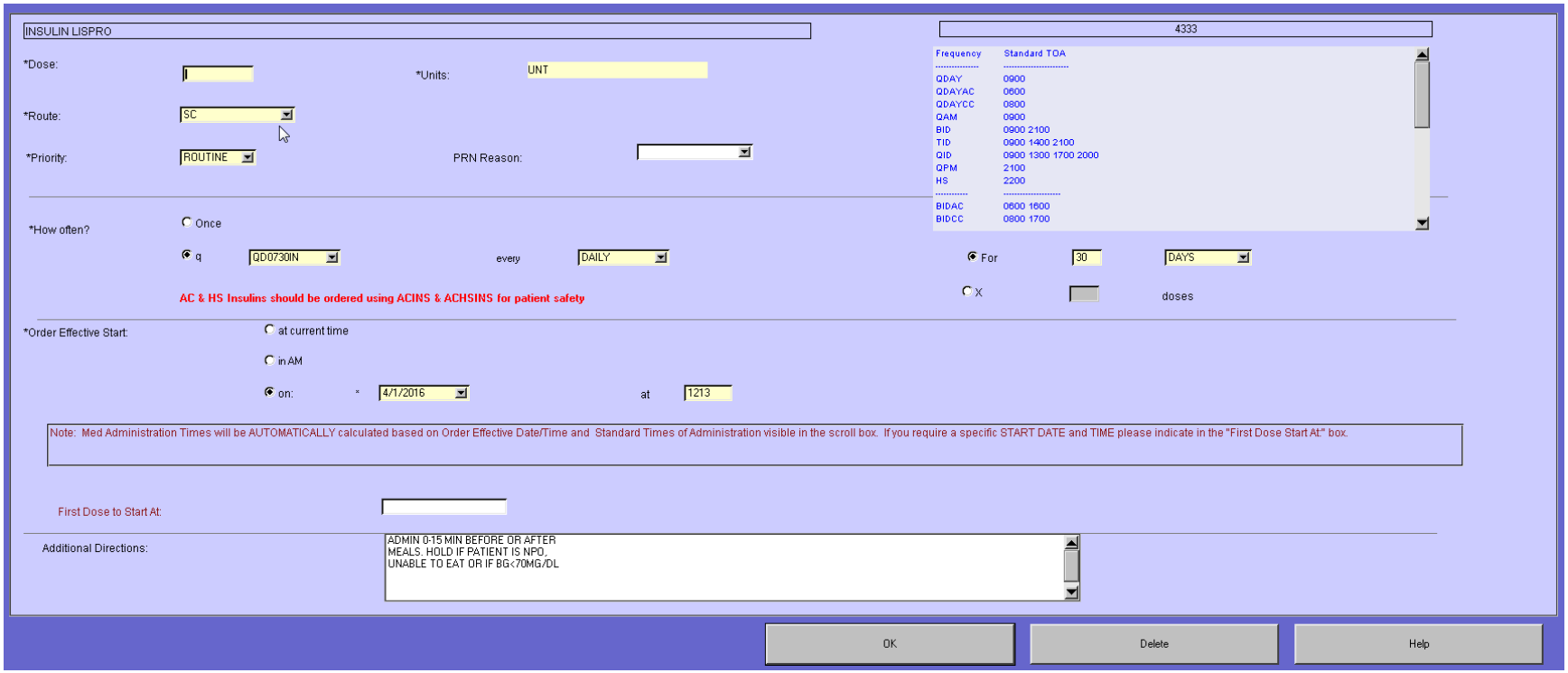
Reminder: Insulin analogs are preferred for basal, mealtime, and correction doses instead of human insulins (regular and NPH). Insulin analogs have a more predictable absorption and action profile in addition to less pharmacokinetic fluctuation in patients with renal insufficiency.

Order Set Changes [Bolus Insulin]



- Ability to customize a dose for each meal within the order set
- **Reminder**: Insulin analogs are preferred for basal, mealtime, and correction doses instead of human insulins (regular and NPH). Insulin analogs have a more predictable absorption and action profile in addition to less pharmacokinetic fluctuation in patients with renal insufficiency.

Order Set Changes
[Bolus Insulin]



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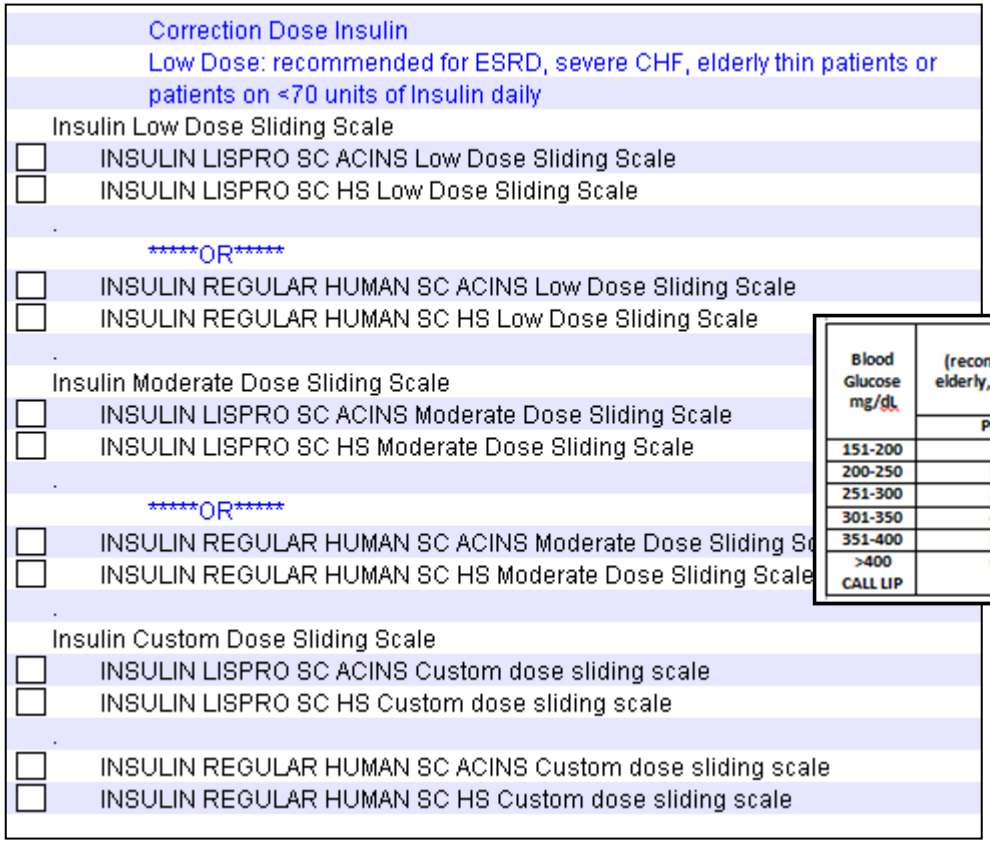
Order Set Changes [Correction Dose Insulin]



Correction Dose Insulin
Low Dose: recommended for ESRD, severe CHF, elderly thin patients or patients on <70 units of Insulin daily

Insulin Low Dose Sliding Scale
- ☐ INSULIN LISPRO SC ACINS Low Dose Sliding Scale
- ☐ INSULIN LISPRO SC HS Low Dose Sliding Scale

*****OR*****
- ☐ INSULIN REGULAR HUMAN SC ACINS Low Dose Sliding Scale
- ☐ INSULIN REGULAR HUMAN SC HS Low Dose Sliding Scale

Insulin Moderate Dose Sliding Scale
- ☐ INSULIN LISPRO SC ACINS Moderate Dose Sliding Scale
- ☐ INSULIN LISPRO SC HS Moderate Dose Sliding Scale

*****OR*****
- ☐ INSULIN REGULAR HUMAN SC ACINS Moderate Dose Sliding Sc
- ☐ INSULIN REGULAR HUMAN SC HS Moderate Dose Sliding Scale

Insulin Custom Dose Sliding Scale
- ☐ INSULIN LISPRO SC ACINS Custom dose sliding scale
- ☐ INSULIN LISPRO SC HS Custom dose sliding scale
- ☐ INSULIN REGULAR HUMAN SC ACINS Custom dose sliding scale
- ☐ INSULIN REGULAR HUMAN SC HS Custom dose sliding scale

- Providers can still customize the doses for correction using the custom dose.
- Doses for bedtime can be reduced to prevent hypoglycemia.

Blood Glucose mg/dL	☐ LOW DOSE (recommended for ESRD, severe CHF, elderly, thin patients, or patients on <70 units of insulin daily		☐ MODERATE DOSE		☐ OTHER	
	Pre-meal	Bedtime	Pre-meal	Bedtime	Pre-meal	Bedtime
151-200	0	0	2 units	0		
200-250	2 units	0	4 units	0		
251-300	3 units	0	6 units	1 unit		
301-350	4 units	2 units	8 units	2 units		
351-400	5 units	3 units	10 units	2 units		
>400 CALL LIP	6 units	4 units	10 units	3 units		

Reminder: Insulin analogs are preferred for basal, mealtime, and correction doses instead of human insulins (regular and NPH). Insulin analogs have a more predictable absorption and action profile in addition to less pharmacokinetic fluctuation in patients with renal insufficiency.

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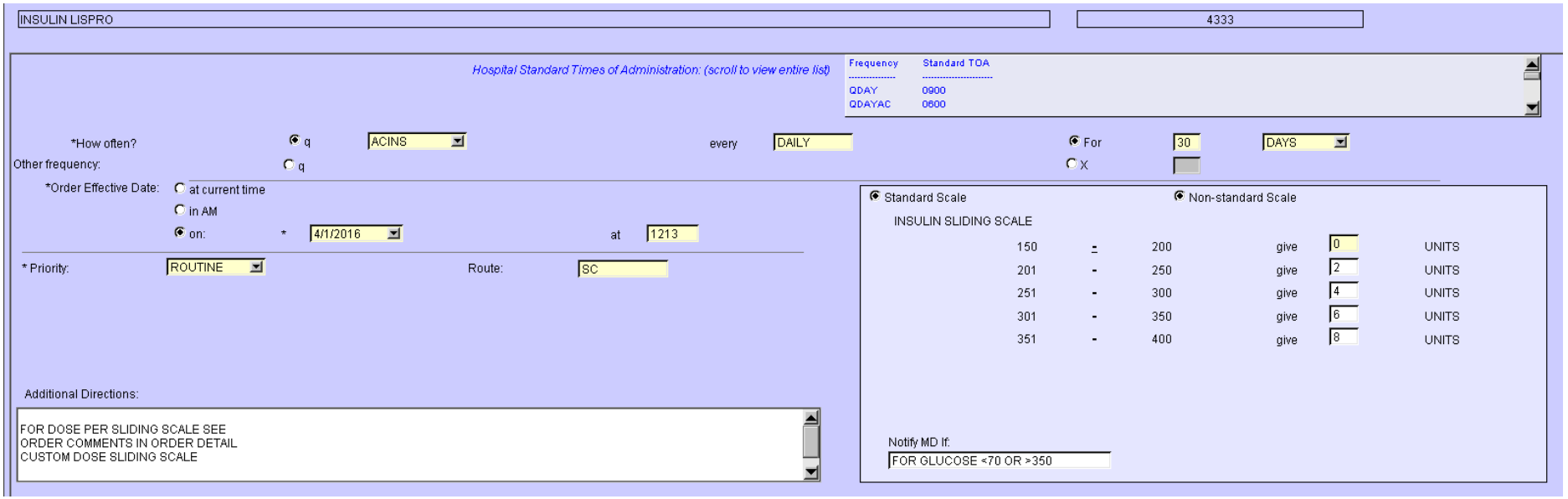
Order Set Changes
[Correction Dose Insulin]



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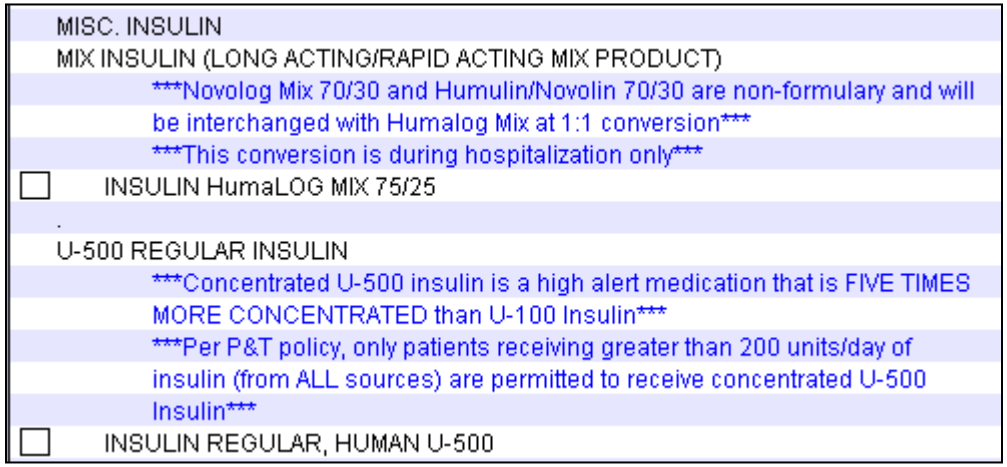
Order Set Changes [Miscellaneous Insulin Products]



MISC. INSULIN

MIX INSULIN (LONG ACTING/RAPID ACTING MIX PRODUCT)

Novolog Mix 70/30 and Humulin/Novolin 70/30 are non-formulary and will be interchanged with Humalog Mix at 1:1 conversion

This conversion is during hospitalization only

☐ INSULIN HumaLOG MIX 75/25

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U-500 REGULAR INSULIN

Concentrated U-500 insulin is a high alert medication that is FIVE TIMES MORE CONCENTRATED than U-100 Insulin

Per P&T policy, only patients receiving greater than 200 units/day of insulin (from ALL sources) are permitted to receive concentrated U-500 Insulin

☐ INSULIN REGULAR, HUMAN U-500

Miscellaneous products will be available after all the correction insulin portion within the order set.

Insulin Infusion Orders will be a **separate** order set from this order set.

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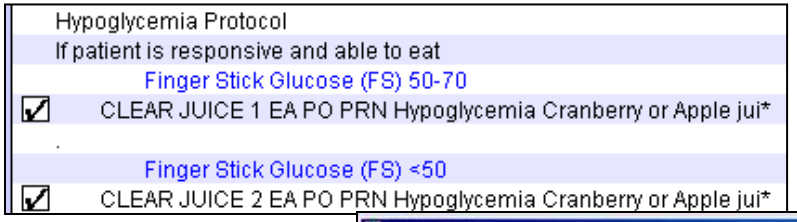
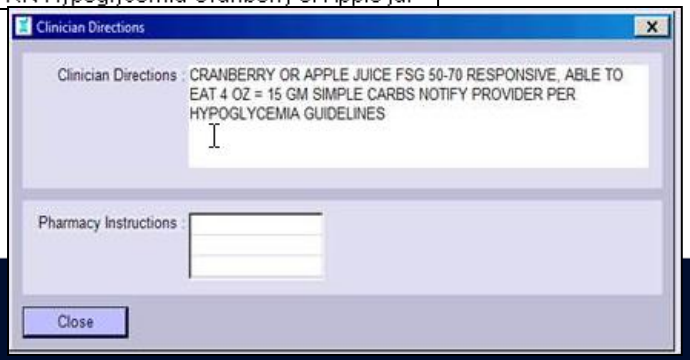
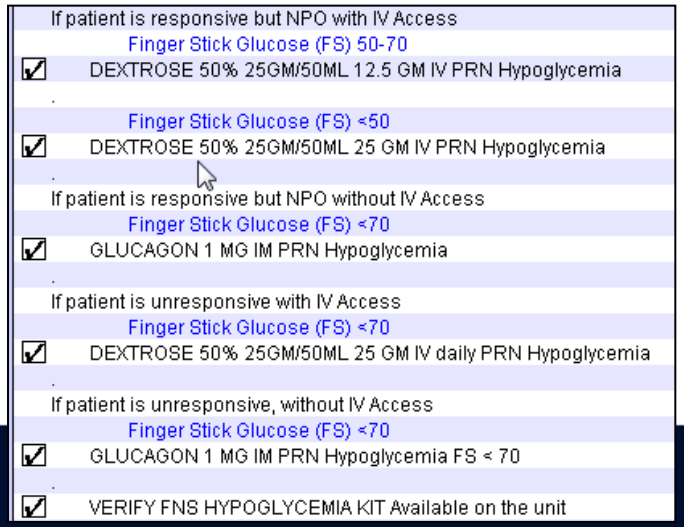
Order Set Changes
[Hypoglycemia Nursing Protocol]

- Contained within the insulin order set. This will be pre-checked off to make sure it is ordered. Be **sure** to delete duplicate orders.
- A separate order set just for hypoglycemia will also be available in CPOE in case there is a need to order outside of the insulin order set.
- Orders for juice will come over to MAK as well. This is be sure that the protocol is followed and proper documentation of the intervention for hypoglycemia.







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Hypoglycemia Nursing Protocol Treatment Guidelines

HYPOGLYCEMIA TREATMENT GUIDELINES 2/2016

Practitioner order REQUIRED for any treatment requiring medication administration (i.e. D50%, Glucagon)

	Responsive, Able to Eat		Responsive, NPO, with IV Access		Responsive, NPO, without IV Access	Unresponsive, With IV Access	Unresponsive, without IV Access
Fingerstick (FS)	FS 50-70	FS <50	FS 50-70	FS <50	FS < 70	FS < 70	FS < 70
Medications / Treatment	15 grams simple carbs (4 oz) *	30 grams simple carbs (8 oz) **	½ amp (12.5 Grams) D50% IVP X 1 dose	1 amp (25 Grams) D50% IVP x 1 dose	Glucagon 1mg IM x 1	1 amp (25 Grams) D50% IVP x 1 dose	Glucagon 1mg IM x 1
Practitioner Notification	Required		Required		Required	Required & call RRT	Required & call RRT
Other Interventions					• Turn patient on left side in case of vomiting • Obtain IV Access		• Turn patient on left side in case of vomiting • Obtain IV Access
Repeat FS	Repeat FS in 15 minutes		Repeat FS in 15 minutes		Repeat FS in 15 minutes	Repeat FS in 15 minutes	Repeat FS in 15 minutes
Repeat Treatment, prn	If repeat FS remains <100, give 15 grams of simple carbs and obtain FS 15 minutes later. Continue this treatment until FS ≥ 100		If repeat FS remains <100, administer ½ amp D50% IVP and obtain FS 15 minutes later. Continue this treatment until FS ≥ 100		If repeat FS remains <100, If IV access obtained, follow steps for "Responsive, NPO, with IV Access" If IV access unsuccessful, administer Glucagon 1mg IM X 1 and notify practitioner ***Do not administer more than 2 doses of glucagon in total.	If repeat FS remains <100, administer 1 amp D50% IVP and obtain FS 15 minutes later. Continue this treatment until FS ≥ 100	If repeat FS remains <100, If IV access obtained, follow steps for "Unresponsive, with IV Access" If IV access unsuccessful, administer Glucagon 1mg IM X 1 and notify practitioner ***Do not administer more than 2 doses of glucagon in total.
After FS ≥ 100	Once FS is corrected to ≥ 100: If patient is not NPO: if patient is not expected to eat a meal within 1 – 1 ½ hours, a snack (15 grams of carbs AND a protein or fat choice) should be provided to help stabilize blood sugars. Nursing should call the diet office to request a half sandwich or the standard diabetic snack for the day, or if dietary office is closed, provide the Nabisco Ritz cheese cracker sandwiches from the hypoglycemia dietary kit. If patient is NPO, collaborate with practitioner for additional orders.						

*15 grams of simple carbs = 4 oz apple or cranberry juice

**30 grams of simple carbs = 8 oz apple or cranberry juice

AVOID orange juice & AVOID adding sugar packets to juice

***Notes about Glucagon IM

- Blood glucose should rise within 10 minutes of injection and peak effect is reached in 30 minutes
- Repeating the Glucagon dose may make nausea/vomiting more likely without raising the blood glucose level any further
- It can cause more insulin to be released and potential for secondary rebound hypoglycemia

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References

- http://spectrum.diabetesjournals.org/content/18/1/39.full
- http://www.dmsjournal.com/content/2/1/49
- http://clinical.diabetesjournals.org/content/20/3/147.full
- http://clinical.diabetesjournals.org/content/29/1/3.full
- http://qualitysafety.bmj.com/content/15/2/89.full.pdf+html
- http://care.diabetesjournals.org/content/30/9/2409.full.pdf+html
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- 11.Cook CB, Kongable GL, Potter DJ, et al. Inpatient glucose control: A glycemic survey of 126 US hospitals. J Hosp Med. 2009;4:E7-E14.