

Inpatient Management of Diabetes Mellitus

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Disclosure

- Jessica Garza does not have any actual or potential conflicts of interest in relation to this presentation.

Objectives

- Review treatment recommendations for inpatient glycemic control.
- Create a glycemic treatment plan for an diabetic inpatient.

Patient Case

- 56 y/o female with type 2 diabetes (T2DM) is admitted to the medical-surgical unit for treatment of community acquired pneumonia.
- Home medications: metformin and glipizide
- Prior HbA1c: 8.5%

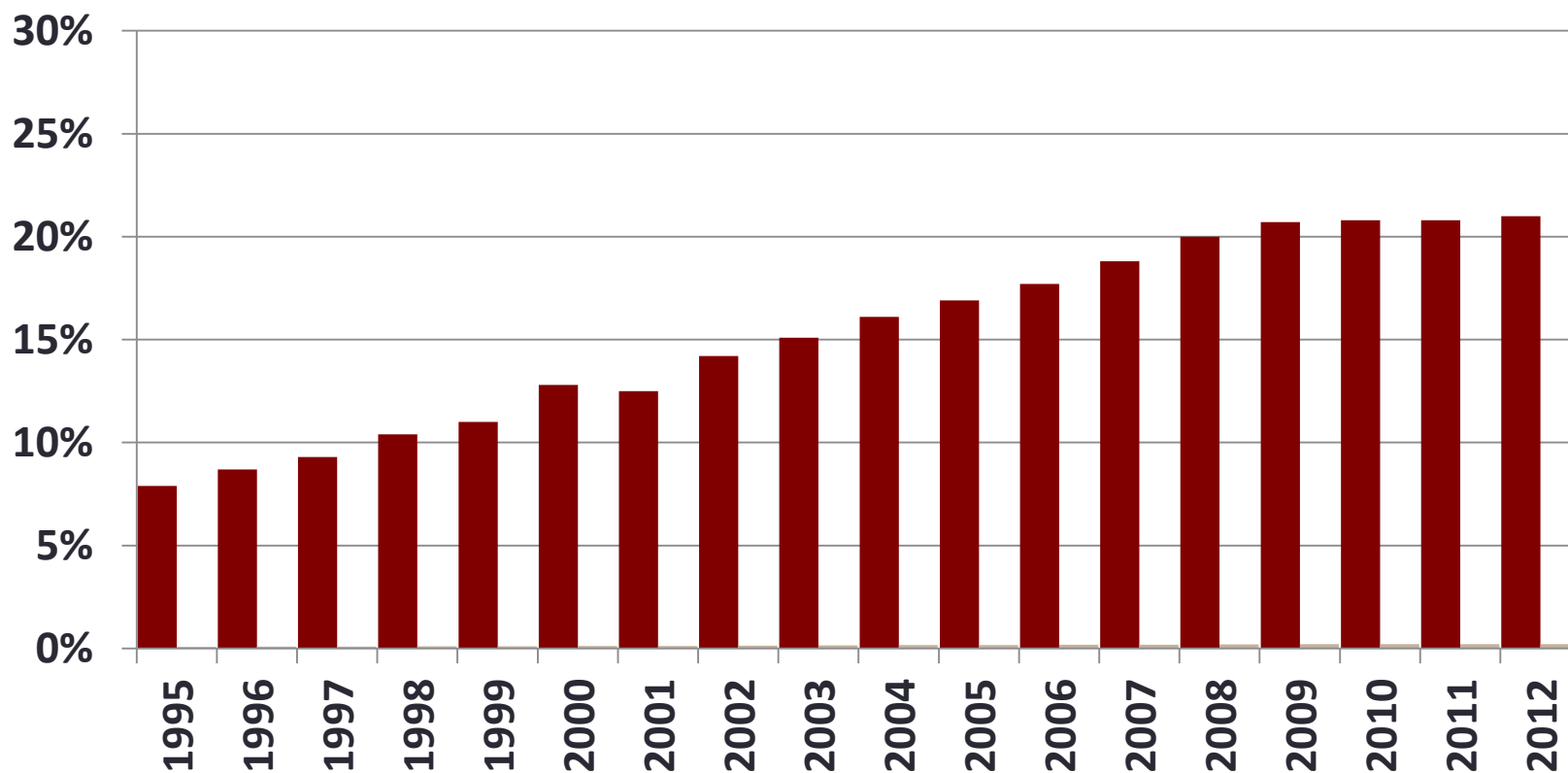
Questions to Consider:

1. *What is this patient's glycemic target while hospitalized?*
2. *What should we do with this patient's home medications?*
3. *Should insulin therapy be initiated?*

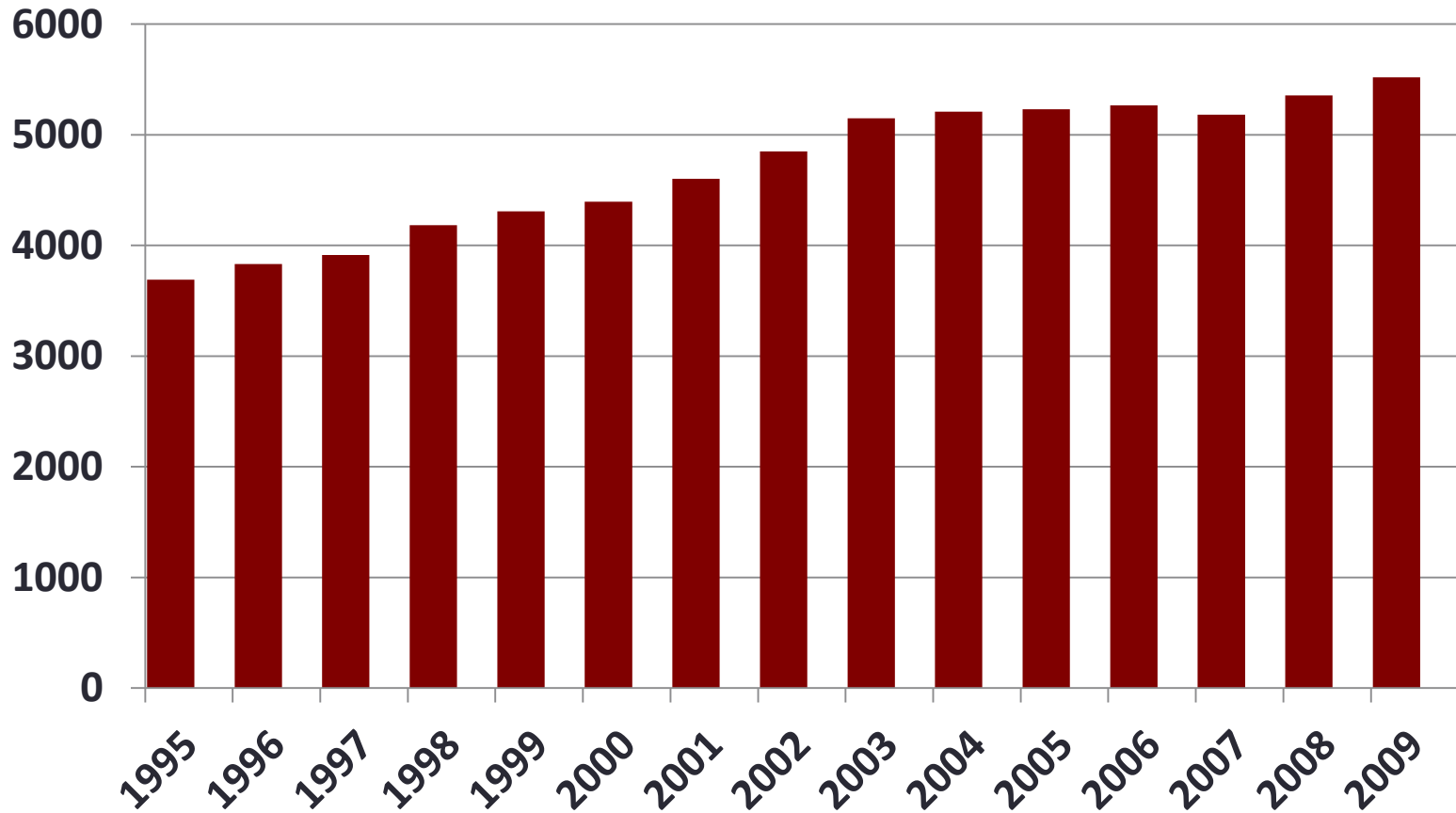
Diabetes

- In 2010, diabetes was the 2nd leading cause of hospitalization.
- Diabetes is the leading cause of blindness and end stage renal disease in the United States.
- In 2012, \$245 billion U.S. dollars were associated with diabetes management and complications.

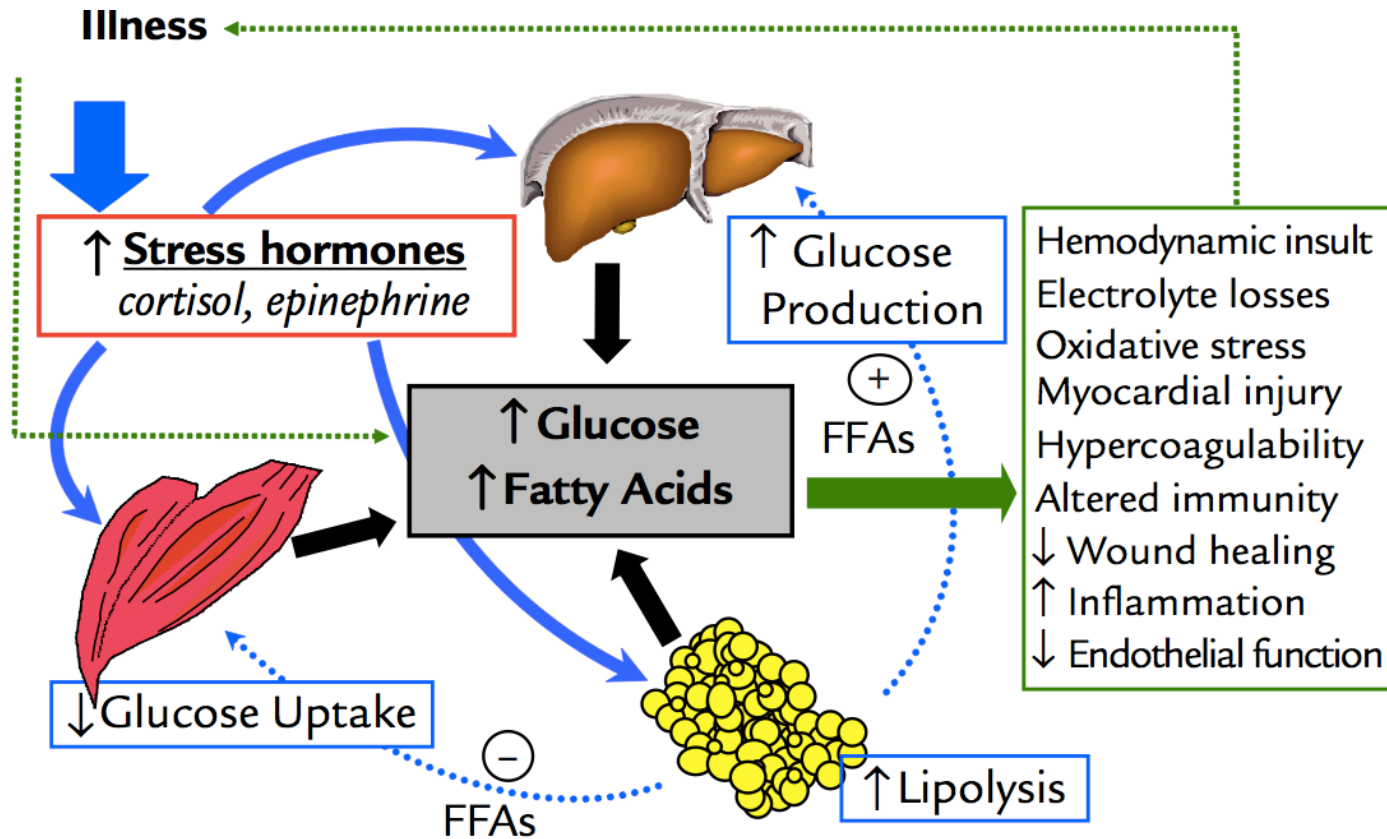
Prevalence of Diabetes



Hospitalizations with Diabetes as any Diagnosis



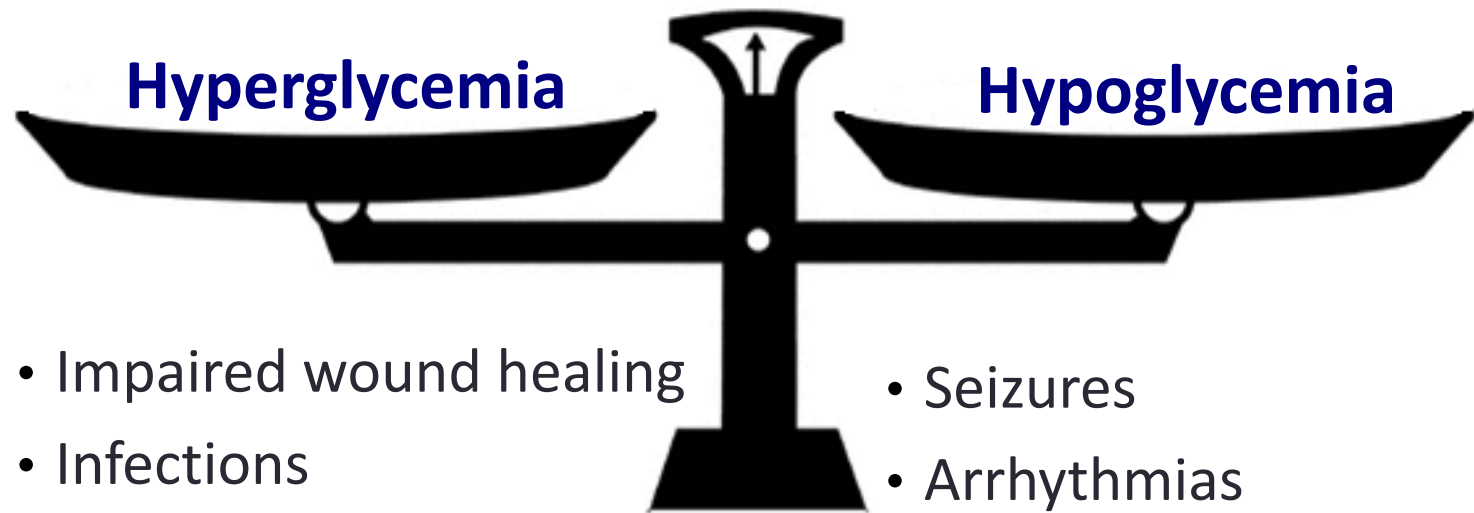
Acute Illness and Hyperglycemia



Stress hyperglycemia may also exacerbate illness.

Medication Precipitators of Hyperglycemia

- Glucocorticoids
- Octreotide
- Vasopressors
- Parenteral/enteral nutrition
- Dextrose containing large volume parenterals



- Impaired wound healing
- Infections
- Hyperglycemic crisis
- Other associations:
 - Increased LOS, complications, transfer to ICU, cost

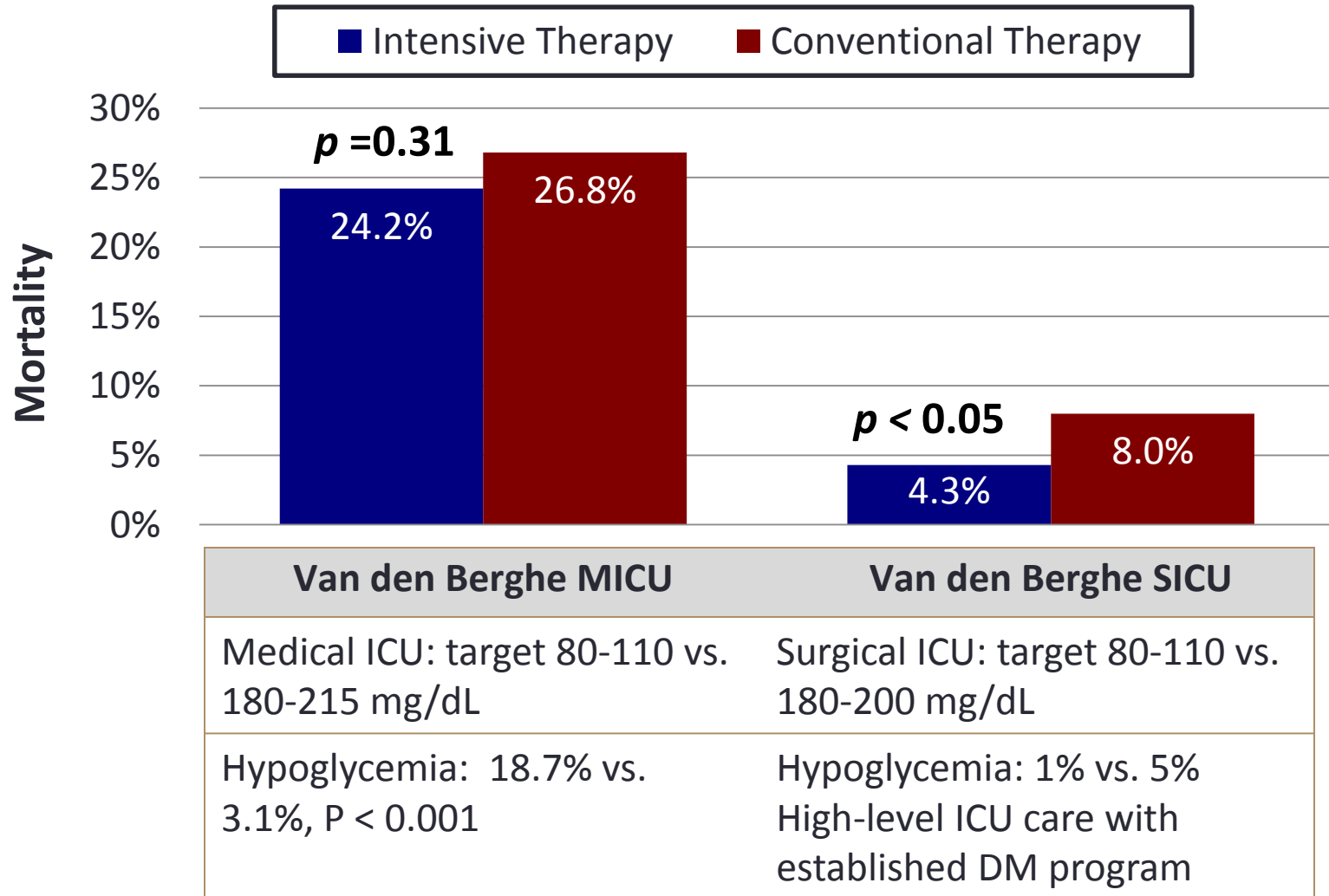
- Seizures
- Arrhythmias
- Confusion
- Coma
- Death

Inpatient Diabetes Management

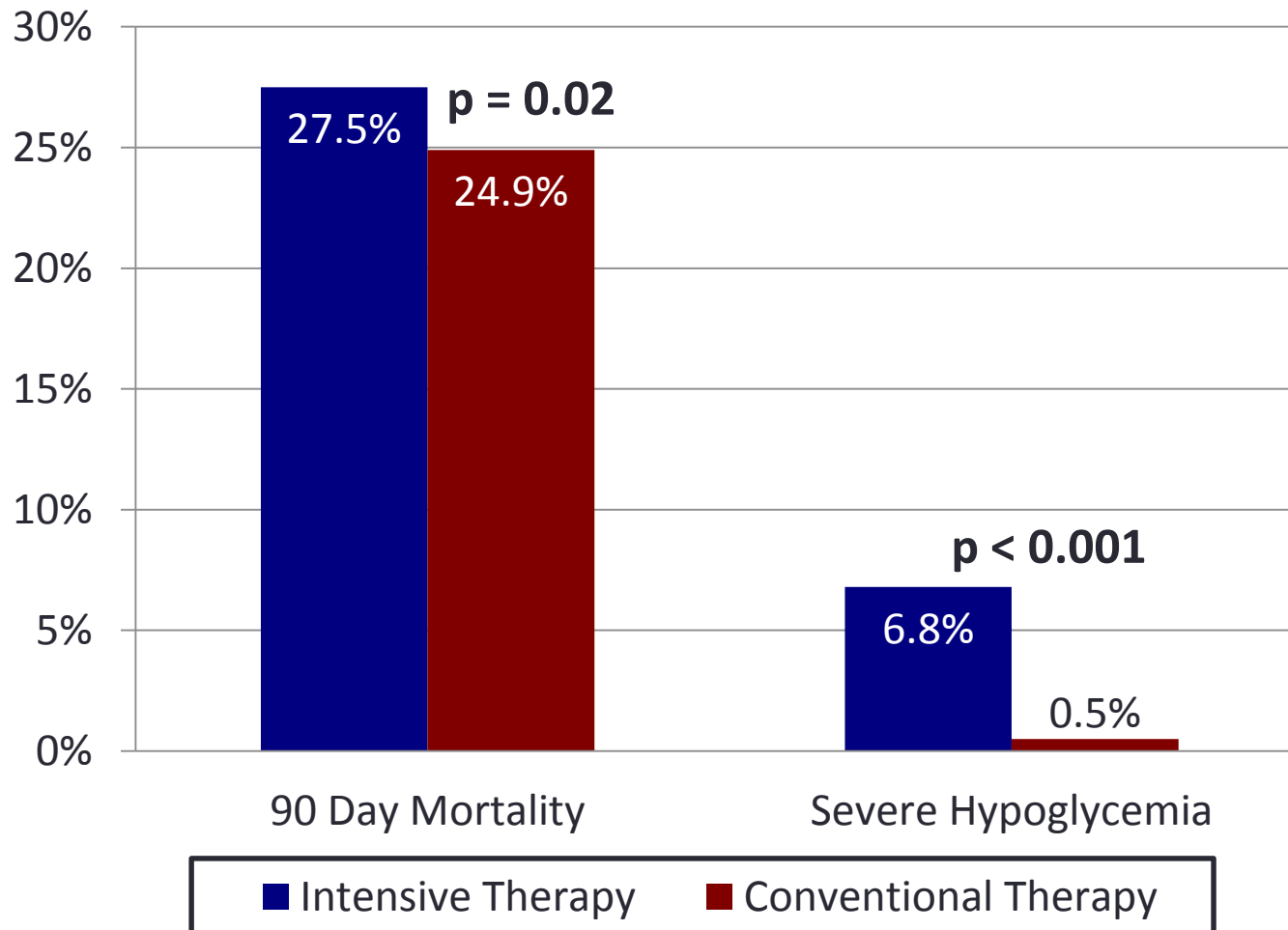
- Hyperglycemia is common in hospitalized patients with or without history of diabetes
- Controversial: Hyperglycemia is a marker of poor outcomes OR patients with hyperglycemia are more critically ill
- Improved glycemic control has shown improved clinical outcomes in the hospital

Glucose Control In Critical Care

Intensive vs. Conventional Insulin

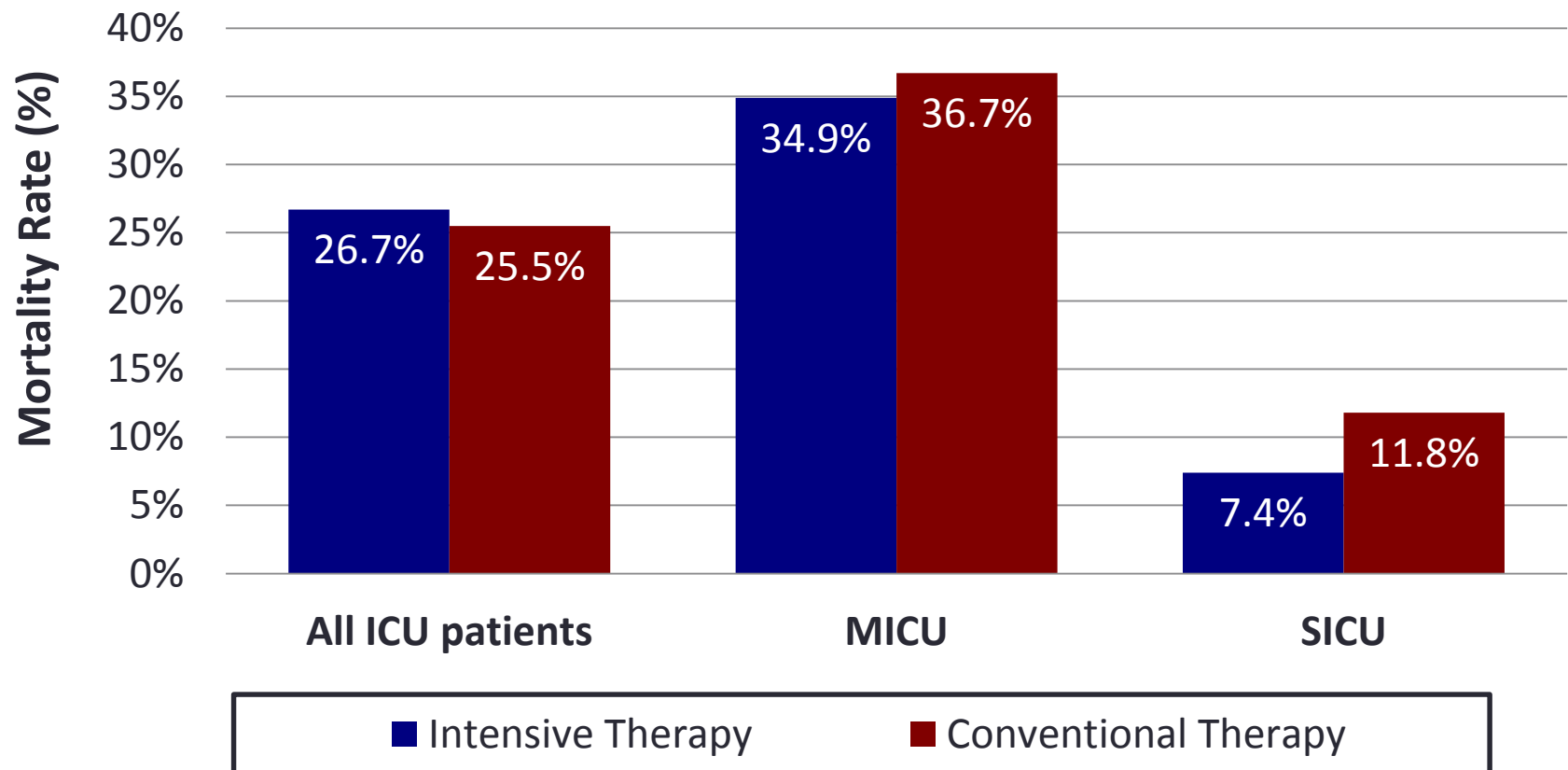


NICE-SUGAR: Intensive vs. Conventional Glycemic Control



Intensive vs. Conventional Insulin

Meta-Analysis: Griesdale, et al

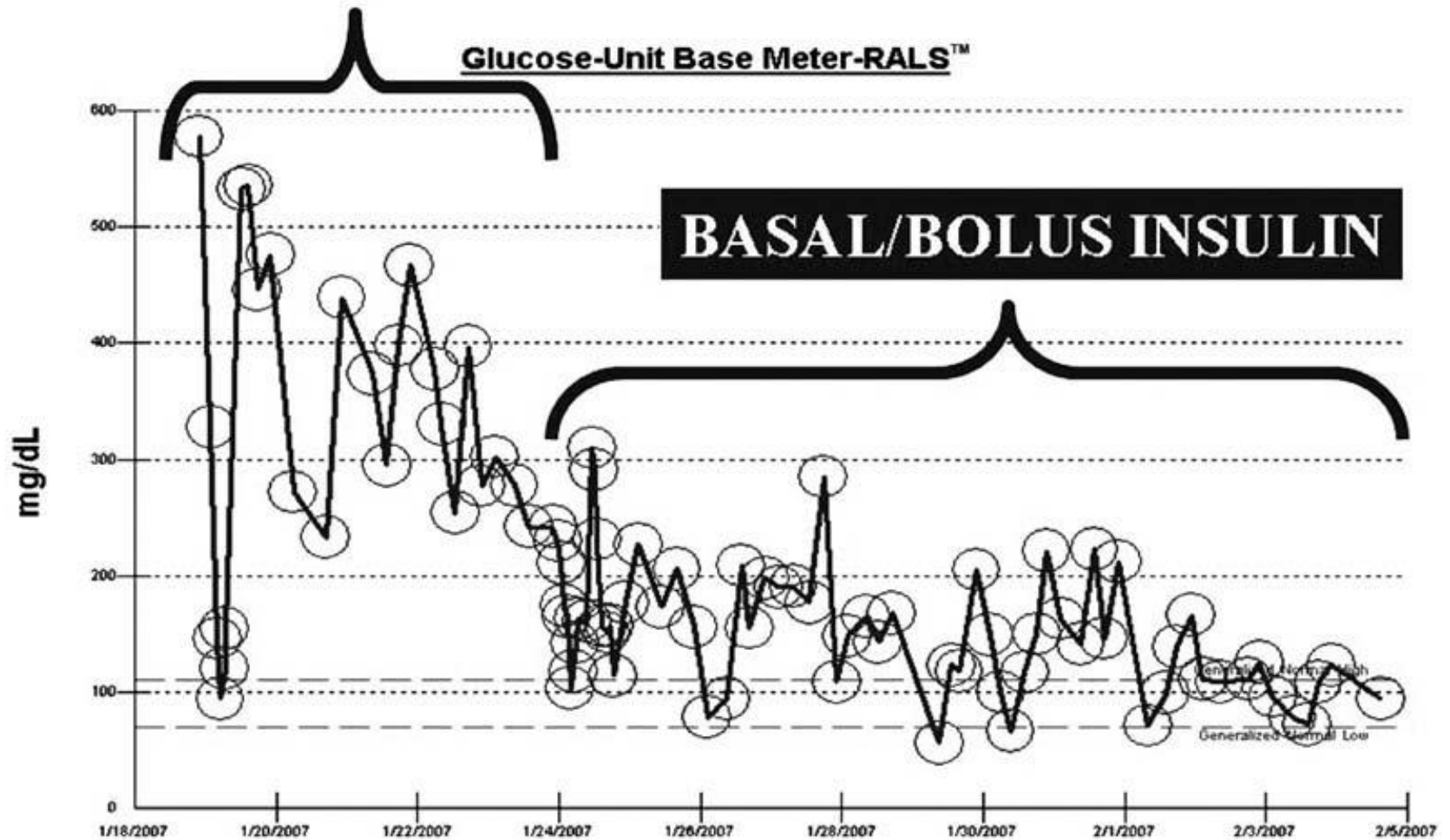


ICU Glycemic Targets Summary

- Inpatient hyperglycemia is associated with poor clinical outcomes
- AACE/ADA recommended glycemic goals:
 - Threshold for starting insulin: **180 mg/dL**
 - Maintain blood glucose: **140-180mg/dL**
 - No longer recommend blood glucose < 110 mg/dL

Glucose Control in Medical-Surgical Units

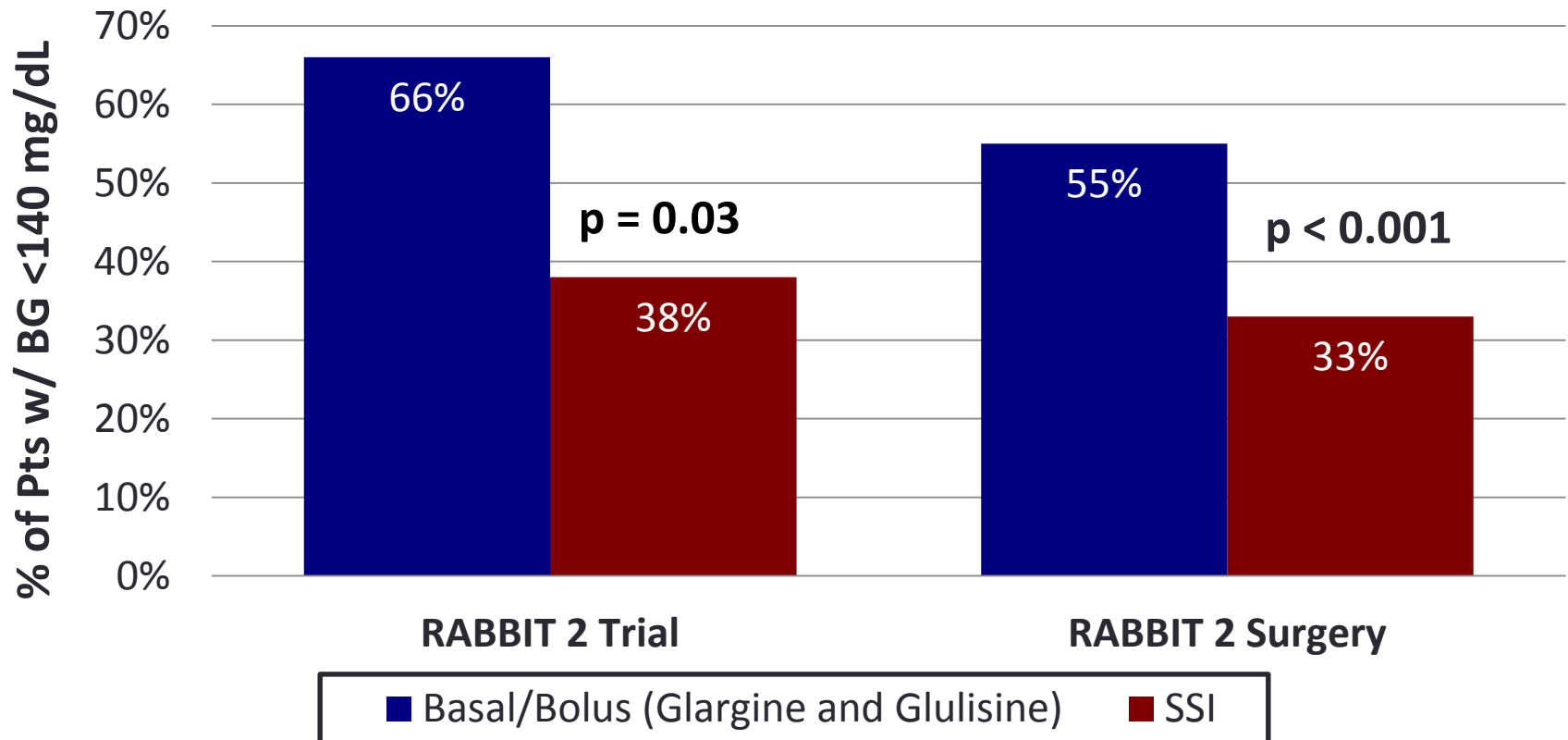
SLIDING SCALE ONLY



RALS = Remote Automated Laboratory System.

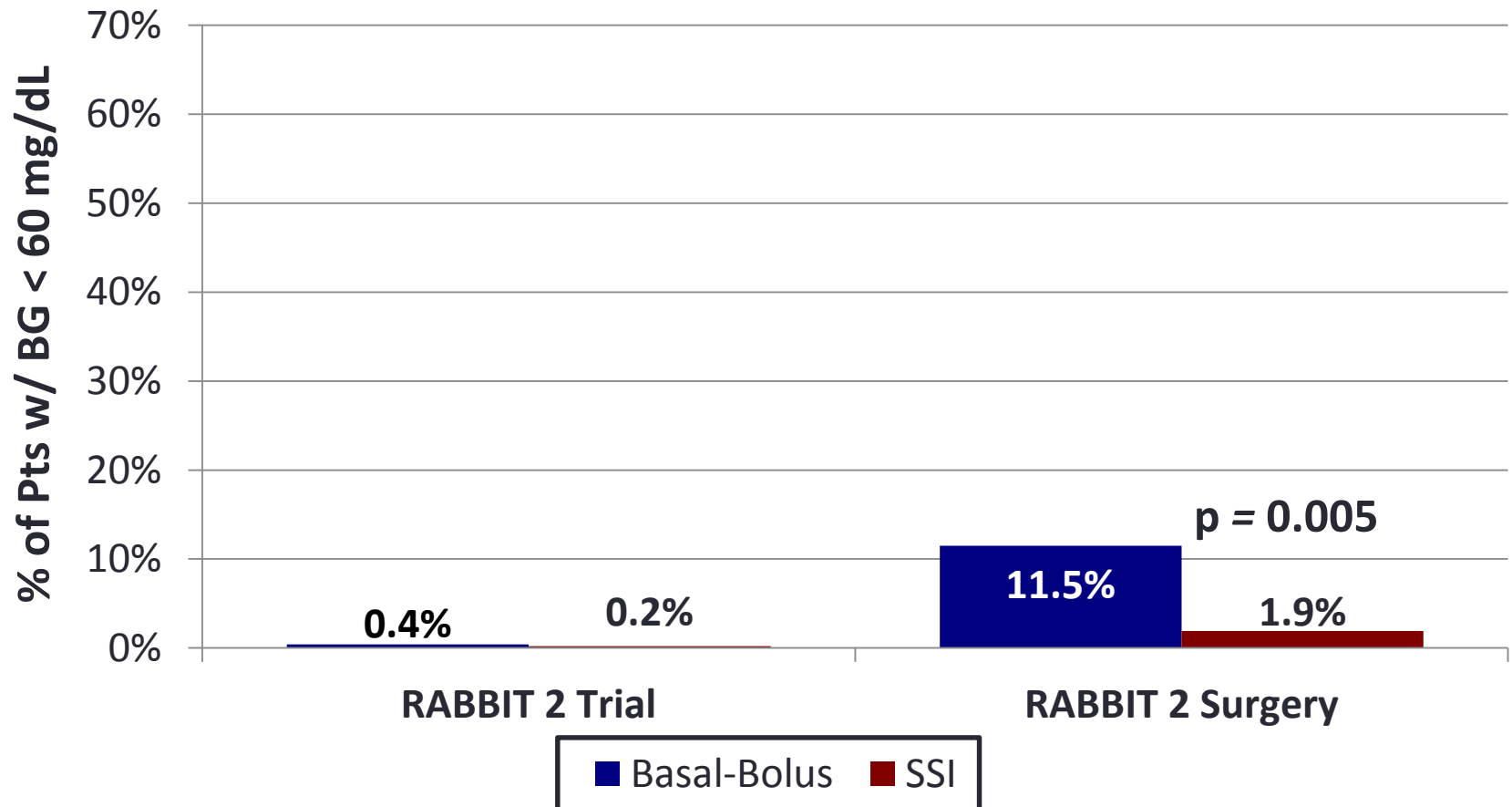
Basal-Bolus vs. Sliding Scale (SSI)

Glycemic Control



Basal-Bolus vs. Sliding Scale

Hypoglycemia

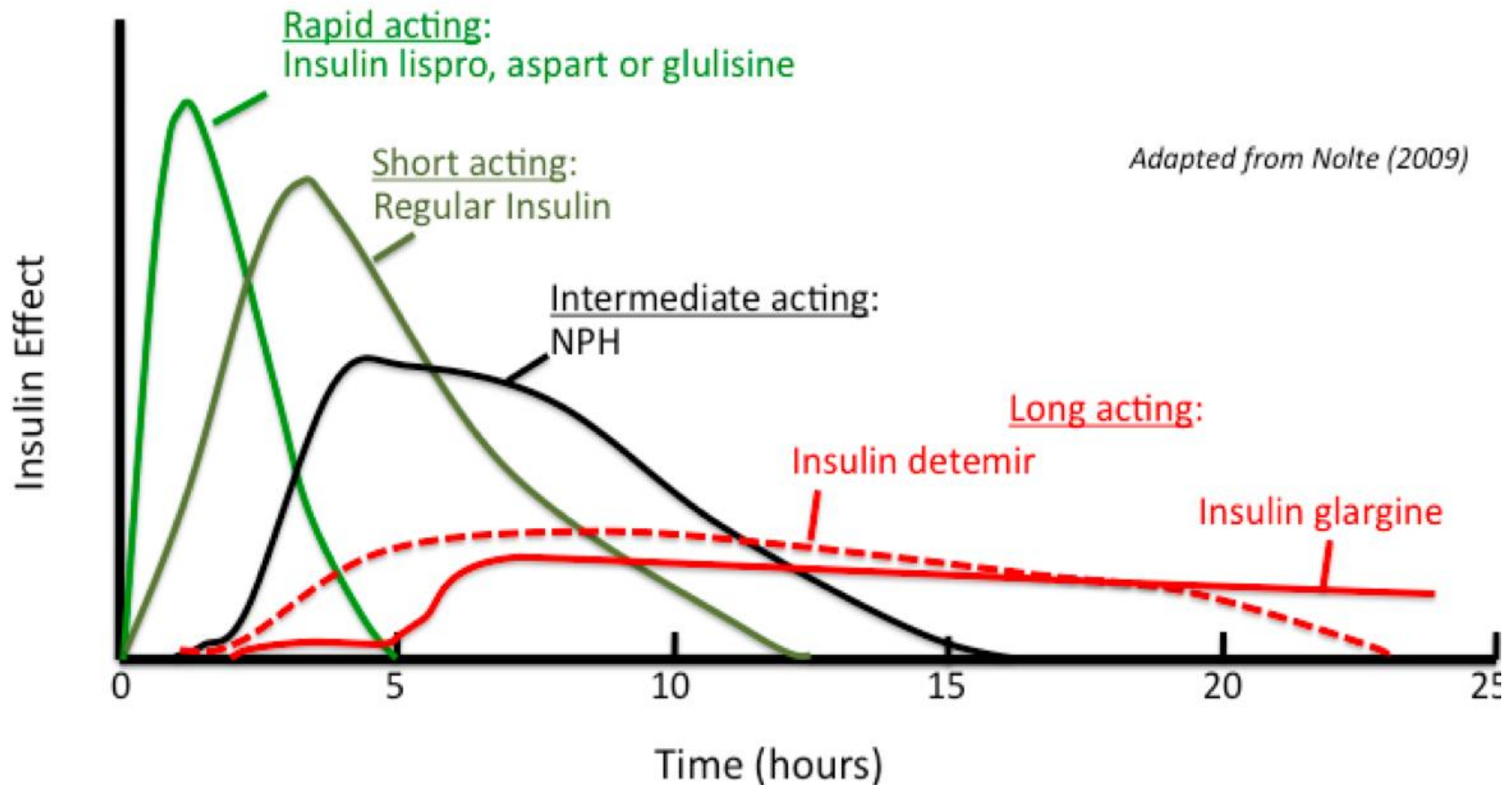


Non-ICU Glycemic Targets Summary

- AACE/ADA recommended glycemic goals:
 - Pre-meal glucose < **140 mg/dL**
 - Random glucose < **180 mg/dL**
 - *Blood glucose < 110 mg/dL no longer recommended.*

Pharmacologic Glycemic Management

Insulin Options



Modifying Home Insulin Therapy

Type 1

- Rapid DKA unless basal and correction insulin.
- Continue home dose unless markedly hypoglycemic.
- Ask nursing to hold mealtime if not eating.

Type 2

- Consider empiric increase if BG >180 mg/dL.
- Continue home dose if 140-180 mg/dL.
- Consider 20% reduction if <140 mg/dL.
- Consider 50% reduction if hypoglycemic.

Initiating New Insulin Regimen

Patient Characteristics	Total Daily Dose Estimation
Insulin sensitivity Underweight Elderly Hemodialysis or renal insufficiency	0.3 units/kg/day
Normal weight	0.4 units/kg/day
Obese Insulin resistance Glucocorticoids	0.5 – 0.6 units/kg/day

Creating a Basal-Bolus Insulin

	Basal-Bolus Insulin for a Hospitalized Patient	Example: 80 kg patient
Step 1	Total Daily Dose (TDD) <ul style="list-style-type: none"> • 0.4 units/kg/day 	80 kg = 40 units daily
Step 2	Basal Insulin <ul style="list-style-type: none"> • 50% of TDD 	50% of 40 units = 20 units daily
Step 3	Mealtime Insulin <ul style="list-style-type: none"> • 50% of TDD • Split between 3 meals 	50% of 40 units = 20 units daily 20 units/3 meals = 6 units AC
Step 4	Correction Scale	Based on insulin resistance

Selecting Correctional Insulin

Blood glucose (mg/dL)	□	□	□	□	□
	Range A (units)	Range B (units)	Range C (units)	Range D (units)	Custom Range (units)
Less than 65					
66-100	0	0	0	0	
101-140					
141-170	1	1	2	4	
171-200	1	2	3	7	
201-250	2	3	4	10	
251-300	3	5	7	15	
Greater than 300	4	7	10	20	

T1DM
(sensitive), or
non-diabetic

“Standard” T2DM,
mild insulin
resistance

“Resistant”
T2DM on high
insulin dose or
steroids

“D” = Danger: usually
too high, add more
basal insulin, glycemic
roller coaster

T1DM & T2DM Patients Requiring Insulin

NPO
Basal: home dose OR 0.2-0.4 unit/kg/day
<i>PLUS</i>
Correctional: based upon sensitivity parameters



Oral Intake
Basal: home dose OR 0.2-0.4 unit/kg/day
<i>PLUS</i>
Mealtime: home dose OR 0.05-0.1 unit/kg/meal
<i>PLUS</i>
Correctional: based upon sensitivity parameters

Titration Insulin Therapy

Basal

- Titrate by 50% of correctional requirements if no hypoglycemia has occurred

Mealtime

- Initiate if BG increases with each meal
- Titrate by 1-2 units per meal

Correctional

- Consider moving up a “scale” for hyperglycemia that does not correct despite titrating basal & mealtime
- Consider moving down a “scale” for hypoglycemia after correctional administration

Oral Anti-Diabetic Medications

Medication/Class	Concerns with Hospital Administration
Sulfonylureas	Hypoglycemia
Thiazolidinedione (TZD)	Fluid retention, heart failure
Metformin	Lactic acidosis, renal insufficiency, IV contrast
α -glucosidase inhibitors	Ineffective, unresponsive hypoglycemia
Glucagon like peptide-1 agonist (GLP-1)	\$\$\$, \uparrow risk of GI effects
Dipeptidyl peptidase IV inhibitors	
Sodium-glucose cotransporter 2 inhibitors (SGLT2)	Renal insufficiency, electrolyte abnormalities, hypotension

Oral Anti-Diabetic Medications

Medication/Class	Recommendations upon hospitalization
Sulfonylureas	Discontinue, especially if acute renal insufficiency and/or NPO
Thiazolidinedione (TZD)	Discontinue, especially if edematous
Metformin	Discontinue, medico-legal risk
α-glucosidase inhibitors	Discontinue, ineffective
Glucagon like peptide-1 agonist	Continue if medically stable/glycemic controlled Discontinue if significant GI disturbances
Dipeptidyl peptidase IV inhibitors	
Sodium-glucose cotransporter 2 inhibitors (SGLT2)	Discontinue, especially if hypotensive or renal dysfunction (decreased efficacy)

T2DM Patients Previously Controlled on Oral Agents

NPO

Discontinue oral agents

INITIATE

Correctional: based upon sensitivity parameters

THEN

- **Basal:** Add/titrate by 50% of correctional need
- Consider mealtime bolus if BG “stacking” occurs with meals

DISCONTINUE ORAL AGENTS*



CORRECTIONAL INSULIN

Oral Intake

Continue *select** oral agent

INITIATE

Correctional: based upon sensitivity parameters

THEN

- **Basal:** Add/titrate by 50% of correctional need
- Consider mealtime bolus if BG “stacking” occurs with meals

T2DM Patients Previously Un-Controlled on Oral Agents

NPO

Discontinue oral agents

INITIATE

Basal: 0.1-0.2 unit/kg/day

Correctional: based upon sensitivity parameters

THEN

- Add/titrate by 50% of correctional insulin need
- Consider mealtime bolus if BG “stacking” occurs with meals

BASAL INSULIN



CORRECTIONAL INSULIN

Oral Intake

Continue *select** oral agent

INITIATE

Basal: 0.1-0.2 unit/kg/day

Correctional: based upon sensitivity parameters

THEN

- Add/titrate by 50% of correctional insulin need
- Consider mealtime bolus if BG “stacking” occurs with meals

Hypoglycemia Concerns

- Stopping or holding enteral or parenteral feeds
- Over-reliance on correctional insulin: hypo/hyperglycemia rollercoaster
- Resolving stress-related hyperglycemia
- Tapering glucocorticoids

Patient Case

- 56 y/o female with T2DM is admitted to the Medical/Surgical unit for treatment of community acquired pneumonia.
- Home medications: metformin and glipizide
- Prior HbA1c: 8.5%
- Current BG: 200, 196 mg/dL
- Diet: Diabetic

Which of the following is the BEST answer?

- A. Discontinue metformin & glipizide
- B. Continue metformin & glipizide
- C. Continue metformin & glipizide; begin correctional insulin
- D. Discontinue metformin & glipizide; begin basal and correctional insulin

QUESTIONS
