



Ten Ways to Prevent Insulin-Use Errors in Your Hospital

ASHP Research and Education Foundation
May 14, 2014

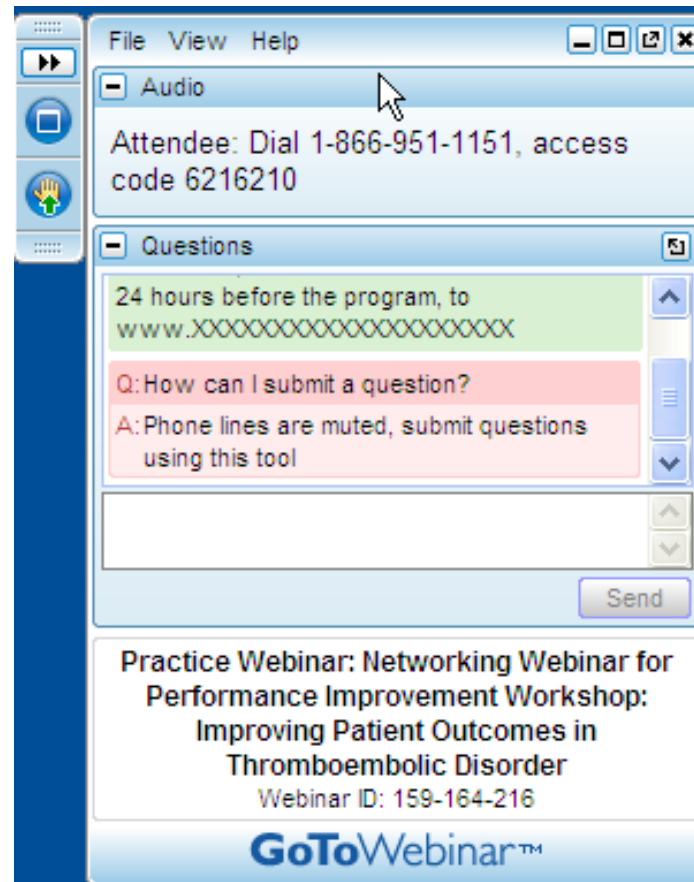
TOGETHER WE MAKE A GREAT TEAM



To Ask Questions and Adjust the Control Panel

Expand or Collapse

Type your question here



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Disclosures

The faculty members have no relevant conflicts of interest to disclose.

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PRESCRIBING

1. Develop protocol-driven and evidence-based order sets for specific uses of insulin such as transition of administration route from intravenous to subcutaneous, administration via subcutaneous insulin pumps, post-discharge dosing, diabetic ketoacidosis, hyperosmolar states, hyperkalemia, and post-cardiac surgery care. These order sets should include orders for glucose monitoring and decision support capabilities that guide insulin use based on the patients' nutrition status. In addition, protocol-driven and evidence-based order sets for the management of hypoglycemia should be developed and integrated into the care of all hospitalized patients who receive insulin.
2. Eliminate the routine administration of correction/sliding scale insulin doses as a primary strategy to treat hyperglycemia.
3. Eliminate the use of "free text" insulin orders in electronic and paper medical records and replace them with protocol-driven and evidence-based order sets that allow for the prescribing of complex insulin regimens.



Enhancing insulin-use safety in hospitals: Practical recommendations from an ASHP Foundation expert consensus panel. *(Continued)*

Dispensing and Storage

4. Store only U100 concentration insulin and U100 administration devices (e.g., syringes, pens) in patient care areas and ensure that they are stored in a secure fashion and segregated from other medications.
5. Develop hospital-wide standard concentrations for insulin infusions to be adopted and used in all patient care areas.

Enhancing insulin-use safety in hospitals: Practical recommendations from an ASHP Foundation expert consensus panel. *(Continued)*

Administering

6. Limit preparation, including in procedural areas, of all intravenous bolus insulin doses and intravenous insulin infusions to the pharmacy department.
7. Hospitals must develop policies and procedures to ensure that insulin pens are used for individual patients only. In addition, hospitals must establish policies and educational programs to ensure the safe use of insulin pens and disposable needle tips.

Enhancing insulin-use safety in hospitals: Practical recommendations from an ASHP Foundation expert consensus panel. *(Continued)*

Monitoring

8. Ensure that insulin-use is linked directly to patients' nutrition status. Meal delivery, point-of-care glucose testing and insulin administration should be well-coordinated and standardized. Patients and their family caregivers should be educated to request administration of rapid-acting insulin when the patient begins her/his meal. In patients with variable nutritional intake, prandial insulin administration should be delayed until completion of the meal. Protocol-driven and evidence-based order sets should be developed for insulin-use and blood glucose monitoring during planned and unplanned interruption of enteral nutrition or total parenteral nutrition.

Enhancing insulin-use safety in hospitals: Practical recommendations from an ASHP Foundation expert consensus panel. *(Continued)*

Evaluating

9. Every hospital should prospectively monitor/measure rates of hypoglycemia and hyperglycemia; insulin use; and coordination of insulin administration, glucose testing and nutrition delivery. Real-time, institution-wide glucose reports should be provided to healthcare team members to ensure appropriate surveillance and management of patients with unexpected hypoglycemia and hyperglycemia.

Planning

10. Provide standardized education, including competency assessment, to all hospital-based health professionals who are responsible for the use (e.g. prescribing, compounding, dispensing, administering, monitoring) of insulin.



Case 1: Incorporates discussion of these questions from the field

Questions from conference attendees:

- Should oral anti-diabetes medications be discontinued, and insulin initiated, upon hospital admission?
 - If so, how should we manage the transition of care to home?
- How do we estimate the amount of insulin to prescribe when patients are admitted to the hospital?
- In patients who are using insulin prior to admission, should their insulin dose be automatically reduced upon admission?
- How should steroid-induced hyperglycemia be managed?



Case: Initiating Subcutaneous Insulin in an obese patient eating regular meals

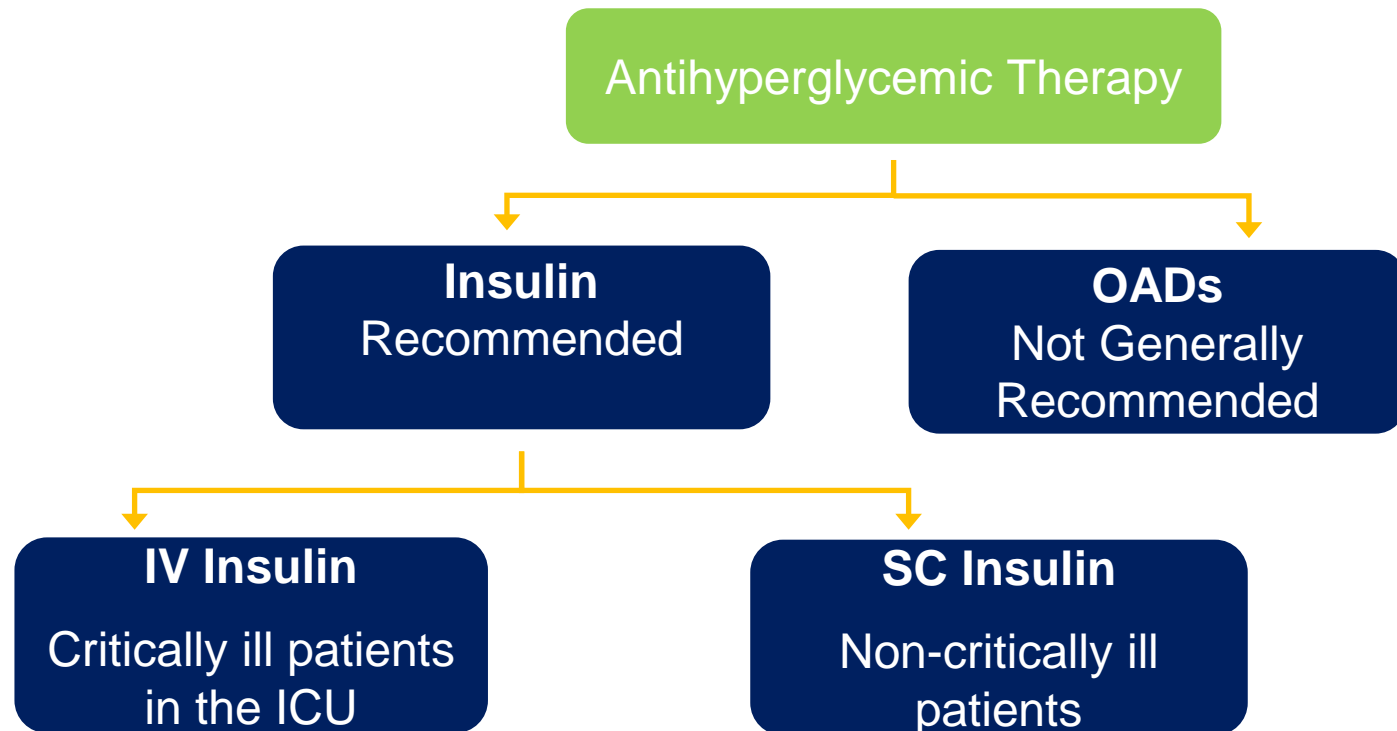
- 56 year old man admitted with a diabetes-related foot infection and COPD, eating regular meals
- Obese, weighs 100 kg
- Home regimen:
 - 2 oral anti-diabetes agents at maximum dose
- **Baseline Control:**
 - HbA1c of 9.5, POC glucose in ED 240 mg/dL
- Not actively wheezing, not on steroids
- What are your initial orders?

Obese male eating regular meals 2 oral agents, 100 kg, A1c 9.5, BG 240

Best regimen?

- A. Continue oral agents and start NPH 10 units at bedtime
- B. Continue oral agents, start glargine 30 units q HS
- C. DC oral agents: Glargine 30 units q HS Lispro 10 units q ac
- D. DC oral agents: Glargine 15 units q HS Lispro 10 units q ac

Recommendations for Managing Patients With Diabetes in the Hospital Setting



1. ACE/ADA Task Force on Inpatient Diabetes. *Diabetes Care*. 2006 & 2009
2. *Diabetes Care*. 2009;31(suppl 1):S1-S110.



Glycemic Targets in Non-Critical Care Setting

- **Pre-meal BG target of <140 mg/dl and random BG <180 mg/dl for the majority of patients.**
- **Glycemic targets need to be modified according to clinical status.**
 - For patients who achieve and maintain glycemic control without hypoglycemia, a lower target range may be reasonable.
 - For patients with terminal illness and/or with limited life expectancy or at high risk for hypoglycemia, a higher target range (BG <200 mg/dl) may be reasonable.
- **For avoidance of hypoglycemia, we suggest that anti-diabetes therapy be reassessed when BG values are 100 mg/dl. Modification of glucose-lowering treatment is usually necessary when BG values are <70 mg/dl.**



200 mg / dL

180 mg/dL

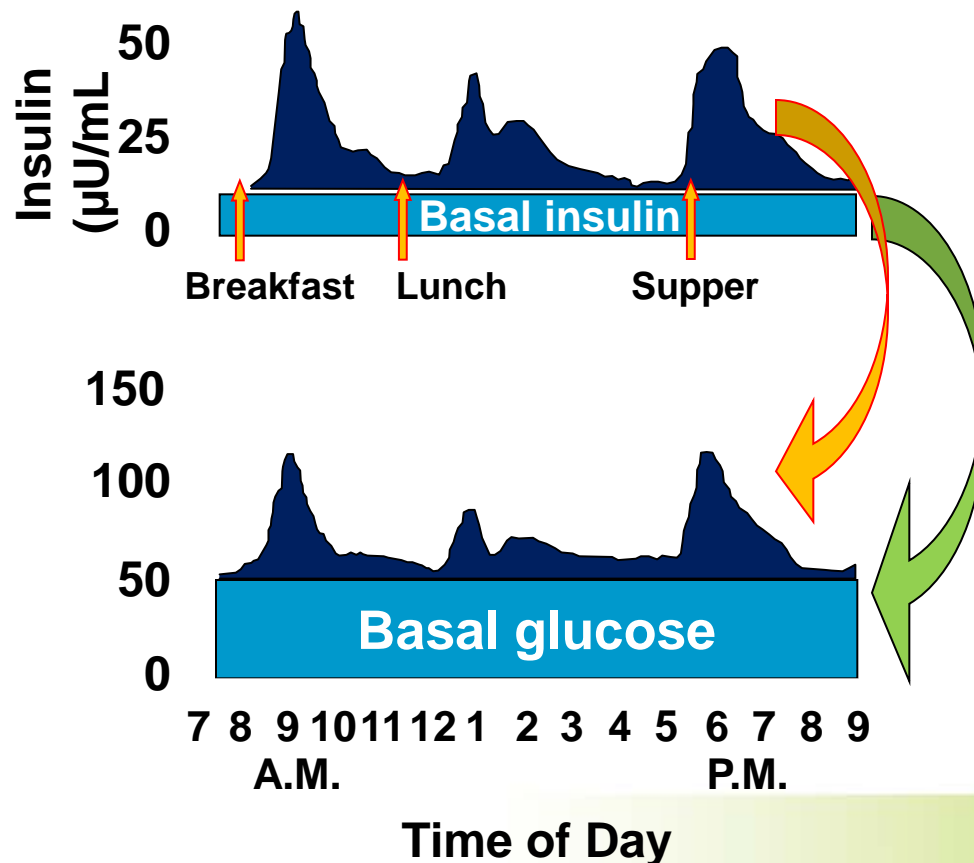
100 mg / dL

70 mg / dL

A1C for Diagnosis of Diabetes in Hospital

- In-hospital hyperglycemia is defined as an admission or in-hospital BG > 140 mg/dl
- HbA1c > 6.5% can be identified as having diabetes; < 5.2% can exclude diabetes
- Implementation of A1C testing can be useful:
 - Assists with differentiation of newly diagnosed diabetes from stress hyperglycemia
 - Assess glycemic control prior to admission
 - Designing an optimal regimen at the time of discharge

Physiologic Insulin Secretion: Basal-Bolus Concept



1. Basal
2. Nutritional
3. Correctional

{ Suppresses glucose production between meals and overnight

The 50/50 rule

Which Patients Need Basal Insulin?

- “Insulin-deficient” patients should always have basal insulin (even NPO):
 - Type 1 DM or DKA, pancreatic insufficiency
 - A history of type 2 DM for 10 years or more
 - On any insulin for 5 years or more
 - Wide fluctuations of glucose values
- Pre-prandial glucose > 140 mg/dL consistently
- Random glucose > 180 mg/dL

Calculating Insulin Dosage (Total Daily Dose)

- **Calculate from insulin infusion amount**
 - Recent steady state hourly rate x 20, for example
- **Add up doses of insulin taken at home, adjust for glycemic control and other factors**
- **Calculate from weight, body habitus, other factors**

Starting Basal-Bolus from Scratch

Calculate starting total daily dose (TDD)

- ✓ 0.4 – 0.5 units/kg/day
- ✓ Reduce to 0.3 units/kg/day if hypoglycemia risk
- ✓ increase to 0.5 – 0.6 units/kg/day if overweight / obese

Adjust TDD up or down based on

- ✓ Past response to insulin
- ✓ Presence of hyperglycemia inducing agents, stress, etc

Basal insulin = 50% of TDD

- ✓ Glargine q HS or q AM, detemir in 1 or 2 doses

Adjusting from home insulin dosing:

Consider moving dose up if:	Consider moving dose down if:
High HbA1c on home dose	Acute renal / liver failure
High glucose levels on home dose	History of hypoglycemia
Increased insulin needs from stress	Dietary intake is very large as outpatient, but will be restricted as inpatient
Steroids are being started	Steroids are being stopped
On oral agents and insulin as outpatient, but only on insulin as inpatient.	Long acting insulin (glargine / detemir) being used to cover both nutritional and basal needs as an outpatient
TPN being started	Suspicion that non-adherence to DM medications led to increases in DM regimen, rather than resistance to the regimen.

Obese male eating regular meals 2 oral agents, 100 kg, A1c 10, BG 240

Best regimen?

- A. Continue oral agents and add NPH 10 units at bedtime
- B. Continue oral agents, start glargine 30 units q HS
- C. DC oral agents: Glargine 30 units q HS Lispro 10 units q ac
- D. DC oral agents: Glargine 15 units q HS Lispro 10 units q ac

Solutions for Obese, eating patient

- Best answer is C
- POC BG checks AC and HS
- Stop oral agents
- TDD: $100 \text{ kg} \times 0.6 \text{ units/kg/day} = 60 \text{ units}$
Glargine (Lantus) Alternative
 - Basal: Glargine 30 units q HS
 - Nutritional: Lispro 10 units q ac
 - Correction: Lispro per scale q ac and HS

Case 1: (cont'd) 56 year old man admitted with diabetic foot infection and COPD, eating regular meals.

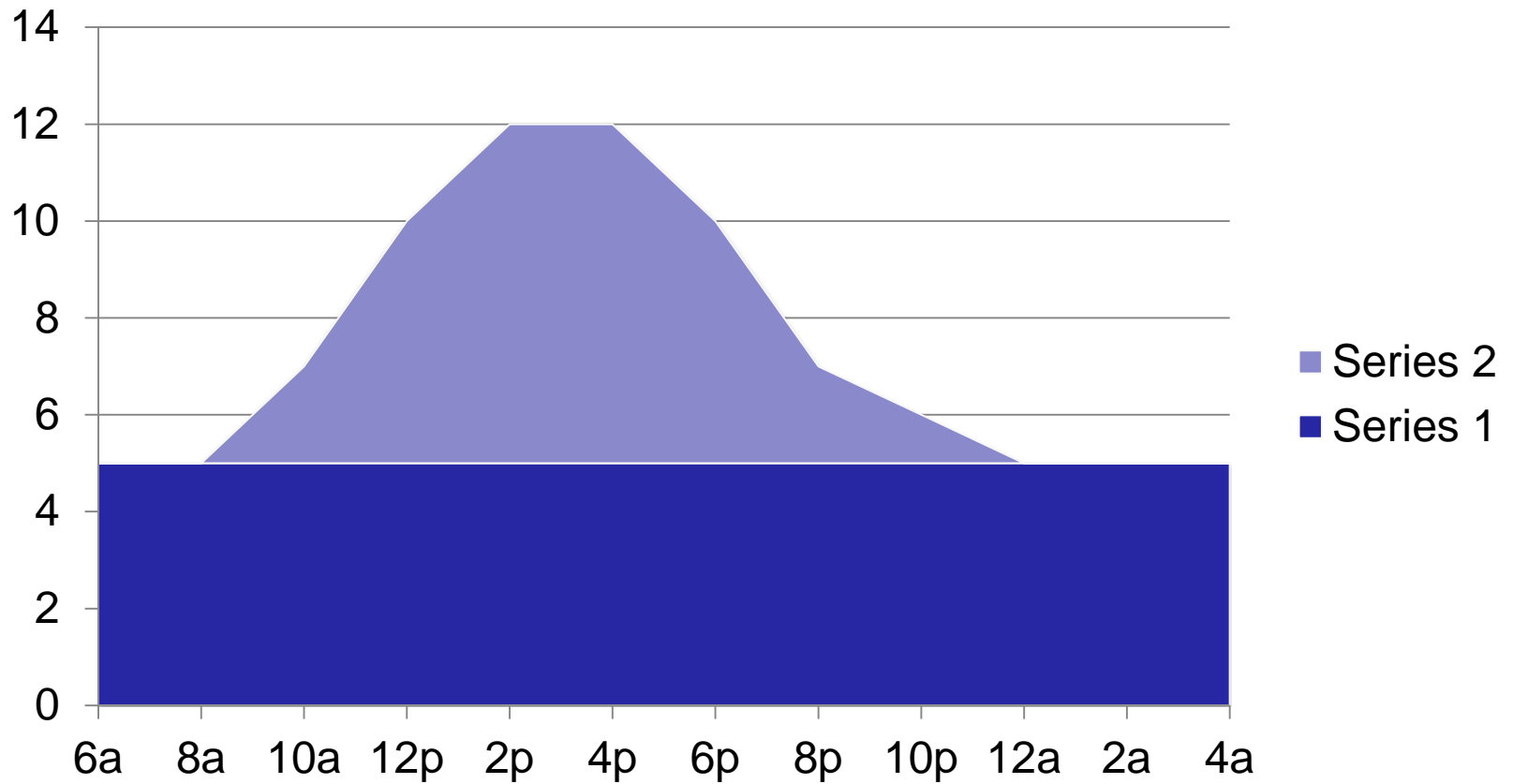
- Controlled *fairly* well on glargine 30 units q HS, RAA-I (lispro) 10 units q AC, POC BG prior day -
 - 150, 165, 140, 175 mg /dL
- COPD flares with excessive wheezing.
- Prednisone 60 mg po q AM to be added to regimen.
- What is the preferred method to adjust for Prednisone?
 - A) Observe and cover hyperglycemic excursions with correction insulin, adjust based on amount of correction insulin required.
 - B) Add NPH 15 units subQ q AM to current regimen
 - C) Increase glargine by 15 units
 - D) Adjust nutritional RAA-I (lispro) upward to 16 units with lunch, 16 units with supper.
 - E) Either B or D are acceptable.

Steroids

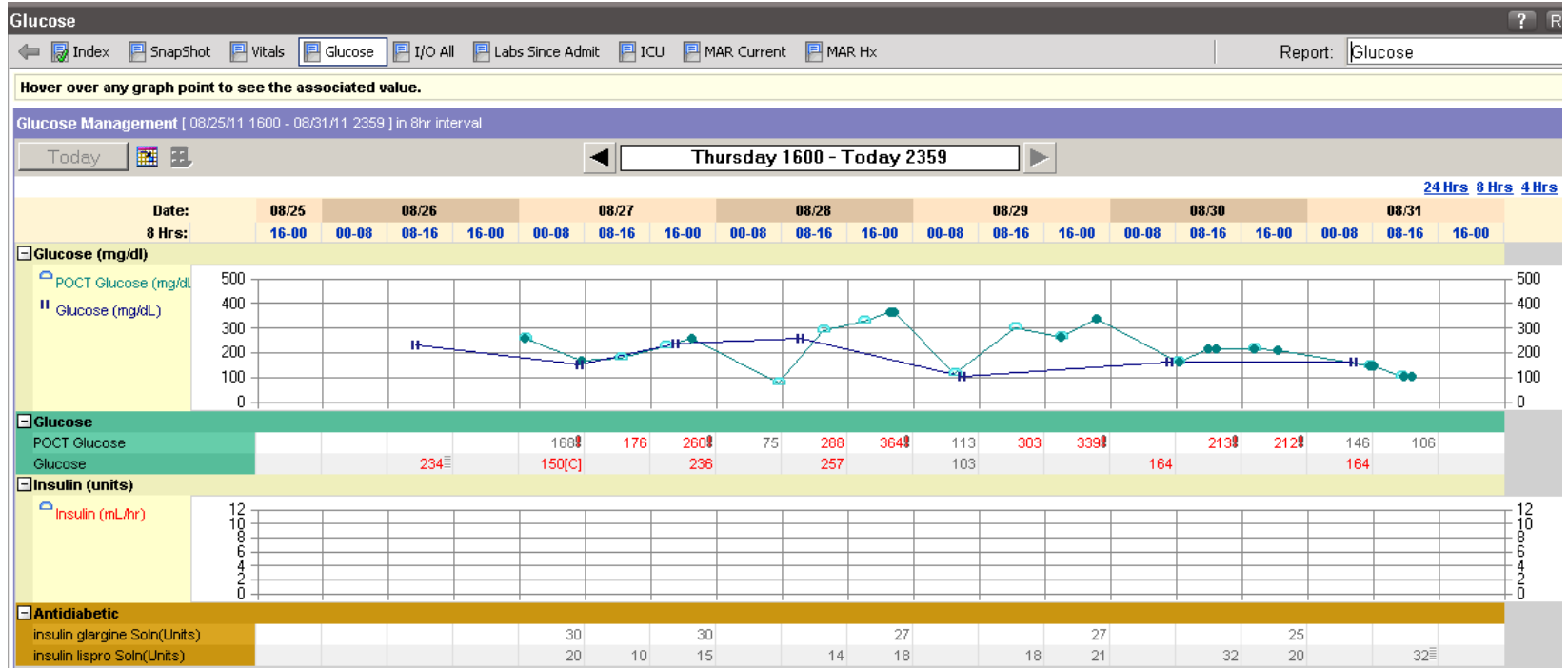


- Steroids cause general insulin resistance w/ much less effect on gluconeogenesis
- Glucose elevation is predominantly postprandial hyperglycemia with a relative lack of fasting hyperglycemia
- Treatment - large doses of a rapid-acting insulin before meals (often only 2 meals depending on time steroid administered)
- Significant increases in basal insulin should be avoided, as overnight hypoglycemia may be induced.

8 a.m. Dosed Steroid



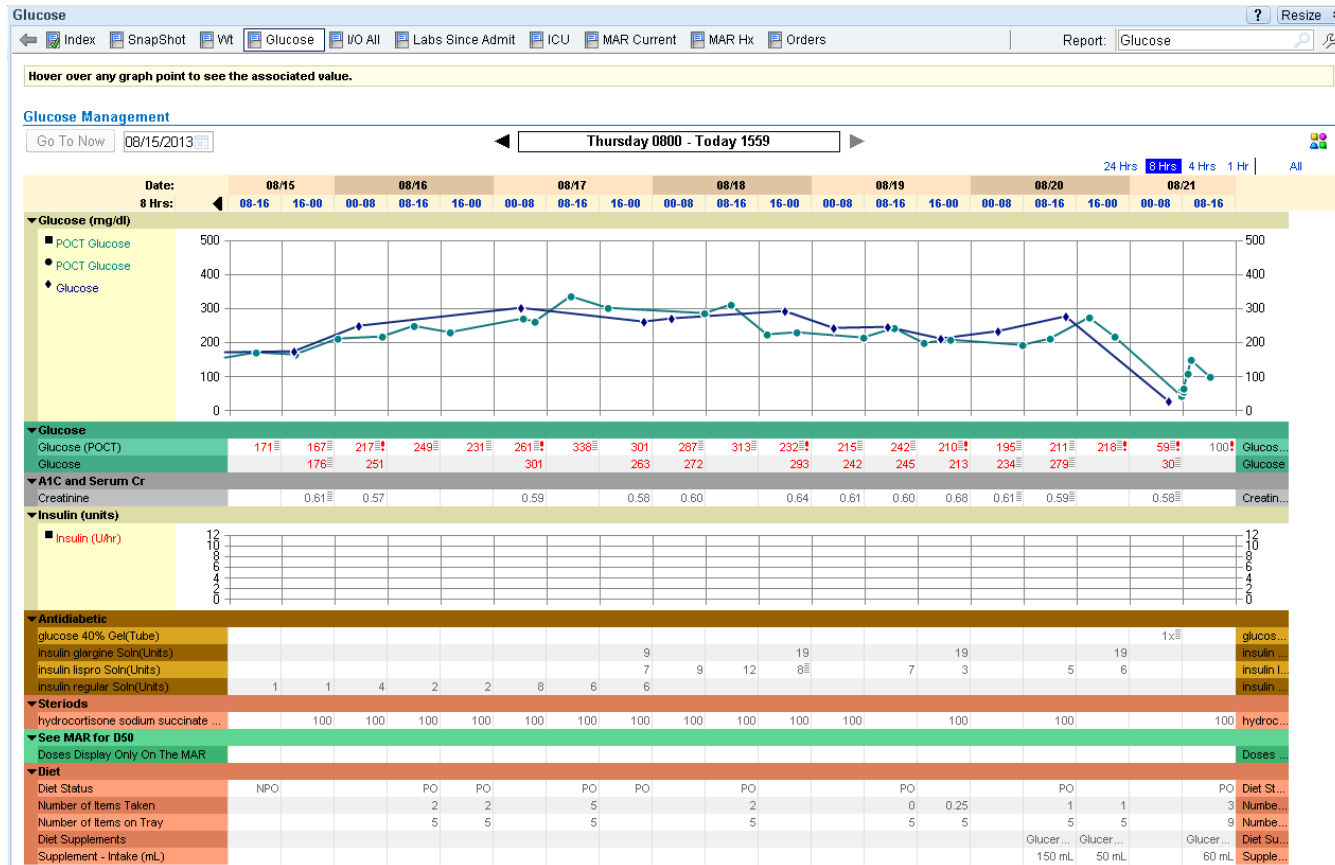
Steroids



High Dose Steroids and Insulin Management

- For patients without hyperglycemia or prior diagnosis of DM or those well controlled on oral agents
 - Always monitor POC glucose, order correction scale insulin
 - Add scheduled insulin if glucose becomes persistently elevated
- For patients previously on insulin, or elevated A1c and persistent hyperglycemia
 - Increase TDD by 20-50% with start of steroid therapy
 - Consider disproportionate increase in nutritional insulin (basal / bolus 40:60 instead of 50:50, for example)
 - Move one step up on correction insulin scale
 - Adjust as required
- Consider adding NPH to basal/bolus
- Low threshold for consultation

Be careful in Lantus only regimen for BID-q6hr steroids, especially when decreasing to once daily



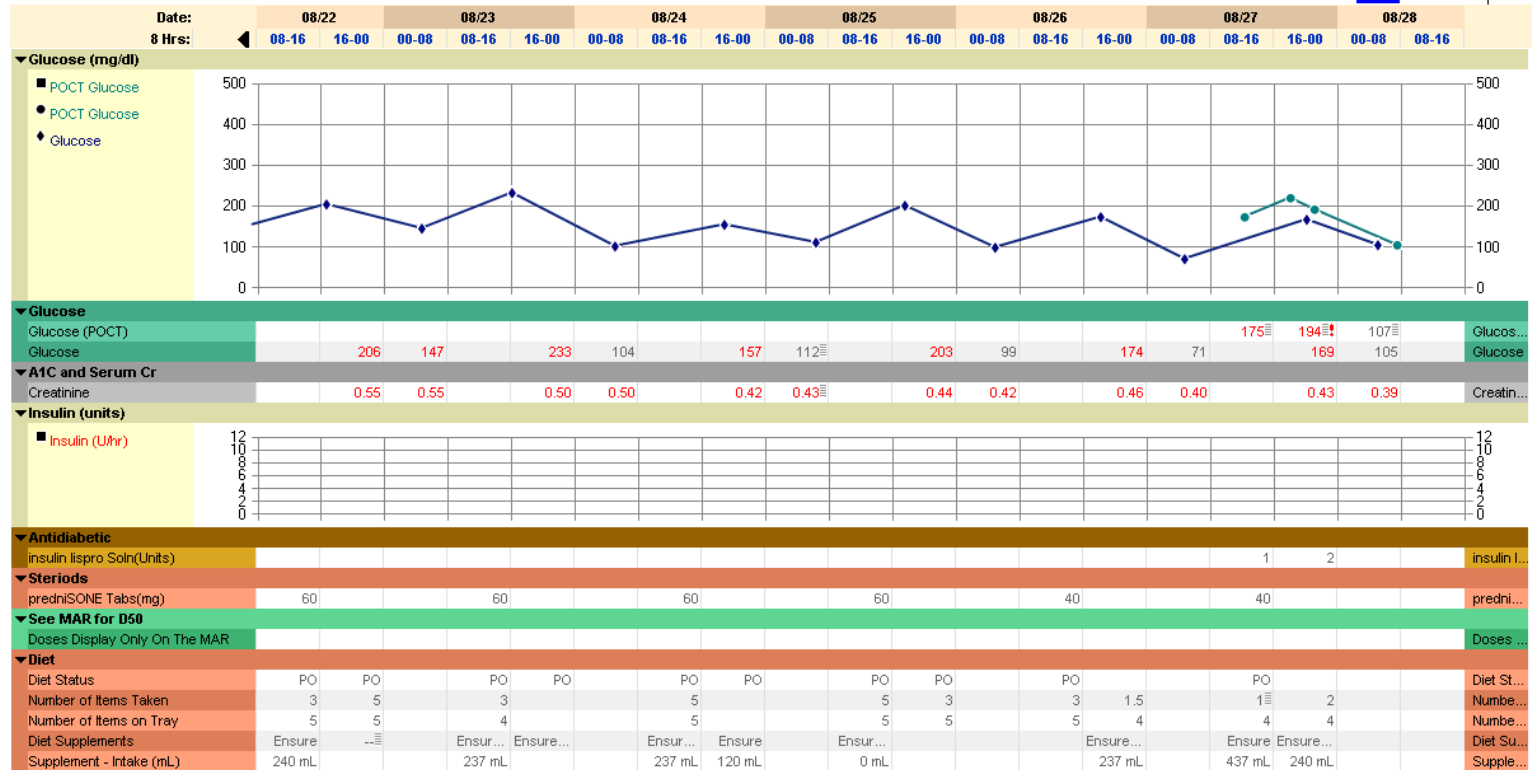
Recommend fingersticks and correction scale at a minimum in all patients (whether h/o DM or not)

Glucose Management

Go To Now 08/22/2013

Thursday 0800 - Today 1559

24 Hrs 8 Hrs 4 Hrs 1 Hr



Case 1: (cont'd) 56 year old man admitted with diabetic foot infection and COPD, eating regular meals

- Controlled *fairly* well on glargine 30 units q HS, RAA-I (lispro) 10 units q AC, POC BG prior day -
 - 150, 165, 140, 175 mg /dL
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- B) Add NPH 15 units subQ q AM to current regimen
- C) Increase glargine by 15 units
- D) Adjust nutritional RAA-I (lispro) upward to 16 units with lunch, 16 units with supper.
- E) **Either B or D are acceptable.**

Case 1: (cont'd) 56 year old man admitted with diabetic foot infection and COPD, ready for discharge tomorrow

- The patient improves and is now down to 10 mg Prednisone / day.
- He has had 3 surgeries on foot with good results.
- He was poorly controlled on admission (A1c 9.5) with outpatient regimen of 2 maximally dosed oral anti-diabetic agents.
- He is being well controlled as inpatient on glargine 25 units q day, lispro 10 units q AC, and is also on a correction scale.
- What should patient be transitioned home on?

Factors to Consider in Crafting Transition Regimen

- Outpatient regimen / control
- Major changes from recent illness / hospitalization
- Inpatient regimen / control
- Changing stress levels, weaning prednisone
- A1c
- Patient preferences
- Financial / social / insurance picture
- Access to follow up

Transition Guide from Inpatient to Outpatient Regimen

A1c <7%	A1c 7-10%*	A1c >10%*
<p>Return to same regimen as prior to admission (oral agents and/or insulin)</p>	<p>Restart outpatient oral agents, optimize orals, consider adding basal insulin once daily at 50% inpt dose</p>	<p>Restart outpatient oral agents, optimize orals, add basal insulin once daily at 75% inpt dose</p> <p>Alternative: stop orals and start 70/30 or basal/bolus at same inpt dose</p>

*Ensure compliance with home regimen, maximize lifestyle changes, optimize orals and add insulin according to funding, compliance and lifestyle on individual basis

Adapted with permission from algorithm by Umpierrez, G., Emory University School of Medicine, 2011.



Case 1: Answers

(probably don't need to show this slide, but maybe we should distribute Q&A in written form to attendees, and post on websites as well)

- Should oral anti-diabetic medications be discontinued, and insulin initiated, upon hospital admission? If so, how should we manage the transition of care to home?

Upon hospital admission, oral agents should generally be discontinued, and insulin should be used to control hyperglycemia over target in the inpatient setting. Regimen going home should take into account several factors, including A1c, patient preference, finances, inpatient control, follow up, etc.

- In patients who are using insulin prior to admission, should their insulin dose be automatically reduced upon admission?

No. A1c, outpatient control, hypoglycemia risk factors, and other factors should be taken into consideration.

- How should steroid-induced hyperglycemia be managed?

Expectant management ok if well controlled with good A1c. Increase insulin proactively if not, focusing especially on expected post prandial excursions. Avoid covering with increased glargine / detemir insulin, especially if steroid dosed q AM.

- How do we estimate the amount of insulin to prescribe when patients are admitted to the hospital?

3 methods, including weight-based, and adjust using clinical factors



Questions for Panel Discussion

- Since conventional teaching is that admitted patients will have changes to their insulin requirement in the hospital, what do you recommend with respect to the patient coming in with an insulin pump?
- In the hospital, do you still use U-100 insulin if a patient was using U-500 at home (i.e., home regimen includes greater than 100 units subcutaneously)?

Questions for Panel Discussion

- What is your opinion on the use of insulin pen devices for routine administration of insulin to inpatients?
- What are the most common remedial sources of inpatient hypoglycemia ADEs?

Proposed CDS Display for hypoglycemia evaluation

Federal Interagency Workgroup to prevent ADE

Report etiology of hypoglycemic event after event resolution

Etiology of hypoglycemic event	
<input type="checkbox"/>	Nutritional interruption without reducing insulin or adding carbohydrate
<input type="checkbox"/>	Prior hypoglycemic event without medication or carbohydrate adjustment
<input type="checkbox"/>	Excessive basal insulin dosing that inappropriately covered nutritional needs, as well as basal needs
<input type="checkbox"/>	Glycemic target that is too stringent for patient condition/co-morbidities
<input type="checkbox"/>	Failure to discontinue oral hypoglycemic agents in the inpatient setting
<input type="checkbox"/>	Time interval between testing was too long
<input type="checkbox"/>	Other failure mode: _____
<input type="checkbox"/>	No preventable factors detected.

Report ACTION taken to MITIGATE hypoglycemia

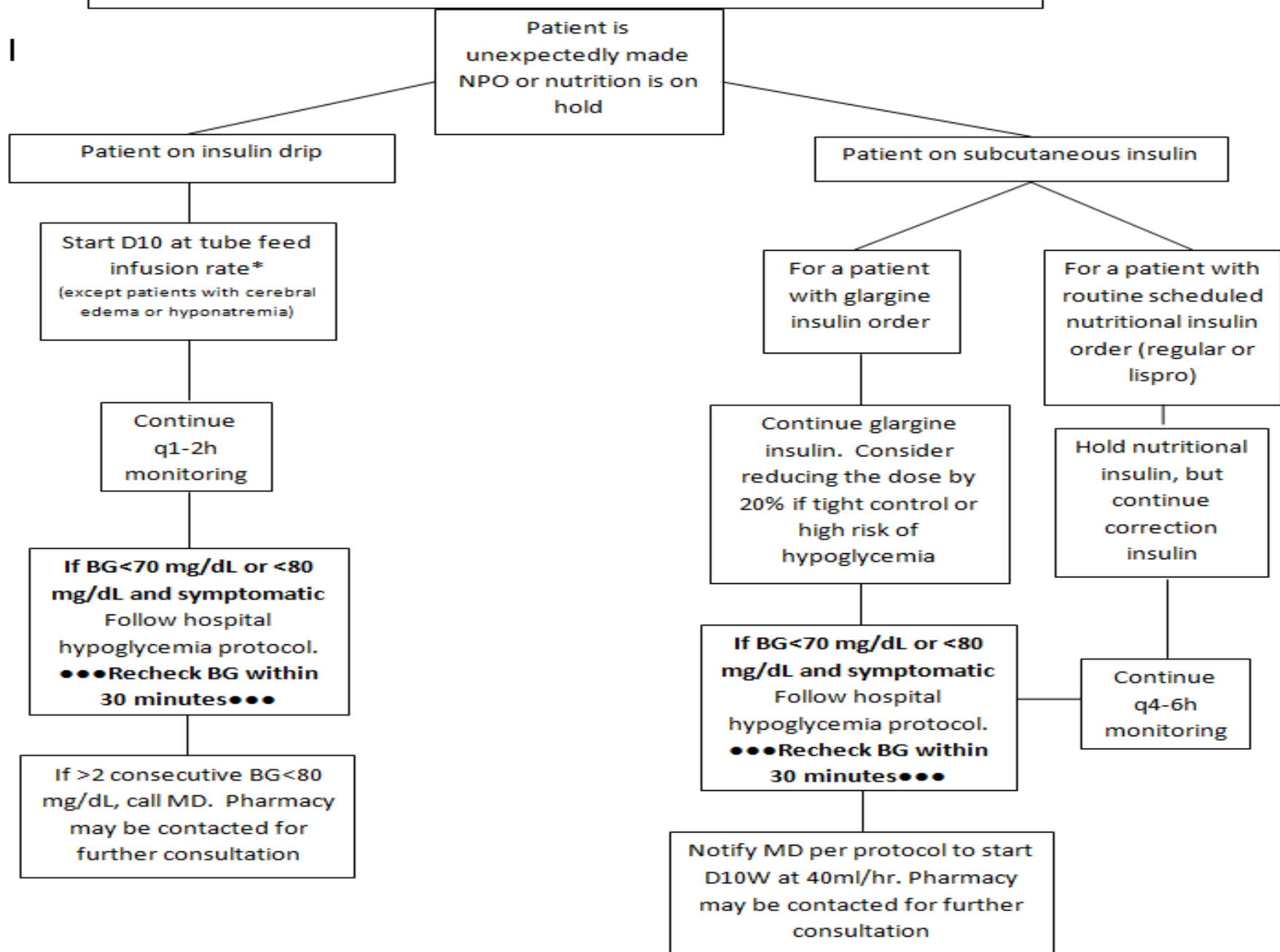
ACTION	
<input type="checkbox"/>	Call to reduce hypoglycemic agent
<input type="checkbox"/>	Call to increase CHO
<input type="checkbox"/>	Education/reinforcement of policy/protocols
<input type="checkbox"/>	Other

Iatrogenic Hypoglycemia from Insulin: Most Common Failures and Strategies to Address Them

- **Inappropriate prescribing**
 - Standardized orders with embedded CDS – mandatory use
 - Ongoing monitoring for inappropriate prescribing, just in time intervention
- **Failure to respond to unexpected nutritional interruption**
 - Protocols and Education
 - Methods to reduce interruptions in tube feeding
- **Poor coordination of nutrition delivery, monitoring, and insulin delivery**
 - Clear directions in protocols and order sets
 - Regular education / competency training
 - Redesign process
- **Failure to respond to a prior hypoglycemic day**
 - Make sure ASSESSMENT is part of hypoglycemia protocol
 - Competency and case based-training
 - Monitor recurrent hypoglycemia rates



Nutrition on Hold Unexpectedly



Questions for Panel Discussion

- Do you have any experience using glycemic control software such as EndoTool, and would you recommend using it?
- In hyperosmolar hyperglycemia, what type of insulin protocol should be used? I have seen both SSI and regular. What is your preference?
- Do you differentiate between asymptomatic and symptomatic hypoglycemia?

To Ask Questions and Adjust the Control Panel

Expand or Collapse

Type your question here

