



Impact of Standardizing Critical Care Glycemic Management

Clifford Cornett, PharmD, BCCCP, BCPS
Critical Care Pharmacist
Appalachian Regional Healthcare
Hazard, KY

J. Ryan Meadows, PharmD, BCCCP, BCIDP, BCPS
Critical Care Pharmacist
Appalachian Regional Healthcare
Hazard, KY

Relevant Financial Disclosure

- No one in control of the content of this activity has a relevant financial relationship to disclose.

Presenters



Clifford Cornett, PharmD, BCCCP, BCPS



J. Ryan Meadows, PharmD, BCCCP, BCIDP, BCPS

Learning Objectives

- Identify both incentives for and barriers to the standardization of glycemic control.
- Discuss the process one hospital used to standardize glycemic control in the critical care setting.
- Describe a method for designing and implementing a standardized glycemic control policy.

Institution

- Hazard ARH Regional Medical Center
- Largest of 14 hospitals in Appalachian Regional Healthcare System
- 358 bed, acute-care community teaching hospital
 - 32 total ICU beds across two units



Patient Impact of HYPERglycemia

Worsened immune function

- Increased rates of infection¹

Increased cardiovascular risks

- Myocardial damage
- Ischemia risk
- Hemodynamic changes
- Increased thrombosis risks¹

Increased mortality

- Up to 400% higher in critically ill patients with BG > 300 mg/dL²
- Found to progressively increase in acute MI patients for every 10 mg/dL above 120 mg/dL³

Don't blame the corticosteroids!

- Worse outcomes with hyperglycemia even without diabetes history⁴

Impact of HYPOglycemia

Commonly a medication induced adverse drug event

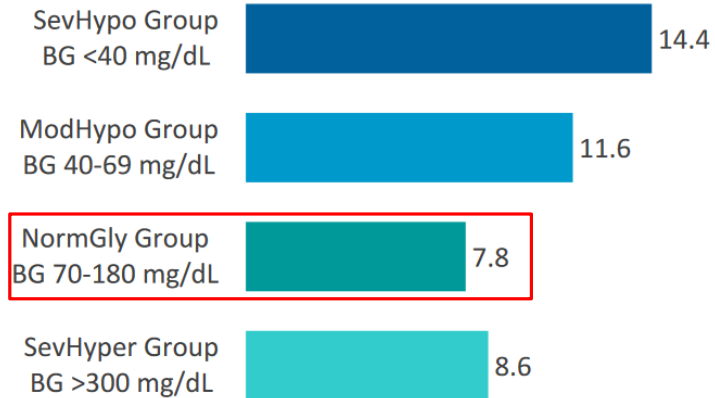
- Related to dosing errors, inappropriate use of hypoglycemic medications, or fluctuations of clinical condition and nutritional status

Associated with increased mortality

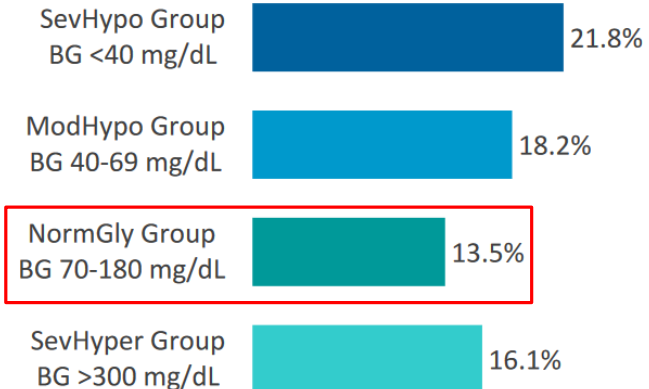
- Progressively increased with worsening severity of hypoglycemic episode
- In-hospital mortality 12.9% for moderate and 24.9% for severe hypoglycemia compared to 11% for controls in one study⁵
- May be more indicative of severe disease progression than direct harm from insulins⁶

Financial Implications of Poor Glycemic Control

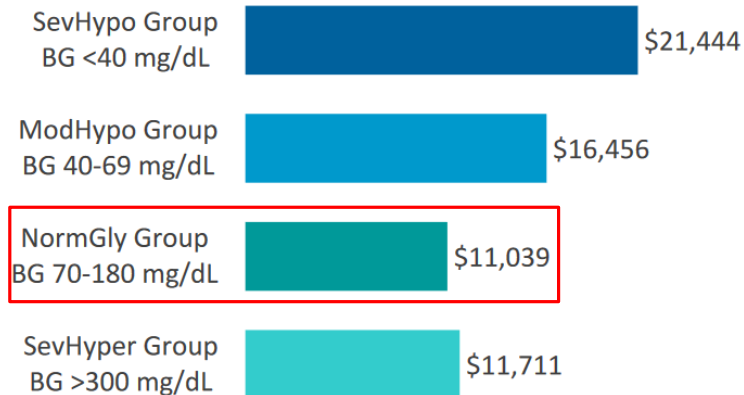
Average LOS (#Days) Per Patient



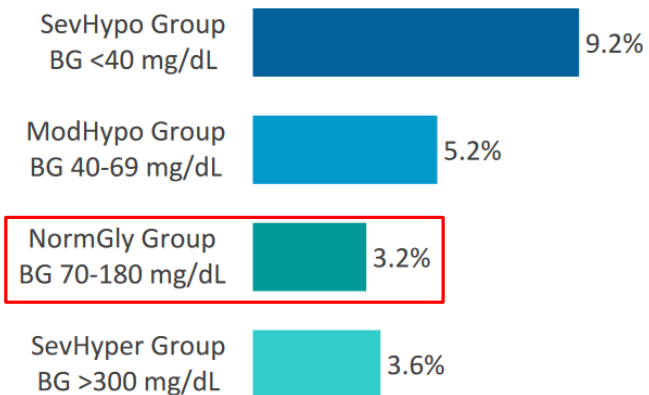
Readmission Rate



Average Cost Per Patient Stay



Mortality Rate



CMS-Quality Measures

- Severe hypo- and hyperglycemia to be added as Electronic Clinical Quality Measures
 - Both found to be “largely avoidable with proper glycemetic management.”
- Will inevitably impact reimbursement and confidence from patients in quality of care
- Data reporting to begin January 1, 2023
 - Payment determination to begin fiscal year 2025

CMS-Hospital Harm from Hyperglycemia

Numerator

Inpatient hospitalizations with a hyperglycemic event within the first 10 days of the encounter minus the first 24 hours, and minus the last period before discharge if less than 24 hours.

A hyperglycemic event is defined as:

1. A day with at least one blood glucose value >300 mg/dL; OR
2. A day where a blood glucose was not measured, and it was preceded by two consecutive days where at least one glucose value during each of the two days was ≥ 200 mg/dL.

Denominator

Inpatient hospitalizations where the patient is 18 years or older at the start of the admission with a discharge during the measurement period, as well as either:

1. a diagnosis of diabetes that starts before or during the encounter; or
2. administration of at least one dose of insulin or any hypoglycemic medication during the encounter; or
3. presence of at least one blood glucose value ≥ 200 mg/dL at any time during the encounter.

The measure includes inpatient hospitalizations that began in the emergency department or in observational status.

<https://cmit.cms.gov/>

CMS-Hospital Harm from Hypoglycemia

Numerator

Inpatient hospitalizations which include:

1. A severe hypoglycemic event during the encounter, defined as a test (laboratory or point-of-care (POC)) for blood glucose with a result less than 40 mg/dL;
AND
2. A hypoglycemic medication administered within 24 hours prior to the start of the severe hypoglycemic event (and that was during the encounter);
AND
3. No subsequent repeat test for blood glucose with a result greater than 80 mg/dL within five minutes of the start of the initial low blood glucose test.

Only the first qualifying severe hypoglycemic event is counted in the numerator, and only one severe hypoglycemic event is counted per encounter. The 24-hour and 5-minute timeframes are based on the time the blood glucose was drawn, as this reflects the time the patient was experiencing that specific blood glucose level.

Denominator

Inpatient hospitalizations where the patient is 18 years of age or older at the start of the encounter, and at least one hypoglycemic medication was administered during the encounter. The measure includes instances of administration of hypoglycemic medications in the emergency department or in observation status at the start of an inpatient hospitalization when assessing inclusion of encounters in the measure denominator.

<https://cmit.cms.gov/>

Organizational ICU Glucose Targets

Table 1. Guidelines from Professional Organizations on the Management of Glucose Levels in the ICU.*

Year	Organization	Patient Population	Treatment Threshold	Target Glucose Level <i>mg/dl</i>	Definition of Hypoglycemia	Updated since NICE-SUGAR Trial, 2009 [†]
2009	American Association of Clinical Endocrinologists and American Diabetes Association	ICU patients	180	140–180	<70	Yes
2009	Surviving Sepsis Campaign	ICU patients	180	150	Not stated	Yes
2009	Institute for Healthcare Improvement	ICU patients	180	<180	<40	Yes
2008	American Heart Association	ICU patients with acute coronary syndromes	180	90–140	Not stated	No
2007	European Society of Cardiology and European Association for the Study of Diabetes	ICU patients with cardiac disorders	Not stated	“Strict” [‡]	Not stated	No

* The guidelines from the organizations listed are available online: American Association of Clinical Endocrinologists and American Diabetes Association, www.aace.com/pub/pdf/guidelines/InpatientGlycemicControlConsensusStatement.pdf; Surviving Sepsis Campaign, www.survivingsepsis.org/About_the_Campaign/Documents/SSC%20Statement%20on%20Glucose%20Control%20in%20Severe%20Sepsis.pdf; Institute for Healthcare Improvement, www.ihl.org/IHI/Topics/CriticalCare/IntensiveCare/Changes/ImplementEffectiveGlucoseControl.htm; American Heart Association, <http://circ.ahajournals.org/cgi/content/short/117/12/1610>; and European Society of Cardiology and European Association for the Study of Diabetes, www.easd.org/easdwebfiles/homepage/escandeasdguidelines.pdf.

[†] The Normoglycemia in Intensive Care Evaluation–Survival Using Glucose Algorithm Regulation (NICE-SUGAR) trial is reported by Finfer et al.¹³

[‡] The guideline recommends “strict blood glucose control with intensive insulin therapy” and refers to studies in which such therapy has target glucose levels of 80 to 110 mg per deciliter (4.4 to 6.1 mmol per liter).

ADA Guidelines for Hospitalized Patients

- Insulin therapy recommended for persistent BG ≥ 180 mg/dL⁷
- Goal range 140 mg/dL – 180 mg/dL for most patients
 - More intensive control associated with increased mortality, but may be appropriate for some (mostly postsurgical) patients
 - Associated with less hypoglycemia than more intensive control⁸
- Higher BG targets may be acceptable in terminally ill patients or in patients at the highest risk of hypoglycemia without close nursing supervision available

ADA Guidelines for Hospitalized Patients

- Basal/bolus regimens are preferred in noncritically ill patients
 - Use of sliding scale insulin alone is strongly discouraged
 - Premixed 70/30 insulins should be avoided
- Intravenous insulin is preferred in the critical care setting
 - More safe and effective than basal insulin with fluctuating clinical status
 - Requires complex protocol for appropriate use
 - Can increase nursing workload
 - Must be addressed with transitions of care
- Hypoglycemia prevention and management should be managed via a standard protocol as well

How can this be achieved?

ADA

- “Insulin should be administered using validated written or computerized protocols that allow for predefined adjustments in the insulin dosage based on glycemic fluctuations.”⁷

CMS

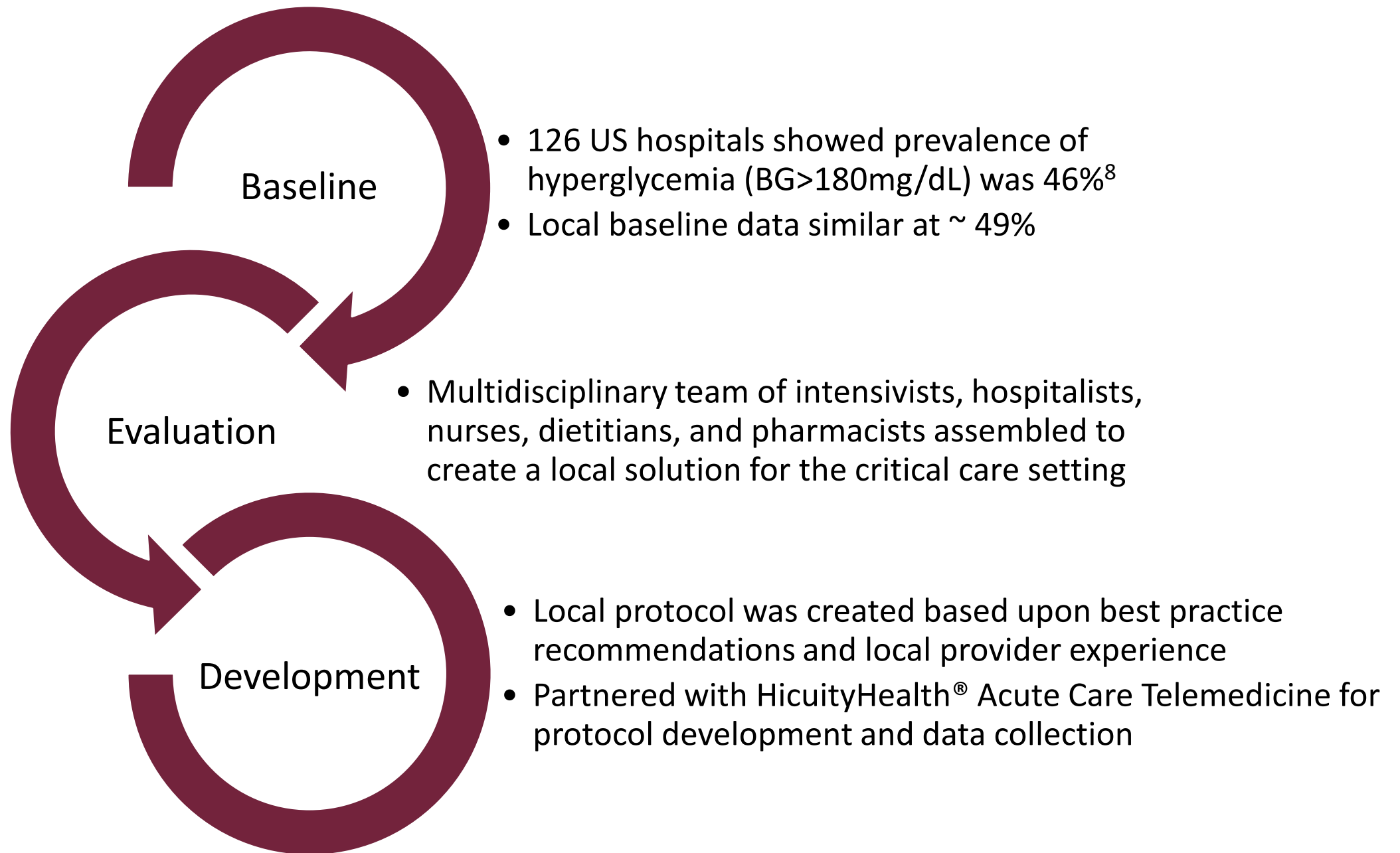
- “The use of evidence-based standardized protocols and insulin management protocols have been shown to improve glycemic control and safety.”

Commercial software exists

- May be cost prohibitive, lack relevance for the intended patient population, or have barriers to implementation

Local standard protocols may be developed

- Tailored to local patient population, resources, and provider experience
- Easily optimized as areas for improvement are found



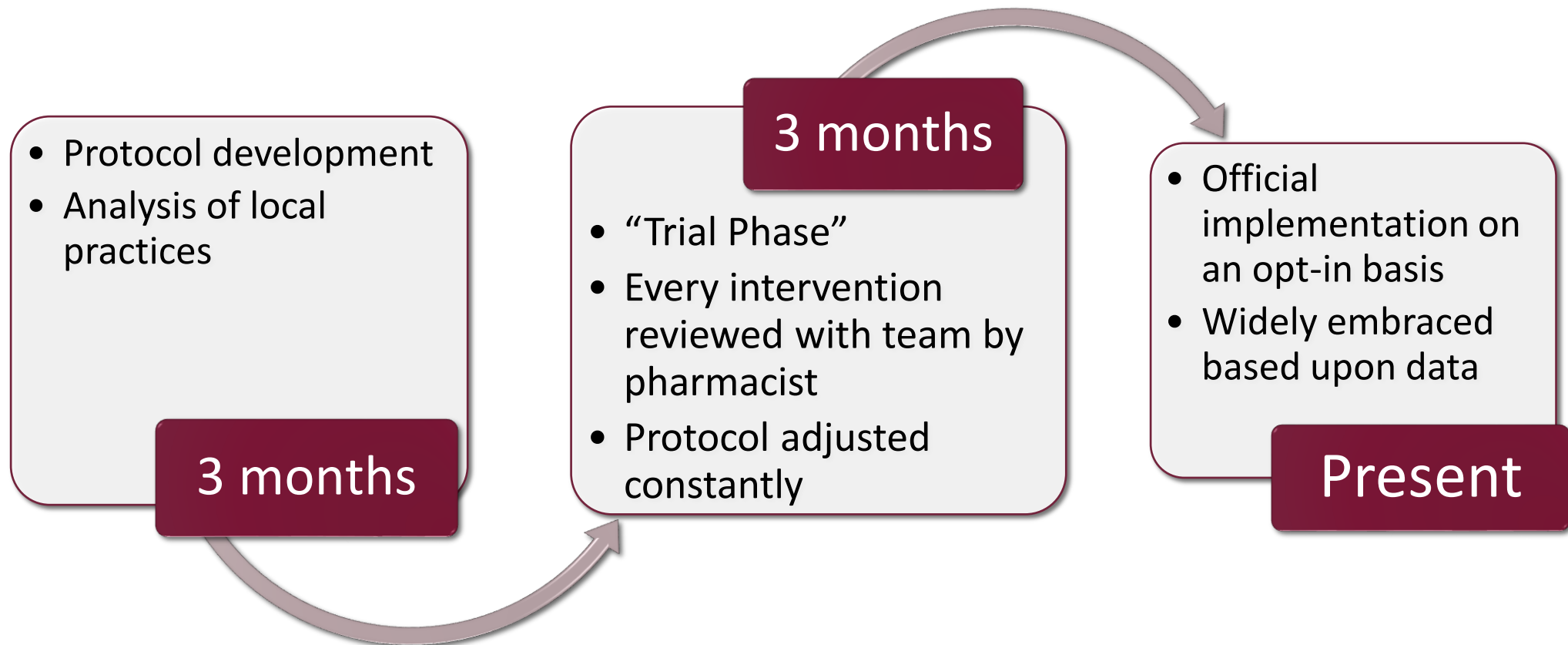
Initial Protocol Objectives

- Create “guardrails” for basic glycemic control that could be followed by any healthcare professional
 - Intensivist, hospitalist, telemedicine physician, nurse, pharmacist, etc.
 - Provider could change therapy, but all patients would receive standard interventions
- Create proactive rather than reactive glycemic interventions
 - Anticipate and prevent hyper- or hypoglycemia rather than react to it
 - Make smaller, more frequent changes
- Treat episodes of hypoglycemia from insulin as “never events”
 - Review with root cause analysis
 - Take steps to prevent further similar events

Initial Protocol Objectives

- Bring glycemic control to the forefront of the focus of the entire team
 - Shared responsibility
 - More opportunities for interventions
- Serve as a reference for less experienced providers
 - Provide education on local standard of care
 - Change standard of practice by “osmosis”
- Increase communication
 - Involve all provider specialties, pharmacists, nurses, and clinical dietitians daily
 - Raise awareness of consequences of other clinical decisions on glycemic control

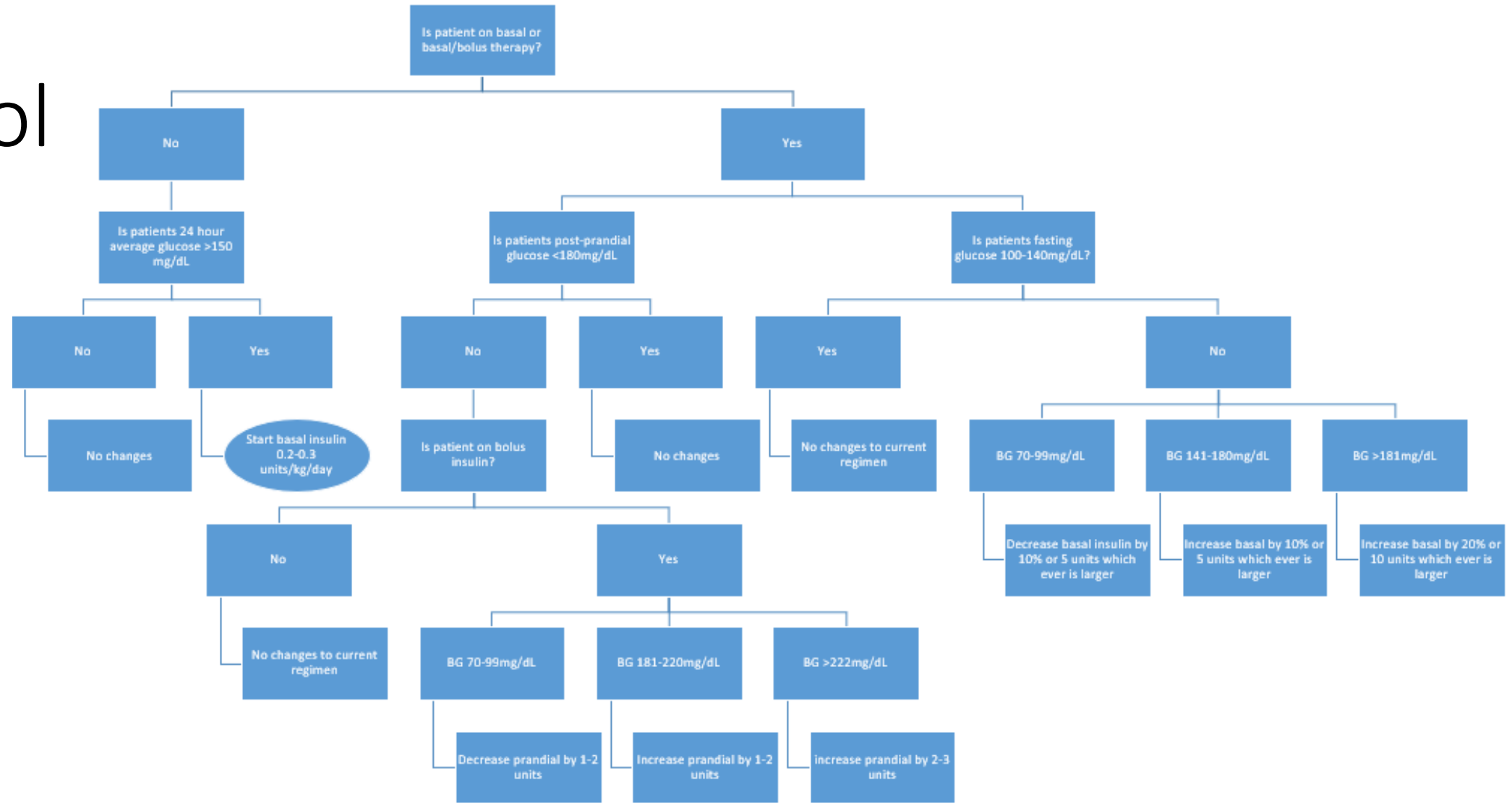
Timeline



Initial Protocol

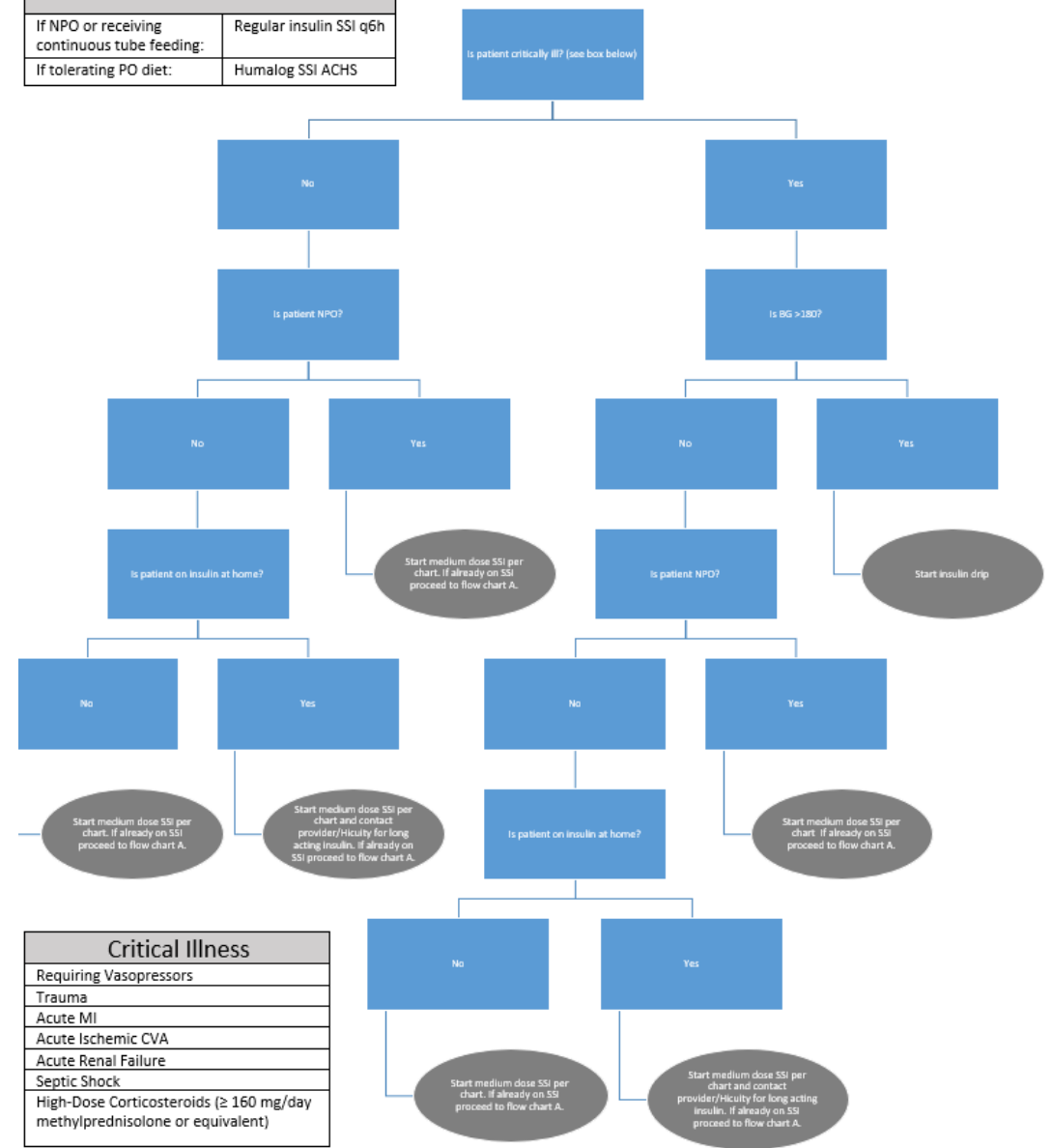


Initial Protocol



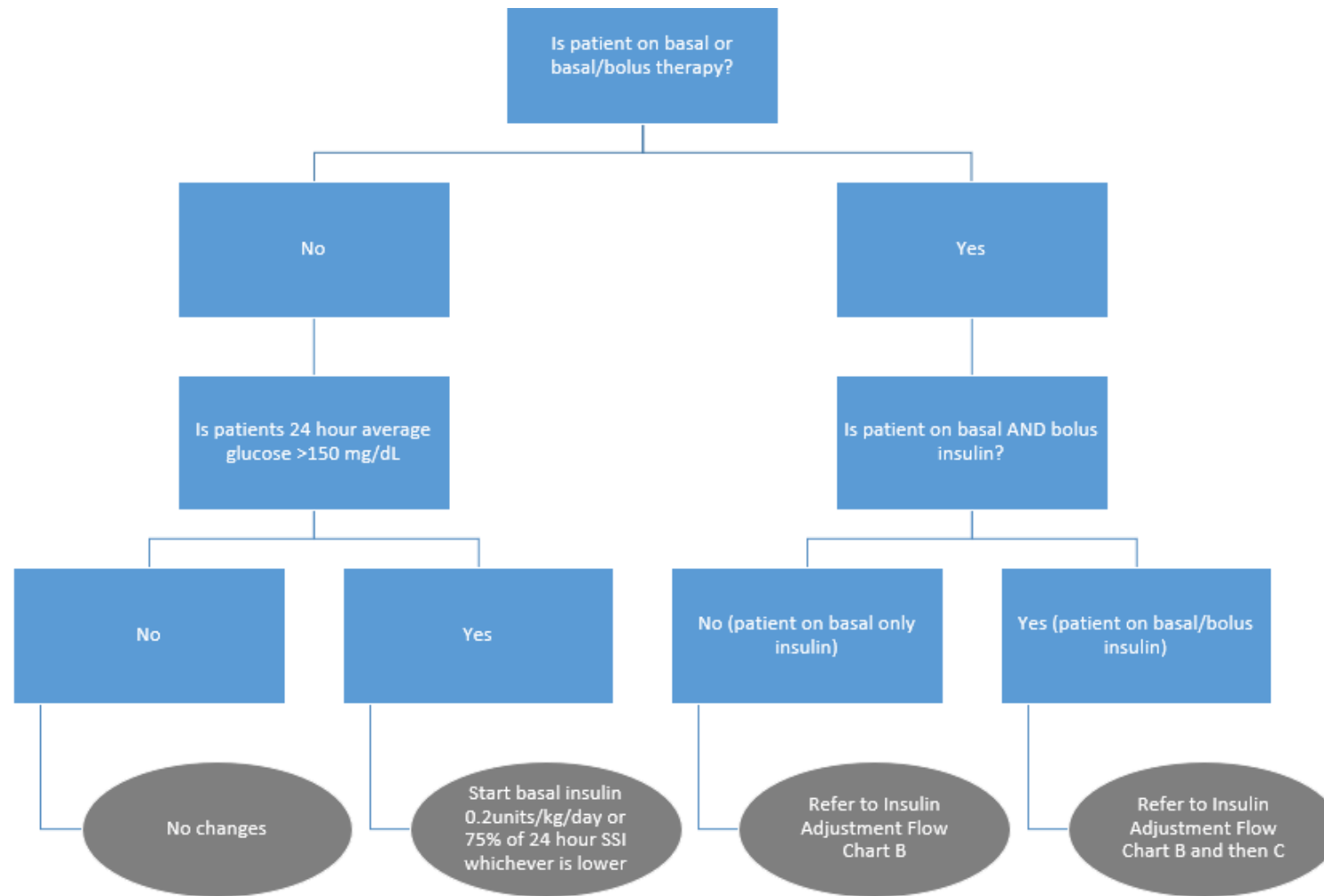
Protocol Today

Sliding Scale Insulin Choice	
If NPO or receiving continuous tube feeding:	Regular insulin SSI q6h
If tolerating PO diet:	Humalog SSI ACHS



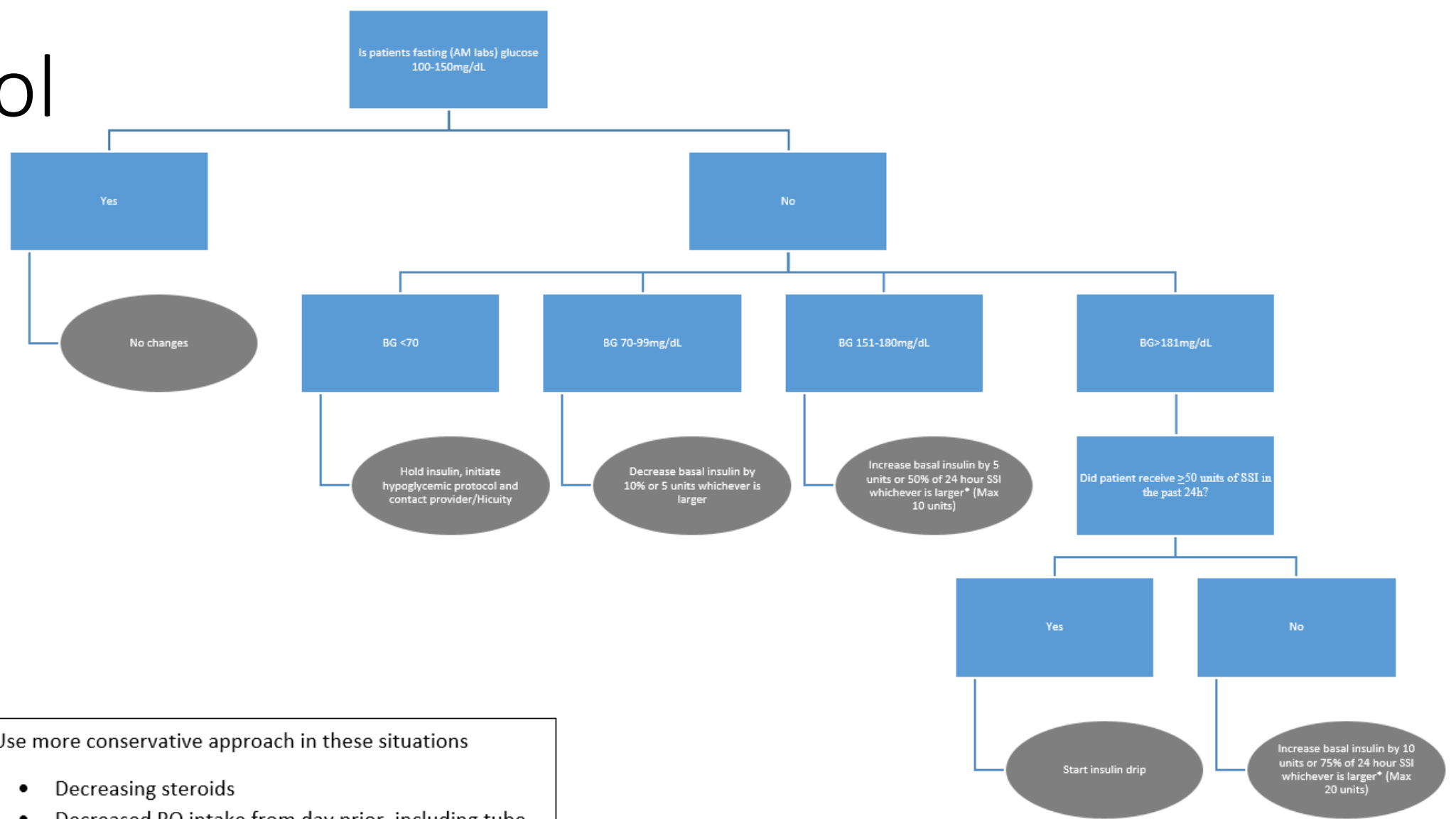
Critical Illness
Requiring Vasopressors
Trauma
Acute MI
Acute Ischemic CVA
Acute Renal Failure
Septic Shock
High-Dose Corticosteroids (≥ 160 mg/day methylprednisolone or equivalent)

Protocol Today



• Please round long acting insulin to nearest 5 units for ease of administration

Protocol Today



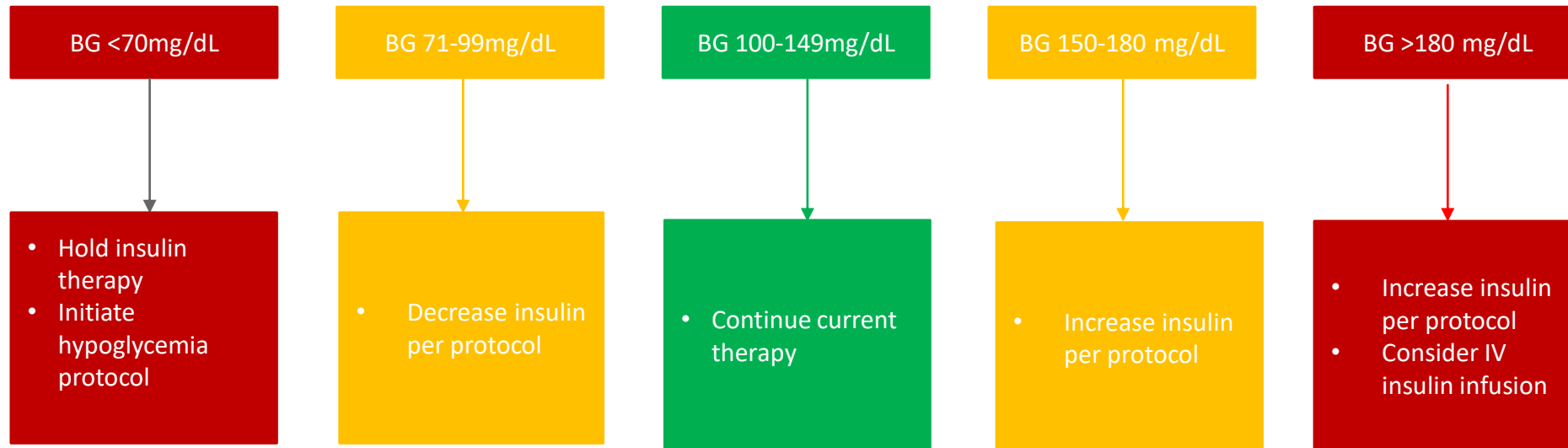
*Use more conservative approach in these situations

- Decreasing steroids
- Decreased PO intake from day prior, including tube feeds
- Hepatic insufficiency
- Renal insufficiency

Nuts and Bolts of Protocol

- All patients initiated on at least q6h FSBG with correctional insulin
 - Discontinue if not needed for 48 hours
- BG >180mg/dL and “critically ill” triggers IV insulin protocol
 - Institution specific criteria for critical illness
 - Decreases nursing workload vs. if all patients were deemed critically ill
- Average glucose >150mg/dL in 24h triggers addition of/adjustment to basal insulin
 - Small, proactive adjustments found to be more safe than waiting for larger adjustments when BG > 180 mg/dL
- BG <100 mg/dL triggers decrease of basal insulin
- Protocol continuously adapted after initially developed

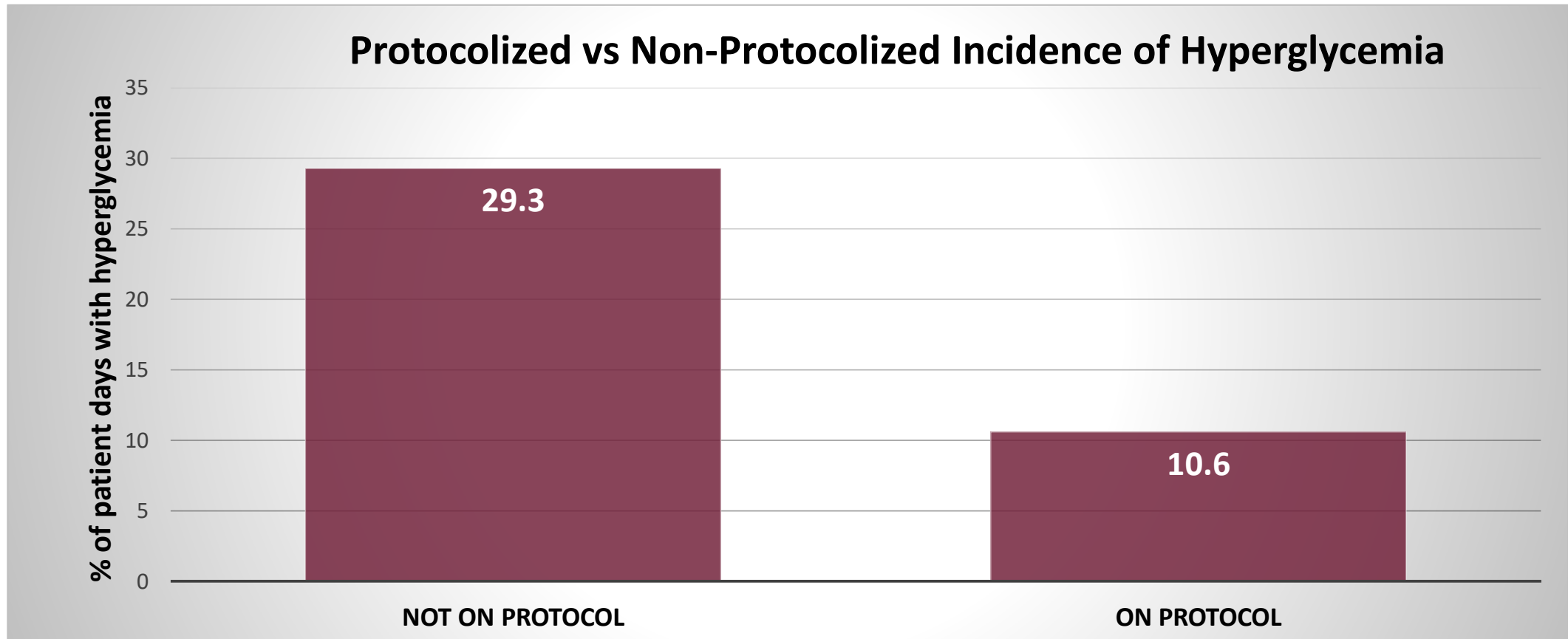
Protocol Summary



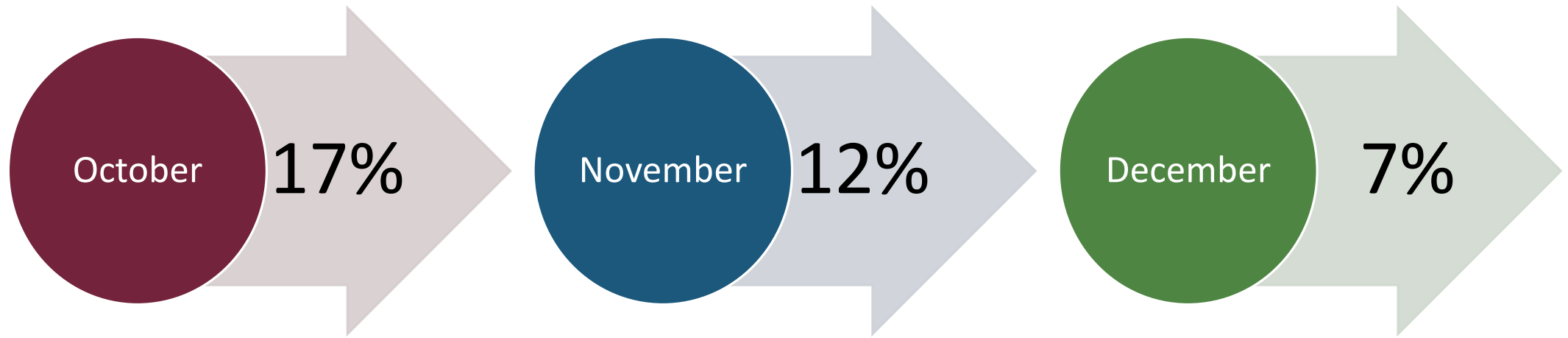
Protocol Pilot Results

- Data collected over 3 month period
 - October 1st 2021 through December 31st 2021
- 333 total patients were included
 - 114 patients in the protocol arm, 219 patients in the non-protocol arm
- Hyperglycemia captured as total patient days with average BG >180mg/dL
 - Reported as percentage of patient days with average glucose >180mg/dL
- Severe hypoglycemia captured as incidence of BG <50mg/dL
 - Reported as percentage of patients that experienced a severe hypoglycemic event

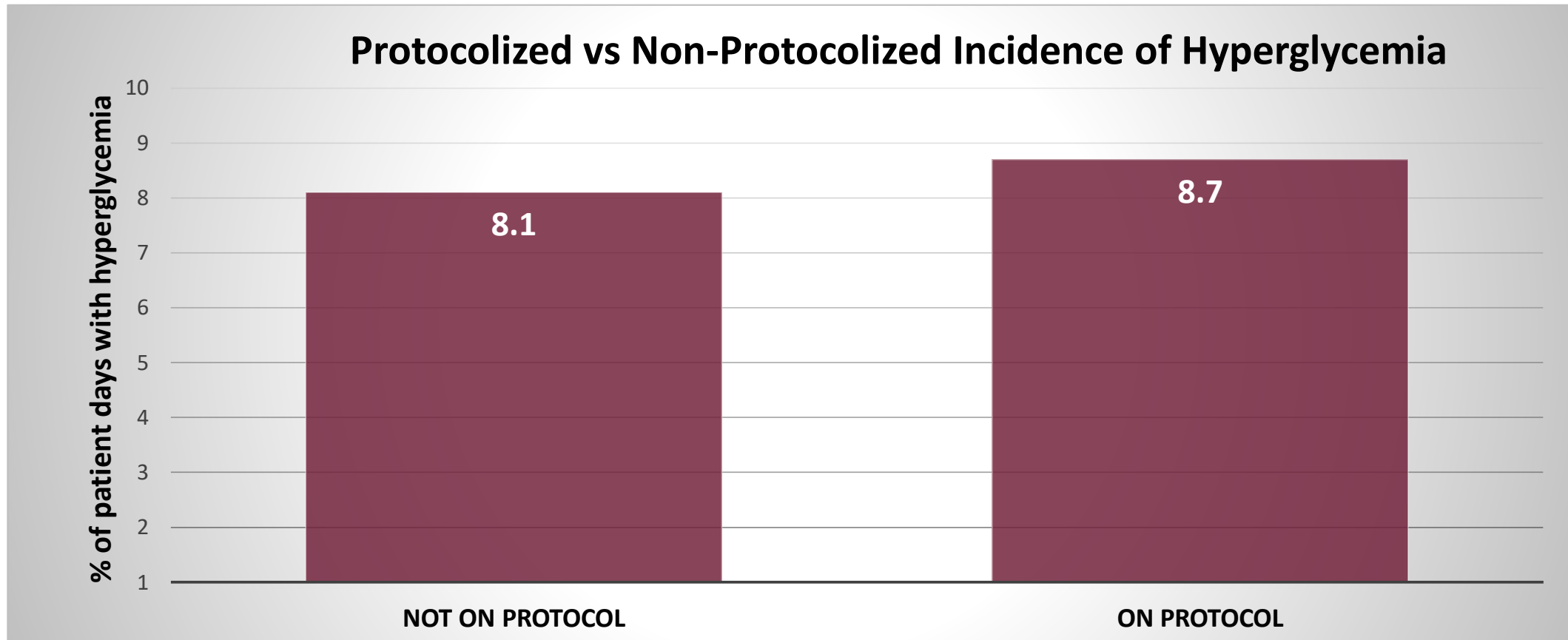
HYPERGlycemia Data – 3 months



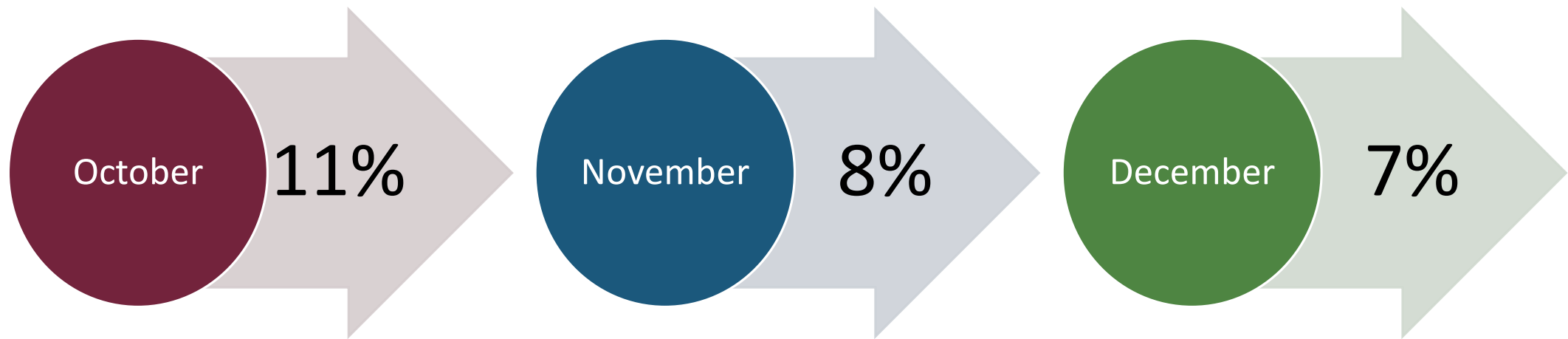
HYPERGlycemia by Month



Severe HYPOglycemia Data – 3 months



HYPoglycemia by Month



Barriers to Implementation

- Open vs. Closed ICU
 - Changes made to medication therapy, nutrition, etc. by multiple providers
 - IV D10W protocol created to address abrupt nutrition changes
 - Frequent communication with clinical dietitians
- Adjustment of corticosteroids
 - Required specific and more conservative insulin adjustments
- Fear of hypoglycemia
 - Similar rates of hypoglycemia despite more glycemic control

Barriers to Implementation

- Intensive monitoring regarding IV insulin
 - Complex protocols to be followed vs. investment in commercial software
 - Culture shift with providers and nurses to embrace safety and efficacy benefits
 - Commitment to transition to subcutaneous insulin quickly
- “Perfect is the enemy of good”

Next Steps


- Further enhance protocols for hypoglycemia prevention
 - Proactive approach to corticosteroid tapers and unexpected changes in nutrition
- Further address “difficult to manage” patients
 - Address “all or nothing” approach to holding basal or correctional insulin
 - Provide more guidance for IV/subcutaneous insulin cross-tapering
- Balance protocol effectiveness with complexity
 - Find middle ground to safely manage all outliers without including every possibility

Implementing a Plan

Utilize a multi-disciplinary approach



Develop a protocol that fits best practice
AND institution specific practice models



Collect data



Adjust protocol in a timely manner based
upon available data

Questions?



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