

Improving Glycemic Control in the Critical Care Setting



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/Hospitalists



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HOSPITALISTS. TRANSFORMING HEALTHCARE. REVOLUTIONIZING PATIENT CARE.

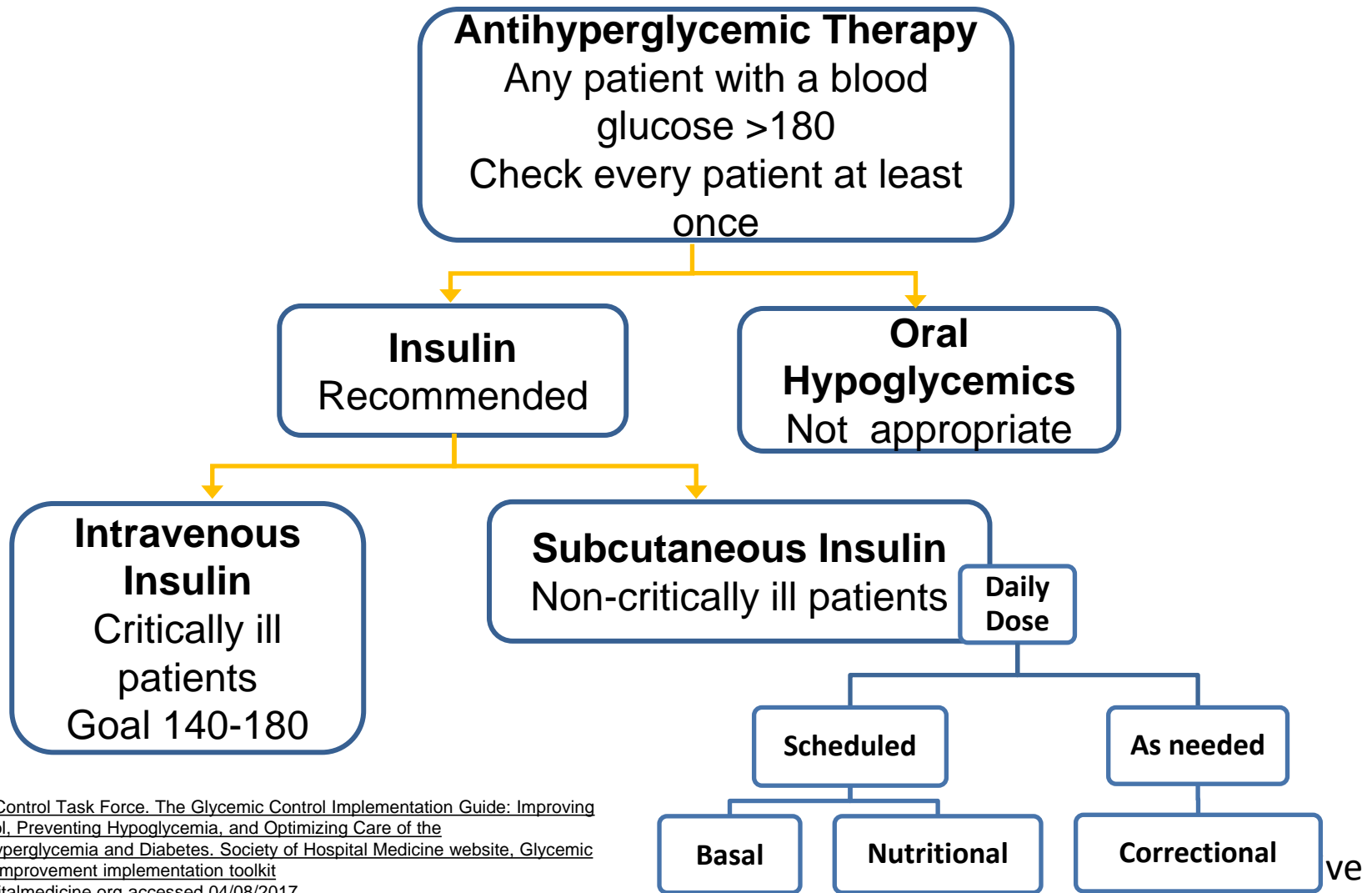
Outline

- Review current guidelines
- Review current glycemic targets
- DKA Treatment
- Building a “perfect” glycemic control protocol
- Transition from IV to SQ insulin
- Special Situations



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Society of Hospital Medicine Guidelines



SHM Glycemic Control Task Force. The Glycemic Control Implementation Guide: Improving Glycemic Control, Preventing Hypoglycemia, and Optimizing Care of the Inpatient with Hyperglycemia and Diabetes. Society of Hospital Medicine website, Glycemic Control Quality Improvement implementation toolkit <http://www.hospitalmedicine.org> accessed 04/08/2017

ADA/SCC Target Glucose Levels in Critical Care/ICU Patients

- American Diabetes Association

- Starting threshold >180 mg/dL
- Once IV insulin is started, glucose level should be maintained between 140 and 180 mg/dL
- Lower glucose targets (110-140 mg/dL) may be appropriate in selected patients
- Targets <110 mg/dL or >180 mg/dL are not recommended

1. *Diabetes Care* 2016; 39 (Suppl. 1):S99-S104
2. Guidelines for the use of an insulin infusion for the management of hyperglycemia in critically ill patients. *Crit. Care Med* 2012 Vol 40, No 12.

- Society of Critical Care Medicine

- Starting threshold of >150 mg/dL and absolutely at 180 mg/dL
- Use protocol to achieve low rate of hypoglycemia <70 mg/dL
- Minimal excursions of <100 mg/dL

Not recommended
<100-110

Acceptable
110-150

Recommended
140-180

Not recommended
>180

Insulin Infusions: Indications

- DKA/HHS; aggressive and intended to lower blood glucose rapidly
- Critical Illness with hyperglycemia; initiate infusion when BG:
 - ADA/AACE: BG >180 mg/dL
 - SCCM: BG >150 mg/dL

1. *Diabetes Care* 2016; 39 (Suppl. 1):S99-S104

2. Guidelines for the use of an insulin infusion for the management of hyperglycemia in critically ill patients.
Crit. Care Med 2012 Vol 40, No 12.



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DKA: Treatment

- Hydration
- Electrolytes
- Insulin
- Co-morbid conditions and/or precipitating factors



Fluids

- Normal saline initially, 1-2L in the first hour
- If (corrected) sodium is normal or elevated, use $\frac{1}{2}$ NS thereafter (+/- dextrose, +/- potassium)
 - Dextrose if BG <200
 - Potassium if K is 3.3-5.2
- Monitor
 - Electrolytes, q2h to start
 - Blood pressure
 - Urine output
 - Osmolality if renal or cardiac disease



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Electrolytes

- Potassium
 - <3.3 ; replace by IV before insulin
 - $3.3-5.2$; add 20-30mEq to IVF
- Bicarbonate, only for pH <6.9
 - 3 amps in 1L d5W until pH >7
- Phosphate
 - Treat if <1.0 mg/dL or if severe cardiac-pulmonary compromise



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Insulin Infusion

- Bolus of 0.1 Unit/kg
- Infusion at 0.1 unit/kg/hr
- (Alternatively, infuse at 0.15 units/kg, no bolus)
- Goal is to decrease BG 50-75/hr
- Evaluate hourly and adjust accordingly
- What about the diet?



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Diagnostic Work Up

- Urinalysis
- Complete Blood Count
- Electrolytes with calculated anion gap
 - $\text{Na} - (\text{Cl} + \text{CO}_2)$
 - Corrected Sodium
- Osmolality
 - Osmolar gap = $\text{Osm} - (2 \times \text{Na} + \text{BG}/18)$
- EKG
- Rule out infection
- Blood Gas (optional)



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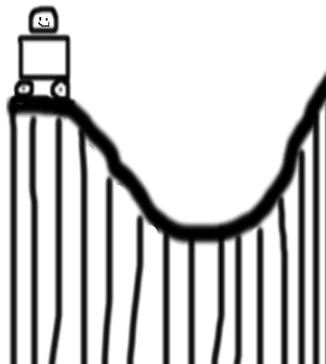
Insulin Infusions: Highs and Lows

Top Causes of Hyperglycemia in the ICU

- Insulin infusion protocol ineffective
- Poor utilization of protocol

Top Causes of Hypoglycemia in the ICU

- Insulin infusion protocol ineffective
- Not following insulin infusion protocol
- Carbohydrate mismatch



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Ingredients for Insulin Infusion Order Sets and Protocols

Table 2. Components of a Safe and Effective Insulin Infusion Protocol

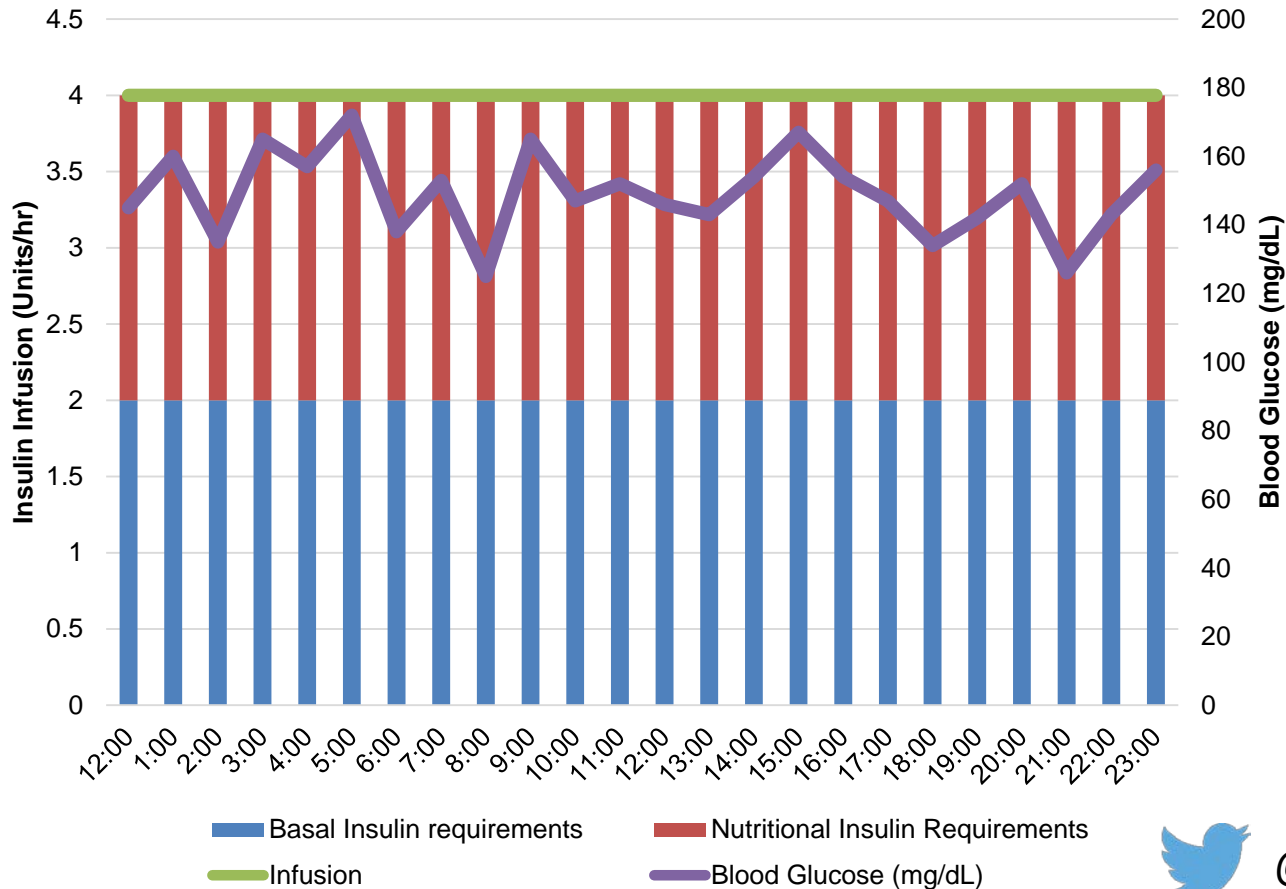
- Includes appropriate glycemic targets
- Identifies threshold for implementation
- Is nurse-managed and easy to implement
- Provides clear, specific directions for blood glucose monitoring and titration
- Includes titration based on both current blood glucose level and rate of change*
- Is safe: carries a low risk for hypoglycemia and includes an embedded protocol for treatment of hypoglycemia should it occur
- Is effective: gets patients to target quickly and maintains blood glucose within the target range with minimal titration
- Includes a plan for transition to subcutaneous insulin

**Rate of change is calculated based on the slope of the blood glucose trend line and is frequently incorporated into column-based protocols by movement to a more aggressive algorithm if blood glucose is not declining by ~ 40–75 mg/dl or to a less aggressive algorithm if blood glucose is declining too rapidly.*

Kelly J.L. Continuous insulin infusion: What, Where, and How? *Diabetes Spectrum*. 27;218-223, 2014

Patient Receiving TPN or Continuous Tube Feeds

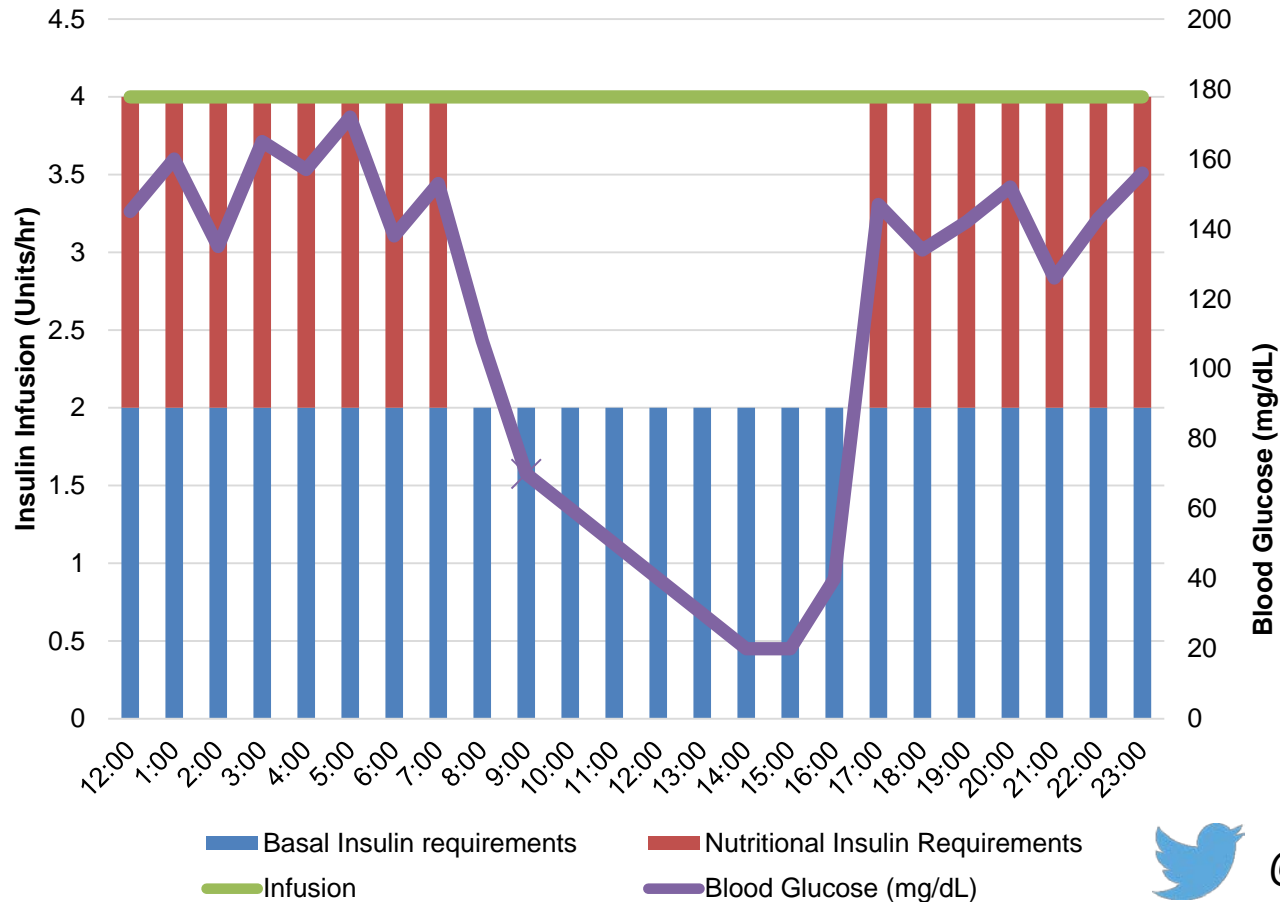
Matching Insulin and Intake



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An interruption in nutrition requires a response!

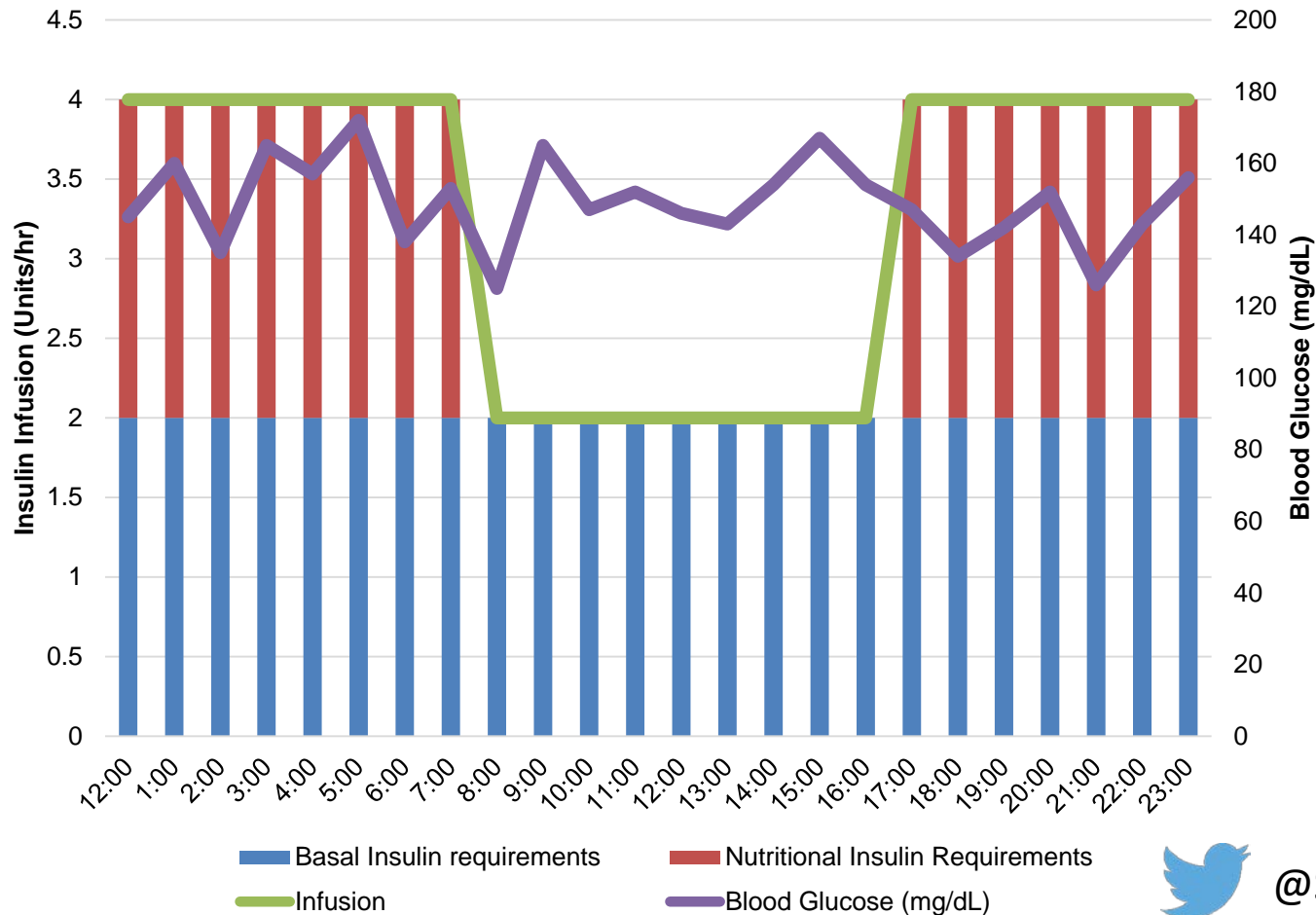
Mismatched Insulin and Intake



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Option 1: You can adjust the insulin

Adjust the Insulin

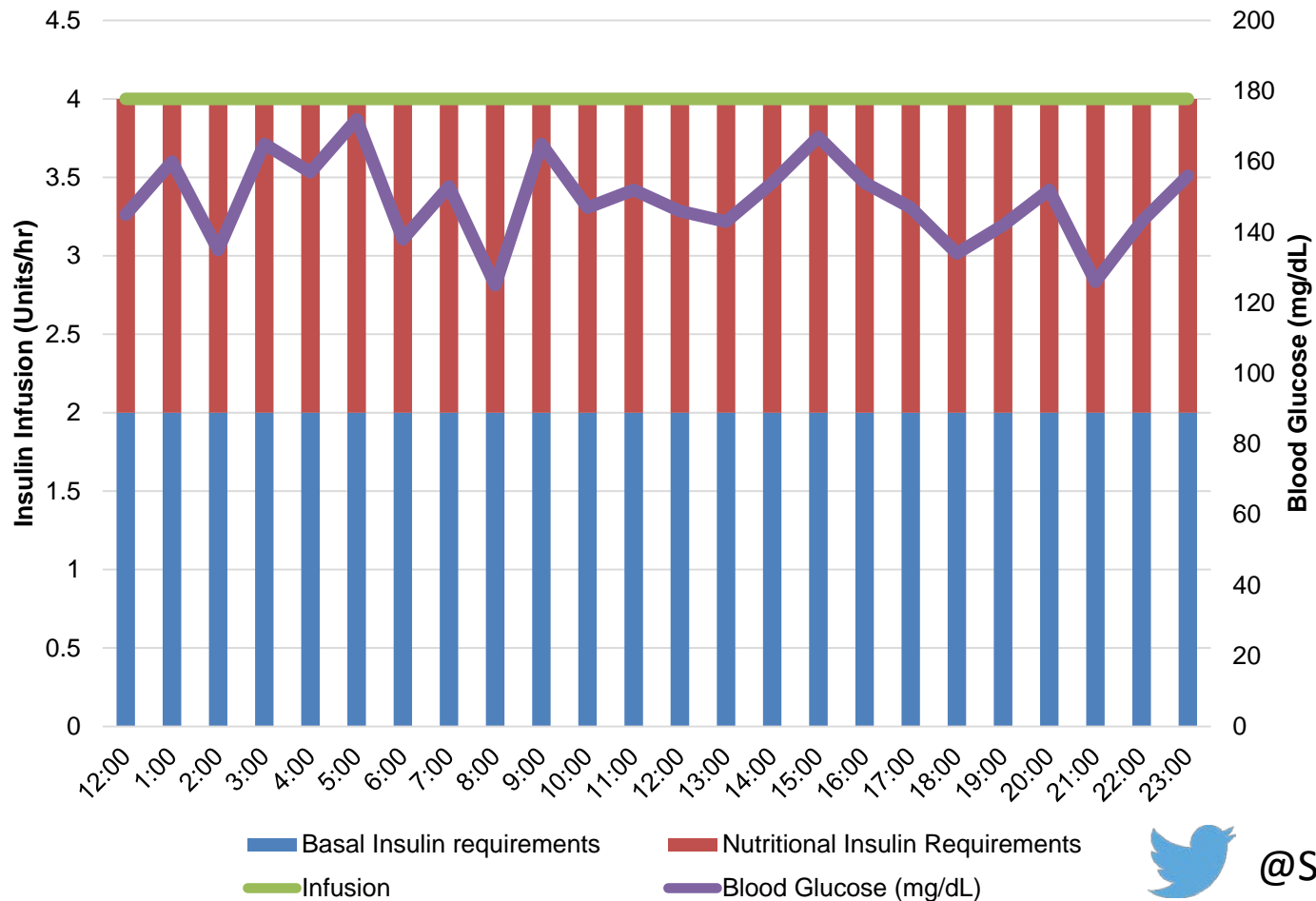


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Option 2: Start alternative dextrose source

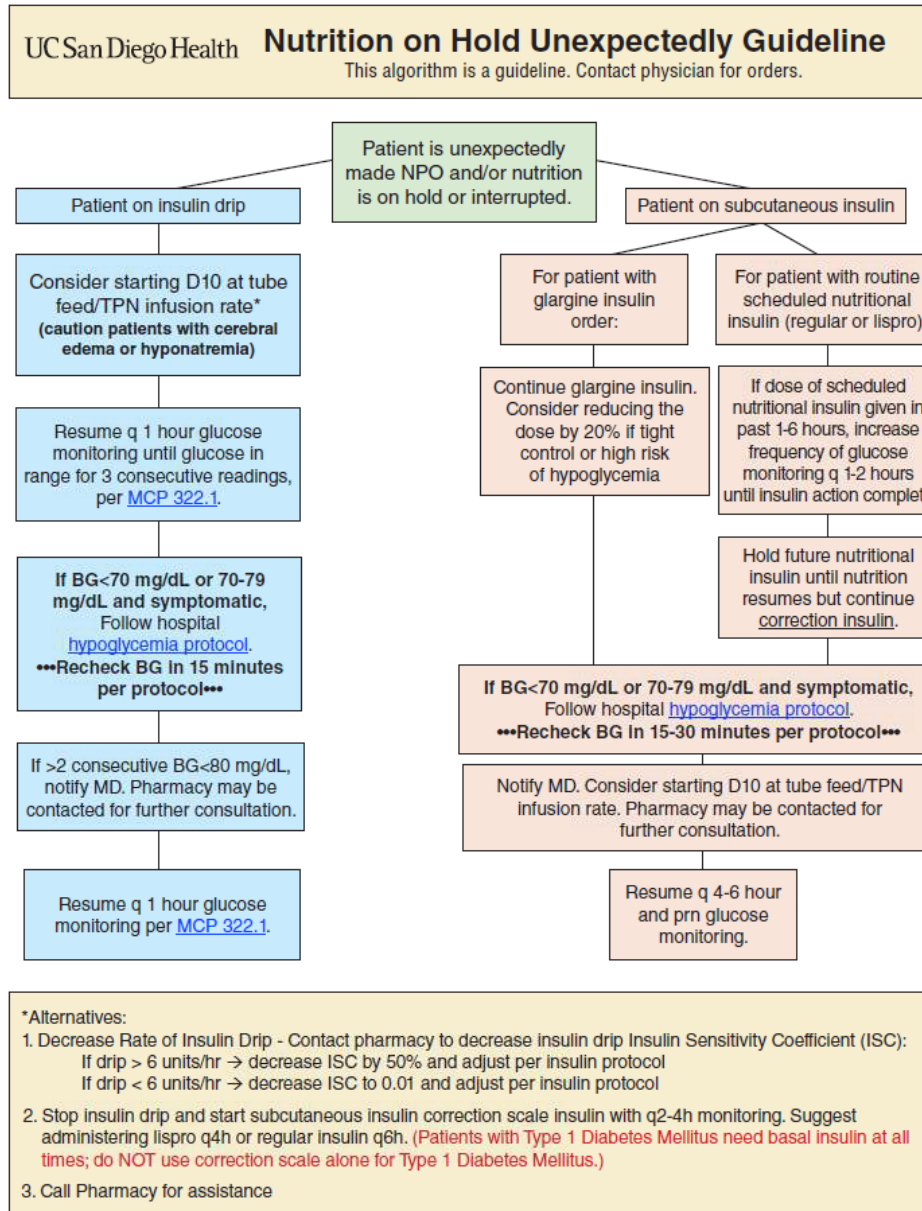
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Matching Insulin and Intake



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Have a plan



WD1119 (3-16)



Example of EMR Alert:

TF on hold + Insulin Adjustment

- Will appear for pt's with "0" charted for TF rate + "on insulin"

BestPractice Advisory - Sicu Test,Four

Hypoglycemic Risk!!
Hypoglycemic Risk
Patient is at risk for hypoglycemia since on insulin and tube feeds held.
Please refer to the insulin and nutrition on hold unexpectedly guidelines.

Acknowledge reason:  

[Open Nutrition on Hold Unexpectedly policy](#)

- Potential Problems
 - RNs don't consistently chart TF interruptions in I/O
 - Charting not always timely if at all



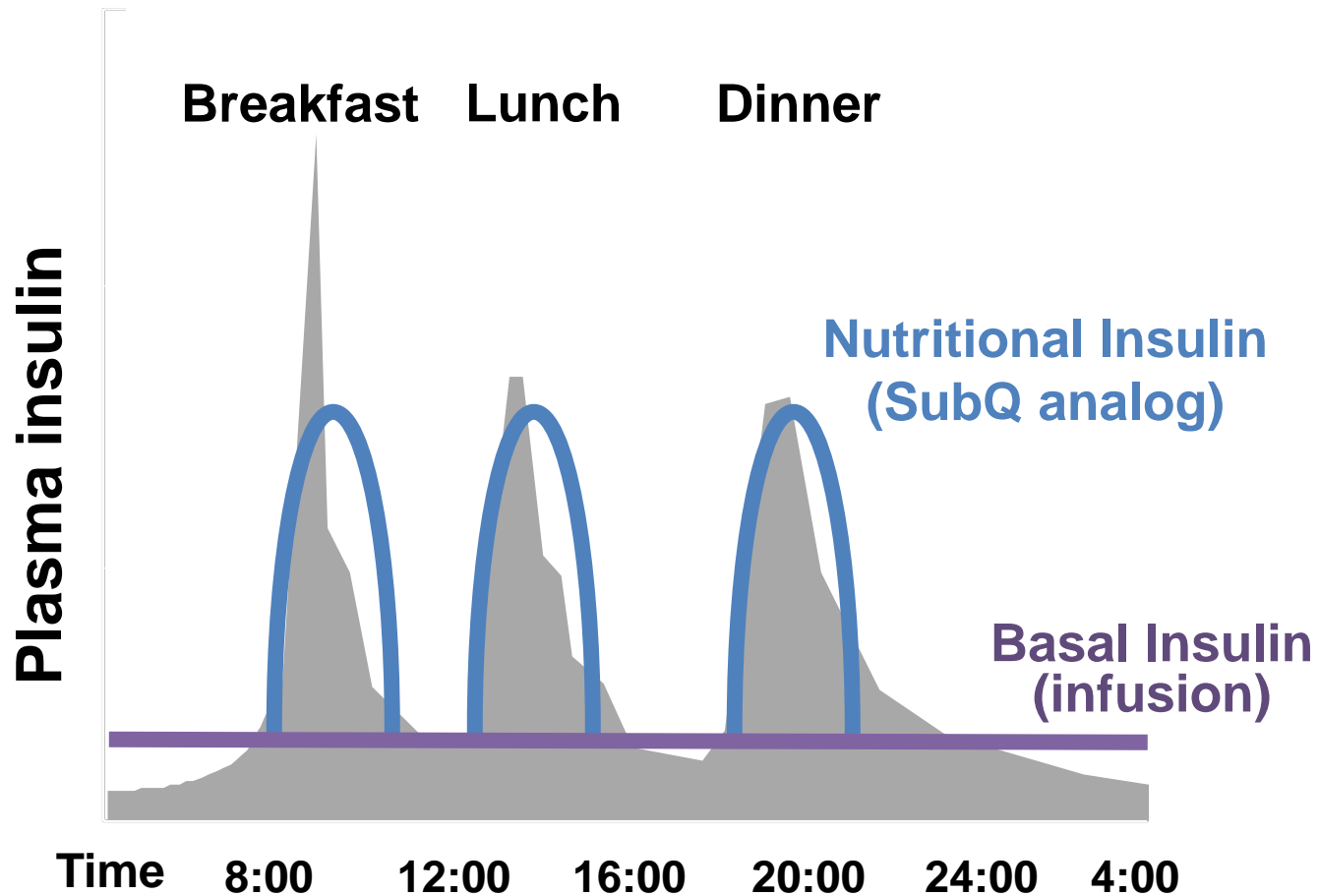
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Laminated pink
caution
sign has “Nutrition on
Hold
Unexpectedly
Algorithm”
On the back for quick
reference



Special Case:

Eating while receiving insulin infusion



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Insulin Concentration

- Prepare all insulin infusions in pharmacy
- Use one standard insulin concentration throughout the hospital if possible or confined to special patient populations e.g. PEDS, L&D
- Most common concentration recommended is 1 unit/mL

Some Approaches

	UCSD	VMMC	NYPH
Order Set (s)	Computer (EPIC)	Computer (Cerner)	Computer (Sunrise)
Protocol(s)	Computerized-web-based	Paper (3 sets)	Paper (2 sets)
BG Target	90-150 (ICU) 90-180 (Step-down) 120-200 (OR)	100-180	100-140 (eg SICU) And/or 140-180 (eg Neuro ICU)
Formula	BG value and rate of change	BG value and rate of change	BG value and rate of change

UCSD University of California San Diego
 VMMC Virginia Mason Medical
 NYPH New York Presbyterian Hospital

VMMC (Cerner EMR): 3 Insulin Infusion Order Sets

Component	Order Details												
IV FLUIDS													
Step 1: Resuscitation - Most patient with hyperglycemic crises have moderate to severe dehydration. Begin resuscitation with isotonic normal saline at 1L/hr up to four hours.													
<input type="checkbox"/> IV Fluid- Bolus, HOSP													
Step 2: Maintenance while blood glucose is >200 mg/dL.													
Supplement potassium in IV fluids if potassium is normal or low, but >= 3.3. If < 3.3, then replace potassium by IV prior to starting insulin therapy.													
<input type="checkbox"/> Sodium Chloride 0.9% 1000 mL + potassium chloride-additive 30 mEq	Rate: 150 mL/hr, Infuse Each bag over 6.7 hr, Volume: 1,000 mL, IV, Routine, Start: 02/08/2016 13:18												
Potassium supplementation not required if potassium >= 5.3													
<input type="checkbox"/> Sodium Chloride 0.9%	Rate: 150 mL/hr, Volume: 1,000 mL, IV, Routine												
Step 3: Maintenance fluid while blood glucose <= 200 mg/dL													
Use 0.9% normal saline for patients with a low corrected serum sodium													
<input type="checkbox"/> Dextrose 5% with 0.9% NaCl	Rate: 150 mL/hr, Volume: 1,000 mL, IV, Routine, Note: Begin when blood glucose <= 200 for patients with low serum sodium												
Use 0.45% normal saline for patients with a high or normal corrected serum sodium													
<input type="checkbox"/> Dextrose 5% with 0.45% NaCl	Rate: 150 mL/hr, Volume: 1,000 mL, IV, Routine, Note: Begin when blood glucose is <= 200 for patients with high or normal serum sodium												
MEDICATION(S)													
Pharmacy to Dose medication. Pharmacy will select initial bolus and infusion rate. RN to manage infusion titration per protocol. Contact Pharmacy at x67757 to communicate additional information that may alter standard dosing.													
<input checked="" type="checkbox"/> Pharmacy to Dose Med	Insulin Infusion - DKA/HHS Protocol, Indication: per DKA/HHS insulin protocol, Dose per Pharmacist, IV, Routine, Start 02/08/2016 13:19, Initiation												
<table border="1"> <thead> <tr> <th>Weight</th> <th>Bolus Dose</th> <th>Start Rate</th> </tr> </thead> <tbody> <tr> <td>>122.4 kg</td> <td>12.5 units</td> <td>12.5 units/hr</td> </tr> <tr> <td>117.5-122.4 kg</td> <td>12 units</td> <td>12 units/hr</td> </tr> <tr> <td>112.5-117.4 kg</td> <td>11.5 units</td> <td>11.5 units/hr</td> </tr> </tbody> </table>	Weight	Bolus Dose	Start Rate	>122.4 kg	12.5 units	12.5 units/hr	117.5-122.4 kg	12 units	12 units/hr	112.5-117.4 kg	11.5 units	11.5 units/hr	
Weight	Bolus Dose	Start Rate											
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117.5-122.4 kg	12 units	12 units/hr											
112.5-117.4 kg	11.5 units	11.5 units/hr											

Details for **Pharmacy to Dose Med**

Details
 Order Comments
 Diagnoses

+

*Pharmacist to Dose Med: **Insulin Infusion - DKA/HHS Protocol**

Dosage Form: **Insulin Infusion - DKA/HHS Protocol**
 PRN Reason: Insulin Infusion - Surgical Protocol
 Duration: levofoxacin
 Additional Instructions: linezolid, metronidazole, nafcillin, NO Sepsis Antibiotic(s) indicated, parenteral nutrition solution, phenytoin, piperillin/tazobactam, ranitidine

*Indication: per DKA/HHS insulin protocol
 *Route of Administration: IV
 Priority: Routine
 Duration Unit:
 For Insulin Infusion Only: Initiation

Dose: Dose per Pharmacist
 PRN: Yes No
 *Requested Start Date/Time: 02/08/2016 13:19
 Stop Date/Time: **/**

No Results Found

UCSD (Epic EMR): Insulin Infusion Order set

Order Sets

▼ IP/ED GEN Intravenous Insulin Infusion Therapy

Add Order

▼ Patient Care

▶ Patient Care Orders

2 of 2 selected

Glucose (POC)

Routine, EVERY HOUR First occurrence Today at 1400 Until Specified
Check fingerstick glucose hourly per computer protocol. May check glucose every 2 hours if 3 consecutive blood sugars are within the protocol target range.

Nursing Misc Order: Please page pharmacist with insulin computer protocol questions.

Routine, ONGOING starting Today at 1345 Until Specified
Specify: Please page pharmacist with insulin computer protocol questions.

▼ Medications

▶ Insulin Infusion

1 of 1 selected

Insulin Infusion

insulin regular (HUMULIN,NOVOLIN) 100 Units in sodium chloride 0.9 % 100 mL infusion
IntraVENOUS, CONTINUOUS starting Today at 1400 Until Discontinued
Infuse per insulin computer protocol

And

insulin regular (HUMULIN,NOVOLIN) IV/bolus from bag 1-15 Units
1-15 Units, IntraVENOUS, ONCE PRN, 1 dose starting Today at 1331 Until Discontinued, Per insulin computer protocol
Bolus dose per insulin computer protocol. Do NOT administer a bolus dose upon initiation of the insulin infusion if a separately ordered bolus dose of insulin was administered within the last two hours.

▶ Fingerstick Glucose Orders for Hypoglycemia Protocol

1 of 1 selected

Glucose (POC)

Routine, PRN starting Today at 1331 Until Specified
Test blood glucose within 15 to 30 minutes of the initial glucose test showing blood glucose < 70 mg/dL with or without symptoms OR glucose < 80 mg/dL with symptoms (e.g., shakiness, diaphoresis, confusion, irritability). If blood glucose is still below 80 mg/dL after treatment, RE-TREAT and check blood glucose again in 15 to 30 minutes. Continue to check blood glucose every 15 to 30 minutes until the glucose is greater than or equal to 80 mg/dL for TWO consecutive values.



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UCSD: Insulin Infusion Calculator (web-based, lives outside of EPIC)

- RNs utilize the **Insulin Computer Calculator** per UCSD protocol
 - **Log-in** to the secure web-based insulin computer protocol site
 - **Select** the patient's unit and patient
 - **Enter** the blood glucose levels as directed
 - **Add comments** (as needed) where indicated

UNIVERSITY of CALIFORNIA
MEDICAL CENTER

Select your Unit:

Select a unit...

- BICU
- BIMU
- CCU
- ED
- FNIP

Login to the Insulin Computer Calculator

The UCSD Medical Center's insulin infusion calculator is a dynamic model designed to provide a safe and effective dosing system for insulin. This program is not intended to replace the sound clinical judgment of the user in the care of patients. If the user does not agree with the recommendation of this tool, please immediately contact physician for further orders.

By logging into this program the user acknowledges and agrees to the terms and conditions above.

Use your Active Directory login:

Username:

Password:

(Use your Outlook or Weboutlook password)

Enter Blood Glucose Levels

Follow this [link](#) to select a new patient for *ICU

PID	Unit	First Name	Last Name	DOB	MRN
798110	*ICU	Patrick	Oshea	11/21/1924	2284963

[View 24 hr report for this patient](#)

Enter Blood Glucose Level

Current Blood Glucose Level:

Re-enter Current Blood Glucose Level:

UCSD: Insulin Infusion Calculator (web-based, lives outside of EPIC)

- Computer program provides recommendation for bolus and rate on initiation and then recommendations for hourly adjustment of infusion rate per hourly BG checks thereafter.

Blood Glucose to Achieve (90 - 150 mg/dL)

Bolus with 5.4 units
Adjust Insulin Infusion Rate to 3.6 units/hr

[View 24 hr report for this patient](#)

PID	Unit	First Name	Last Name
798110	*ICU	Patrick	Oshea

CURRENT RESULTS
Current Glucose: 241



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NYPH Critical Care Drips

Requested By: Me Other: Source: [Allergy Details](#)

Date: - - Time:

Session
Type: Reason:

Searching for ...

Order	Cost
 Insulin DRIP 100 Unit/100ml	\$12.02/vial
INSULIN, SHORT-ACTING. Do NOT confuse with HumaLOG	
 Insulin Drip Adult ICU Goal BG 100-140 (NOT DKA/HHS)	
 Insulin Drip Adult ICU Goal BG 140-180 (NOT DKA/HHS)	



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Criteria for Transition to SubQ Insulin

<u>DKA</u>	<u>HHS</u>	<u>Hyperglycemia in CC</u>
BG <200	BG <300	Resolution critical illness
Two of the following: Gap <12 Bicarbonate >15 pH >7.3	Normal osmolality	Off vasopressors
	Normal mentation	Stable infusion rate for ~6hrs

Transition to SubQ

- Overlap IV and SubQ by two hours
- Know the home regimen and whether or not it was adequate.
- Formula
 - Average rate method
 - Weight based dosing
 - Individualize...



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Transition to SubQ Insulin



- Step 1
 - Is patient ready for transition from IV to SubQ insulin?
 - Critical illness resolved? Off pressors?
 - DKA/HHS resolved?
 - Rate stable for ~ 6hrs?



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Transition to SubQ Insulin (Cont.)

- Step 2
 - Does patient have history of DM? A1C?
 - No DM and A1C <6.0% --> correction scale only
 - Yes DM or A1C >6.0% --> basal bolus regimen



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Transition to SubQ Insulin (Cont.)

- Step 3
 - Use 80% of the lowest of the following to determine TDD:
 - the dose administered over the last 12 hours multiplied by 2
 - the dose administered over the last 24 hours
 - Use average hourly rate over the last 6 hrs (if stable) and multiply by 20 (80%)
 - Weight



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Transition to SubQ Insulin (Cont.)

- Step 4
 - Determine if TDD = basal or basal + nutritional
 - If basal dose only, then dose can be doubled and divided accordingly when nutrition added
 - If basal + nutritional, then give 50% as basal and 50% as bolus
- Give basal insulin dose and turn off insulin drip 2 hrs later



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(This protocol applies only to patients on an insulin drip for >24 hours. Physician to make a clinical judgment on all others.)

Step 1: Is the patient ready for transition?

Patient meets following criteria:

- Pt is not critically ill or requiring vasopressors
- Blood glucose in target range all of last 6 hours

No



Continue Insulin Drip

Yes



Step 2: Does patient need scheduled subcutaneous insulin?

No:

- Patients with no history of diabetes AND HbA1C < 6.0%

Yes:

- All patients with DM 1
- Patients with DM 2 and insulin drip rate > 1.0 unit/hour
- Patients with HbA1C > 6.0%

No



Transition to
Correction Scale Only

Yes



Step 3: Calculate Total Daily Dose Insulin Requirement (call Pharmacy to use insulin calculator transition and/or use equation below)

Average the rate of insulin infusion over the previous 6 hours and multiply this number by 20. (24 is not used for safety reasons.)

(avg drip rate) _____ units/hr x 20 = _____ (calculated insulin)



Step 4: Evaluate patient nutrition while on drip to determine insulin distribution

Full nutrition: Pt is *currently* eating >50% of their meals, on goal tube feeds, goal TPN or receiving Dextrose IVF > 50mL/hr

Minimal nutrition: Pt is *currently* NPO, taking <50% of their meals, is on a zero carbohydrate clear liquid diet, or 6 hours used in Step 3 calculation is period of fasting (i.e. overnight).



Full Nutrition: calculated insulin = TDD

1. Give 50% of the TDD as basal insulin ordered as Lantus (glargine) once daily to be administered 2 hours before stopping the insulin infusion .
2. Give 50% of the TDD as nutritional insulin divided TID if tolerating meals (Lispro) or Q6 hours if on continuous tube feeds (Regular) using CPOE orderset.
3. Order appropriate correction scale once drip is discontinued using CPOE orderset.

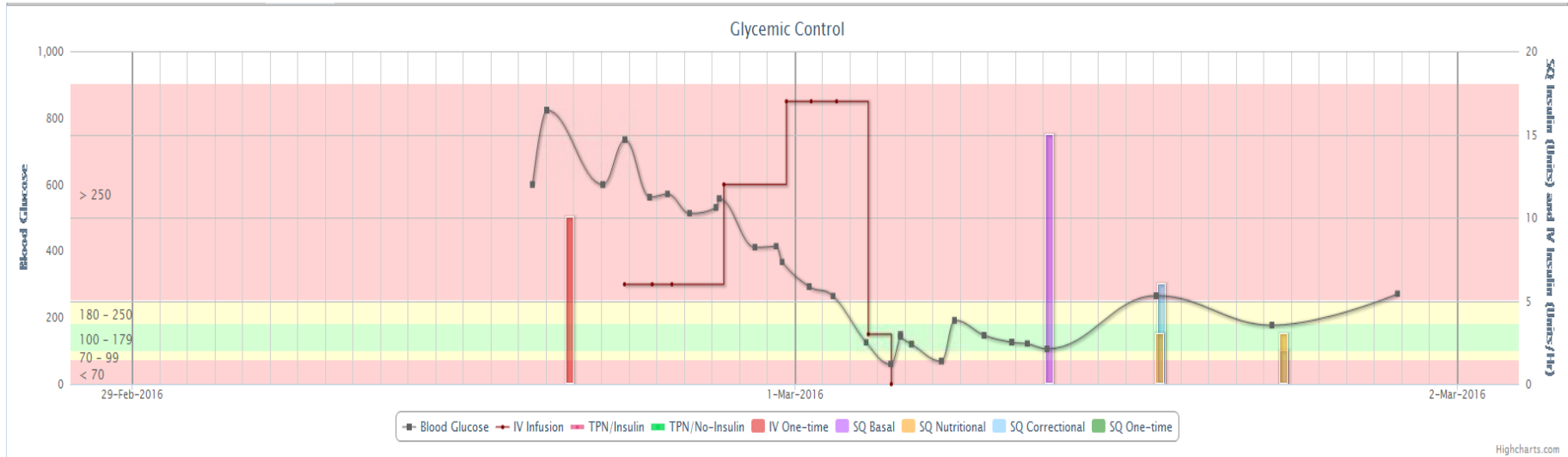


Minimal Nutrition: calculated insulin = BASAL insulin

1. Give 100% of calculated insulin as basal insulin ordered as Lantus (glargine) once daily to be administered 2 hours before stopping the insulin infusion.
2. Add nutritional insulin when clinically indicated.
3. Order appropriate correction scale once drip is discontinued using CPOE orderset.

Address all questions to ICU Pharmacist or Endocrine/Diabetes pager HC 290-4320, LJ 290-5272.

Example of hardwired transition algorithm at VMCC



Daily Dose Summary -- Patient Weight: 62.4 kg

Date	Min BG (Goal 100 - 180)	Max BG (Goal 100 - 180)	IV	TPN	Basal	Nutritional	Correctional	SQ One-time	Total Daily Dose (TDD)	% SQ Basal (Goal 50-70%)	% Correctional (Goal 0%)	SQ Basal Units/kg (Goal 0.15-0.25)
02/27/2016	n/a	n/a	0	0	0	0	0	0	<24hrs			
02/28/2016	n/a	n/a	0	0	0	0	0	0	0			0.00
02/29/2016	366	823	64	0	0	0	0	0	<24hrs			

IV to Subcutaneous Transition Tool

Diagnosis: (Dropdown menu: -- Select Diagnosis --, Diabetes Type 1, Diabetes Type 2)

Infusion Goal: (Dropdown menu)

Nutritional Status: (Dropdown menu)

Post-Transition: (Dropdown menu)

Risk Adjustment: Apply

Avg Rate (6hr):

Est TOD:

Diagnosis: Hyperglycemia NOS

Diabetes Diagnosis:



Common Pitfalls



- No overlap between infusion & subcutaneous insulin
- Premature transition, difficult to determine a stable rate
- Mismatch between insulin infusion & nutritional status on infusion and at transition
 - Interruptions of tube feeds/TPN
 - Unclear whether or not infusion used to meet nutritional needs



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Key Points

- Insulin infusion protocols (IIPs) indicated for:
 - DKA/HHS
 - Critically ill patients BG >180 mg/dL
- DKA Treatment: Focus on hydration, electrolytes, insulin, and precipitating factors
- Safe & effective IIPs: clear, concise, BG direction & rate of change and hypoglycemia management & prevention
- Transition from IIP to subcutaneous regimen is complex and involves a delicate balance of art & science



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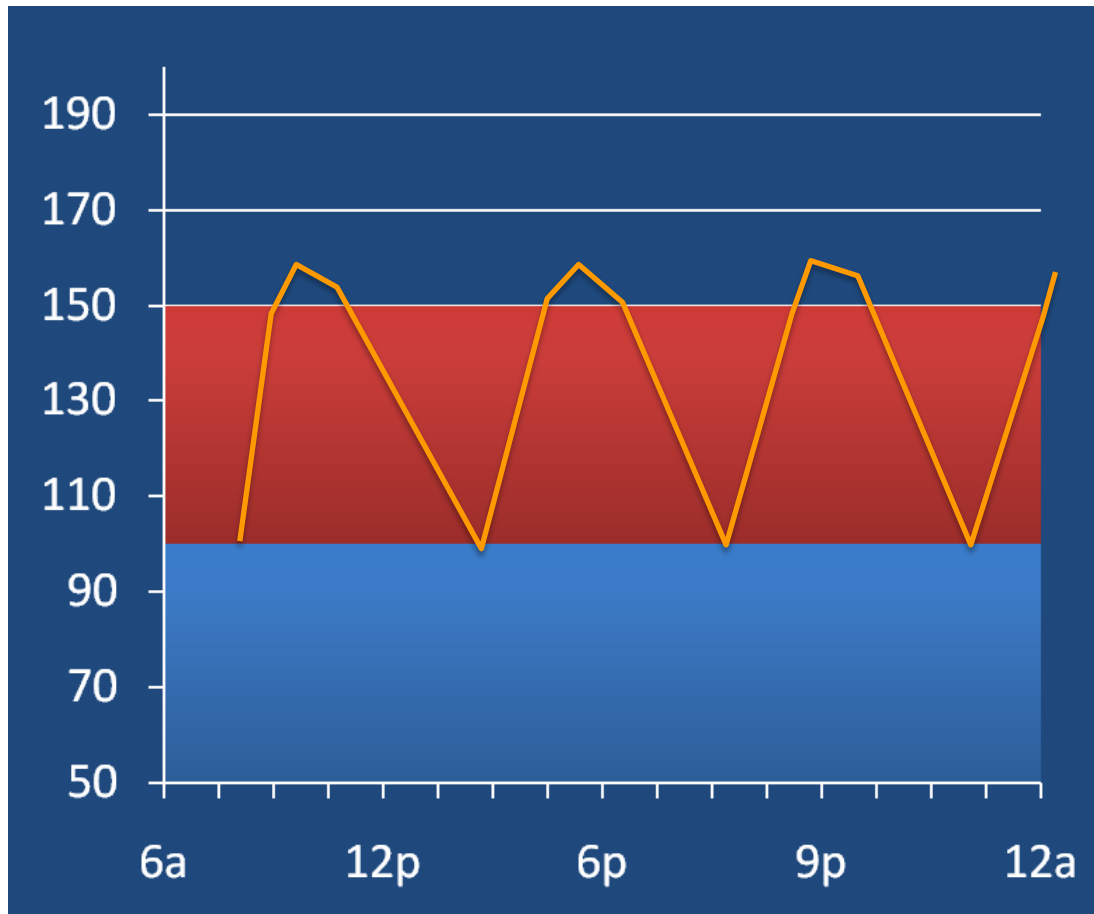
Special Situations

- Continuous Nutrition
 - Tube feeds
 - TPN
- Steroids
- Perioperative BG Control



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Patient receiving continuous TF or TPN



Continuous nutrition coverage options:

- Analog q4hr
- Regular q6hr
- Intermediate q12hr
- Long acting q12-24hr



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Tube Feedings and TPN

- “Super Nutrition”
- Often requires higher ratio of nutritional insulin compared to basal given continuous delivery of high levels of carbohydrates
- Can be as much as 40:60, 30:70 or even 20:80 ratio of basal:nutrition



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Tube Feeding and TPN: Insulin Strategies

- Several options to cover *nutritional* component
 - Rapid acting q4hr
 - Regular q6hr
 - Intermediate (NPH) q12hr
 - Long acting q12-24hr
 - For TPN- regular insulin can be added to TPN
- Choice should be uniform across institution
- Indication and holding parameters should be included in every nutritional insulin order so RN knows when to give and when to hold
- Increase basal insulin carefully in case nutrition is interrupted

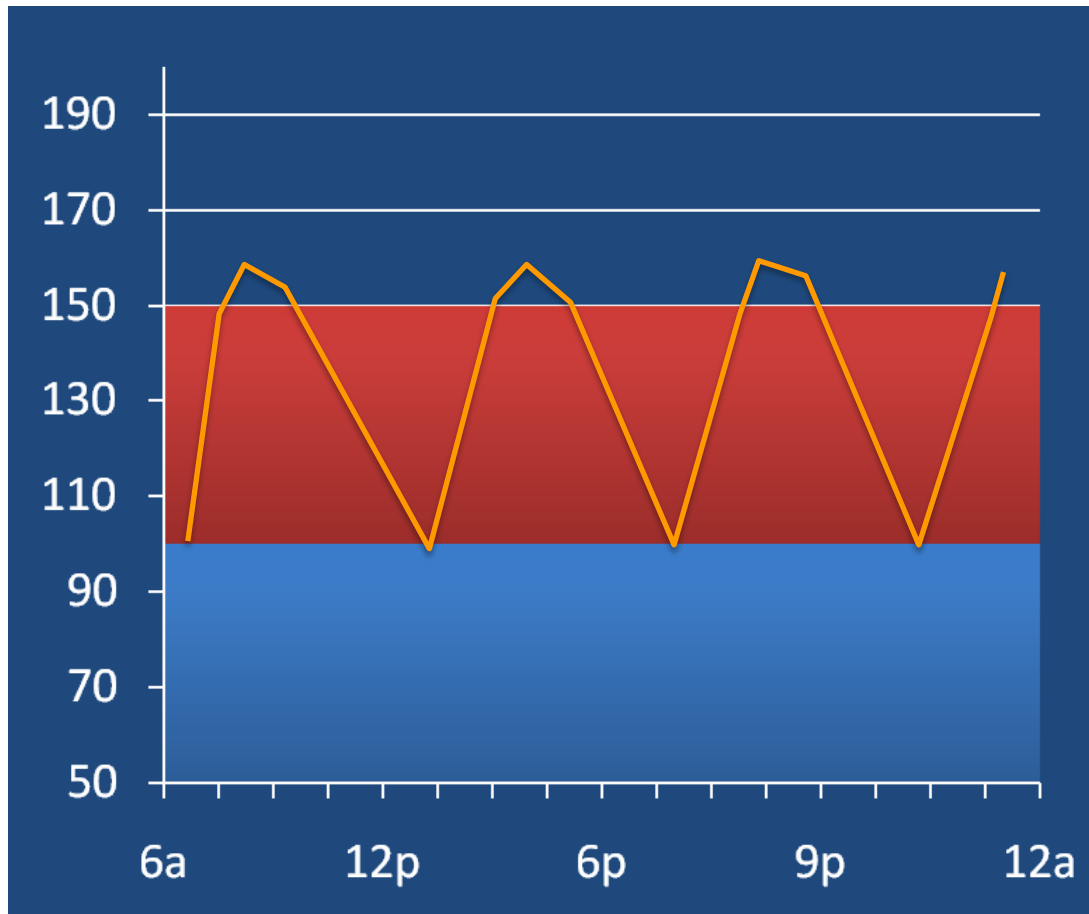


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Interruption in Nutrition

- Unexpected
 - Pt on continuous TF pulls out NG tube
 - Middle of the night?
 - 1 hour after nutritional insulin given?
 - 5 hours after nutritional insulin given?
- Expected
 - Pt on continuous TF going to Radiology
 - 1 hr for CT?
 - 6 hrs for procedure?
- **HAVE A PLAN & AN Order!!**  @SHMLive

Patient receiving continuous TF or TPN



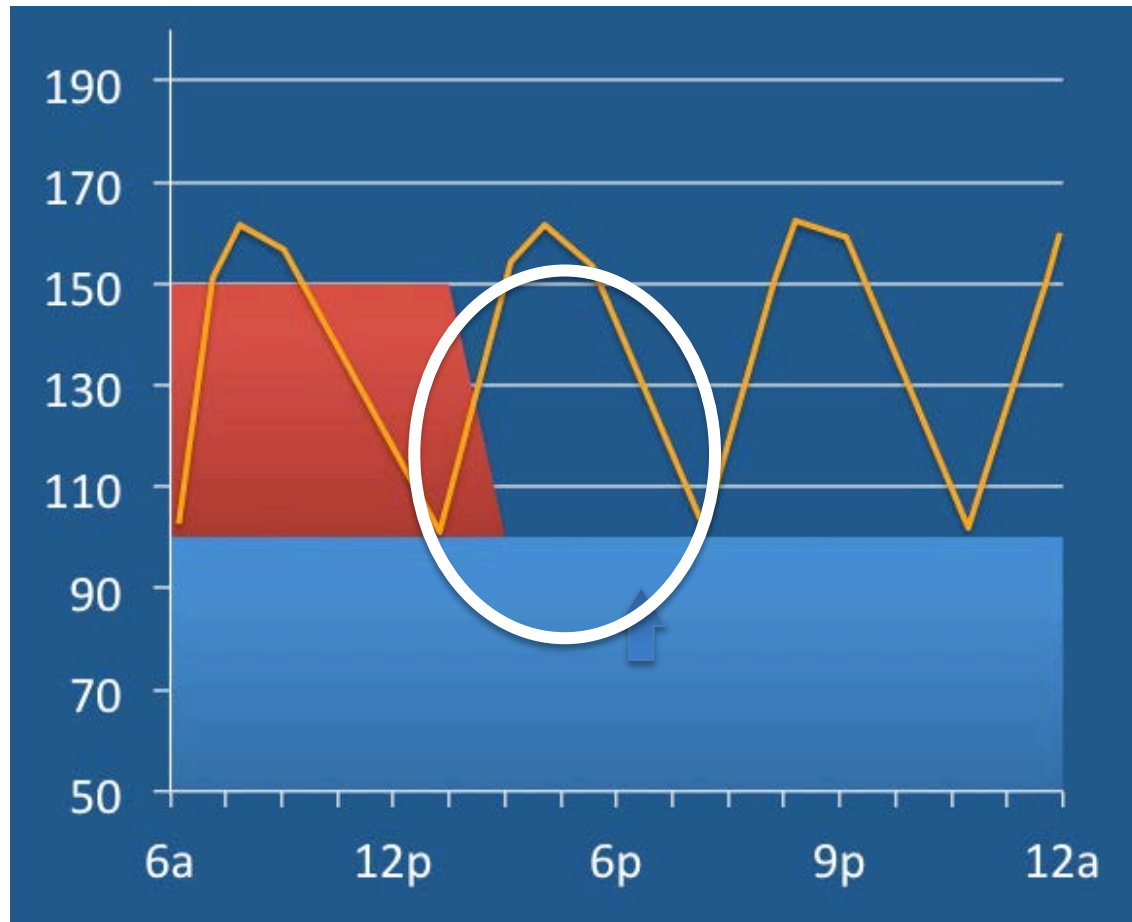
Continuous nutrition coverage options:

- Rapid acting q4hr
- Regular q6hr
- Intermediate q12hr
- Long acting q12-24hr



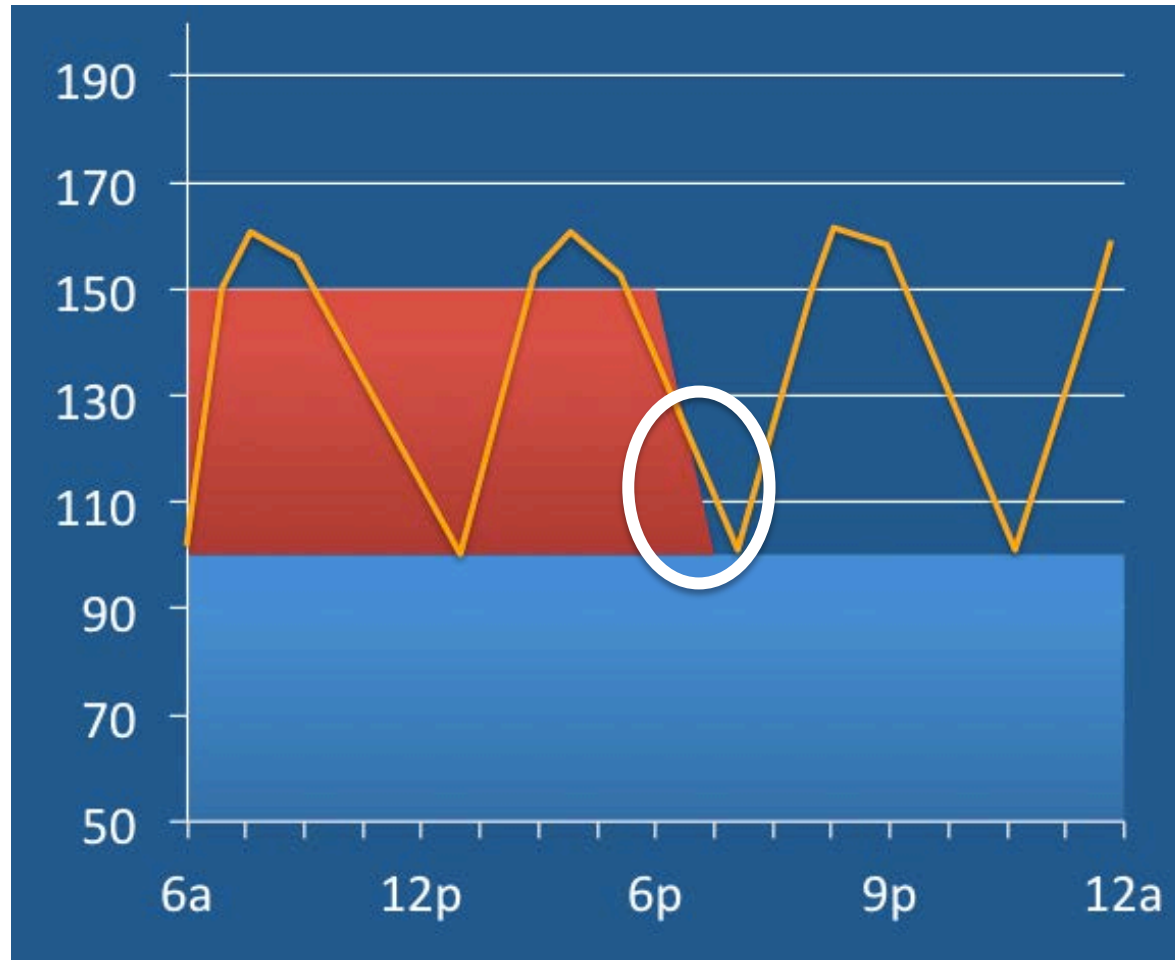
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1 Hour After Nutritional Insulin Given



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5 Hours After Nutritional Insulin Given



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Steroids

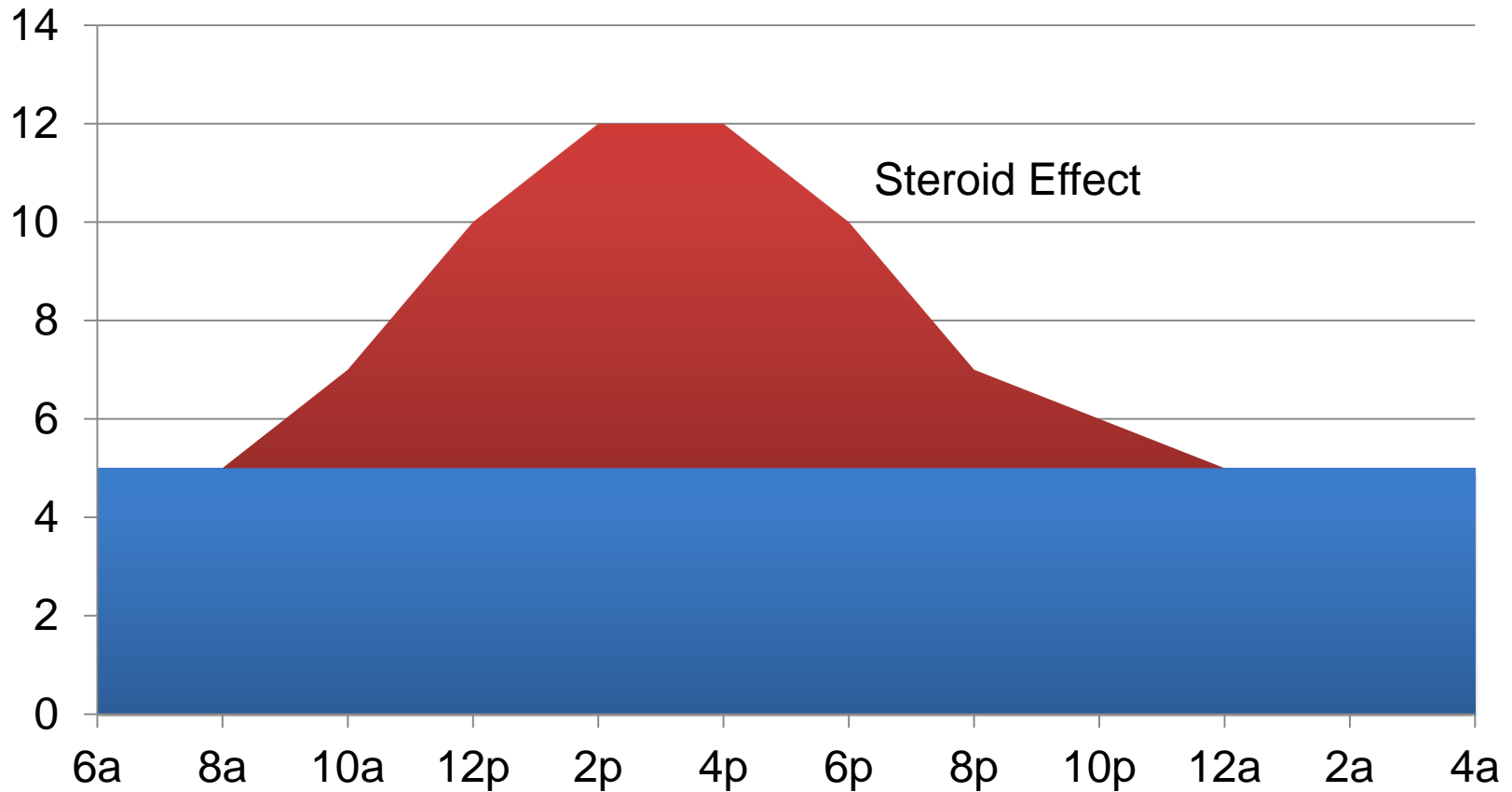


- Steroids commonly prescribed in hospital
 - COPD & asthma exacerbations
 - Transplant patients
 - Anti-emetic for chemotherapy
 - Post-operatively, e.g. orthopedics
- Steroids cause general insulin resistance w/ much less effect on gluconeogenesis
- Glucose elevation predominantly postprandial hyperglycemia, relative lack of fasting hyperglycemia



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8am Once Daily Steroid Dosing



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Relative Potencies of Systemic Glucocorticoids

<i>CORTICOSTEROID</i>	<i>ACTIVITY</i>	<i>RELATIVE POTENCY</i>	<i>EQUIVALENT DOSE (MG)</i>
Dexamethasone	Long-acting	25	0.75
Prednisone	Intermediate-acting	4	5.0
Methylprednisolone	Intermediate-acting	5	4.0
Hydrocortisone	Short-acting	1.0	20.0

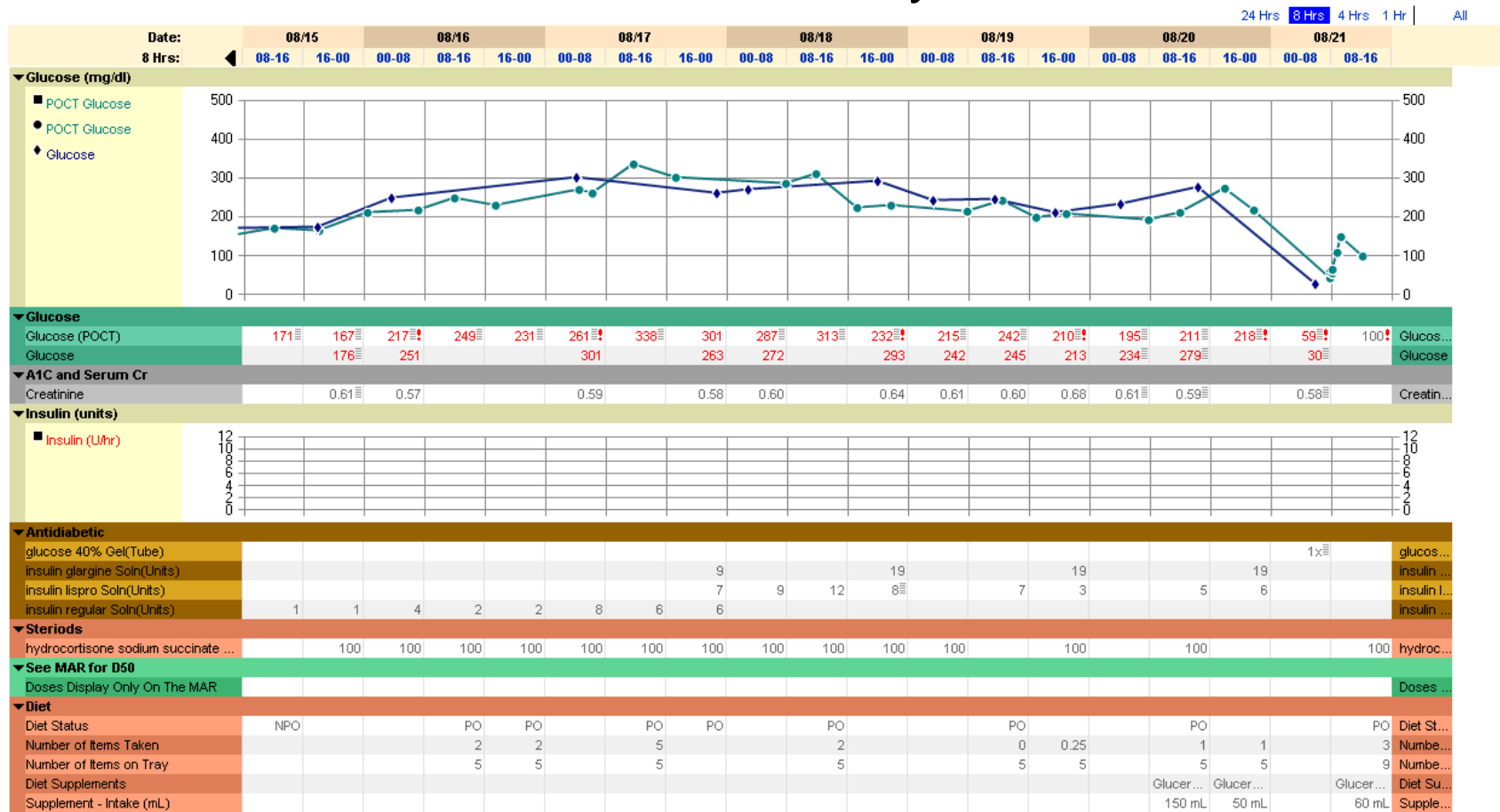
Equivalent Physiologic Replacement Doses:

- Dexamethasone: 0.8-1.2 mg
- Prednisone: 5-7.5 mg
- Hydrocortisone: 20-30 mg

Treatment of Steroid Induced Hyperglycemia

- Insulin dosing depends on frequency/timing of steroid administration (eg once daily, BID, TID, QID)
- Treatment may consists of :
 - Large doses of rapid-acting pre meal +/- basal insulin
 - OR
 - NPH alone or in addition to usual basal + bolus regimen
- Avoid significant increases in basal insulin with once daily steroid dosing, as overnight hypoglycemia may occur
- Insulin doses should be adjusted in concert with steroid dose changes

Basal heavy regimen to cover BID-QID steroids when steroid tapered to *once daily* → significantly increases risk of hypos...
 Titrate insulin simultaneously with steroids!!



Tapering Steroids

- Decrease nutritional insulin dose and/or NPH dose as you taper steroids
- Be sure to adjust basal insulin dose if dose was increased to cover BID-QID dosed steroids



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Perioperative Glycemic Control

- Perioperative hyperglycemia associated with worse outcomes
 - Malglycemia causes oxidative stress
 - Increased risk of inflammation & infection
 - Increased risk of thrombosis
- Association between hyperglycemia in postop period & adverse outcomes, e.g. infections, arrhythmias and renal impairment
- Published studies show interventions to improve glycemic control reduces risk of complications

Akhtar Anesth Analg 2010, *Diabetes Care* 2009

Whitcomb et al. (2005), Freire et al. (2005), Zerr KJ, et al. (1997)

Standards of Care

- A1c value should be obtained preoperatively for those with diabetes or diabetes risk factors, with appropriate adjustment in the outpatient regimen prior to surgery.
- Use intravenous insulin infusions in patients with type 1 or type 2 diabetes treated with insulin and undergoing major surgical procedures, with target glucose between 120 and 180 mg/dL.
- Administer subcutaneous correction dose insulin or an intravenous insulin infusion during minor or short surgical procedures, with target glucose between 140 and 180 mg/dL, and monitoring every 1 – 2 hours, depending on insulin used and type of surgery.



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Standards of Care (Cont.)

- Anesthesiologist and OR team should make sure that:
 - Glucose levels are monitored at least every hour for patients on infusion.
 - If using insulin during surgery, potassium levels are measured every 4 to 6 hours during surgery
 - Glucose is measured in the recovery room immediately after surgery

Source: AACE / ADA guidelines for Perioperative Care: American College of Physicians (PIER): Society for Ambulatory Anesthesia Guidelines on Perioperative Management of the Adult Patient with Diabetes.



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Thank you!

- Questions...?



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