

# Inpatient Hyperglycemia:

*A case study that sounds all too  
familiar*

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# Objectives:

- Case presentation
- Prevalence and impact
- Current guidelines
- Treatment strategies and common pitfalls
- Revisit of case presentation

# Case Presentation:

- *42 y/o WF w/ cc of dysuria & back pain*
  - Dx=pyelonephritis/ARF
  - PMH: “diet controlled” DM
  - Admit glucose = 290 mg/dl



# Case Presentation:

- *Admit Orders*
  - Glargine/Lispro order set
  - Insulin “sensitive”
  - POC AC/HS checks
  
- *Hospital Day #1*
  - POC values 195 to 365 mg/dl
  - Changed to insulin “resistant”
  - Inpatient Diabetic Education ordered



# Case Presentation:

- *Hospital Day #2*
  - POC ranges 210 to 265 mg/dl
    - Rx **glargine 5 units** daily
  - Received Diabetic Education



# Case Presentation:

- *Hospital Day #3*
  - POC ranges 220 to 225mg/dl
  - A1c pending
  - Discharged



Sound familiar?



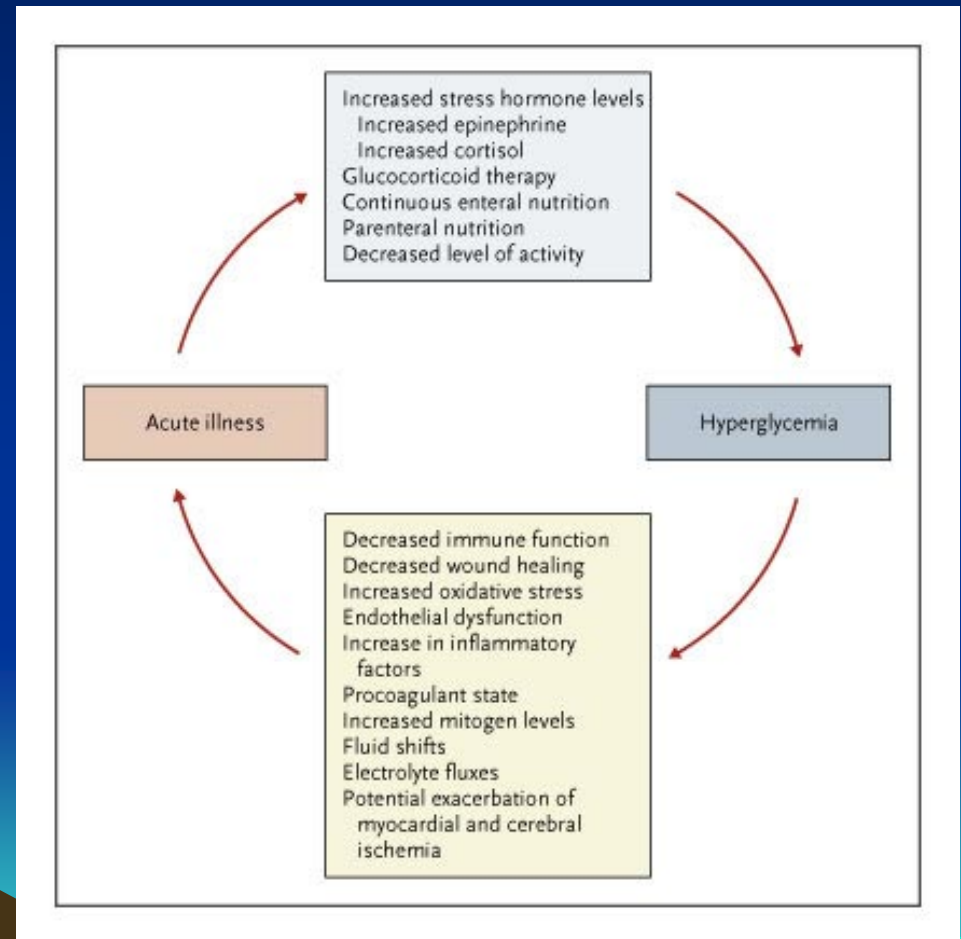
# Inpatient Hyperglycemia: *Definitions*

- Medical History of Diabetes
- Unrecognized Diabetes
  - FBG  $\geq$  126 mg/dl or RBG  $>$  200mg/dl
- Hospital-related Hyperglycemia
  - FBG  $\geq$  126 mg/dl or RBG  $>$  200mg/dl that normalizes after discharge

# Inpatient Hyperglycemia:

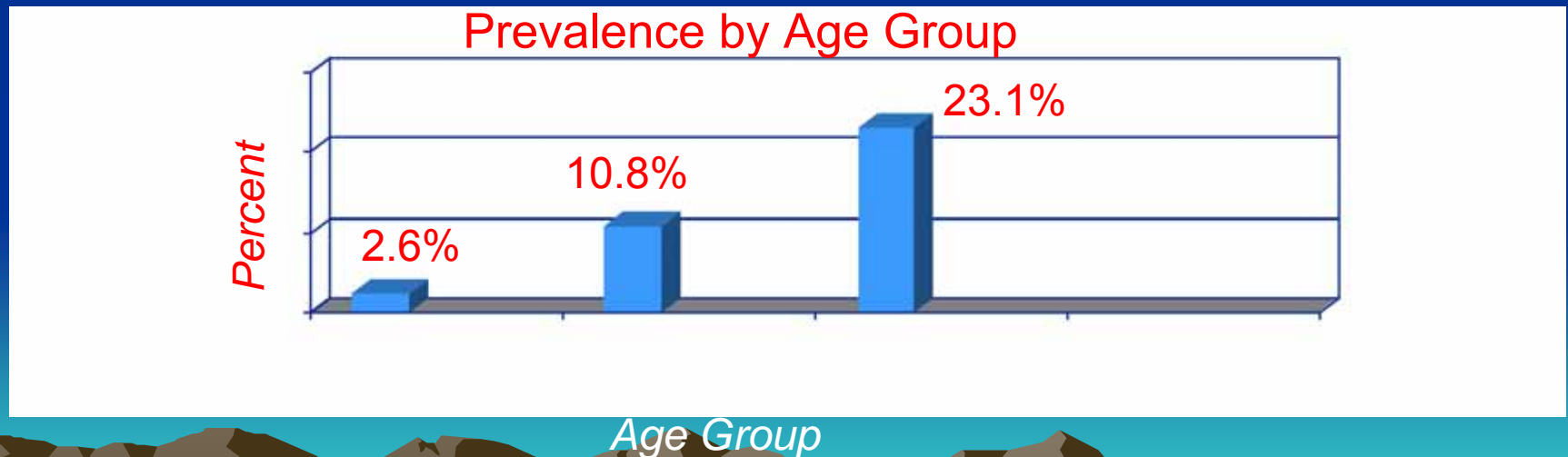
*What causes this?*

- Diabetes
  - DM 1 & 2; diagnosed vs undiagnosed
- Iatrogenic
  - Glucocorticoids, TPN, etc
- Stress-hyperglycemia



# Inpatient Hyperglycemia: *Prevalence*

- Prevalence
  - 7.8% of population has DM (23.6 million)
  - 12.4-38% of all hospitalized adults
  - Estimated ~25% at UCH

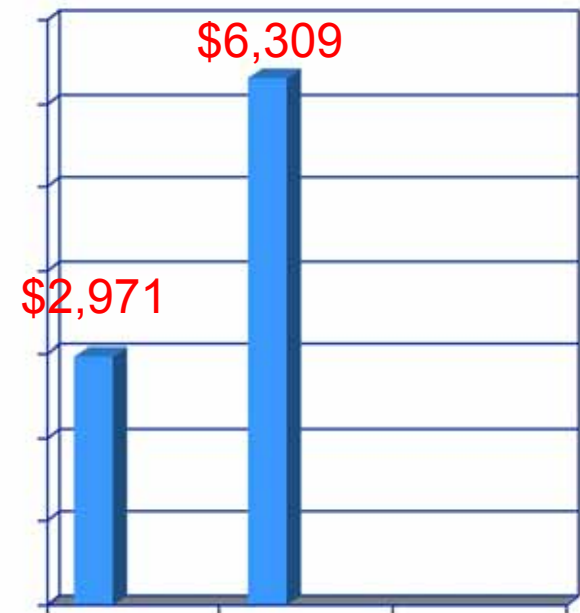


# Inpatient Hyperglycemia: *Associated Costs*

- Associated Costs
  - Total: \$174 billion (\$116 billion-direct)
    - Hospital-related costs ~44%
  - Expenditures 2.3x greater

## Hospital Care Costs:

### Non-Diabetic vs Diabetic



Clement et al. Management of Diabetes and Hyperglycemia in Hospital. Diabetes Care 27(2): 553-591, 2004

CDC. National diabetes fact sheet: general information and national estimates on diabetes in US, 2007. Atlanta, GA: U.S. Dept of Health & Human Services, CDC. 2008

# Inpatient Hyperglycemia: *Current Treatment Goal Guidelines*

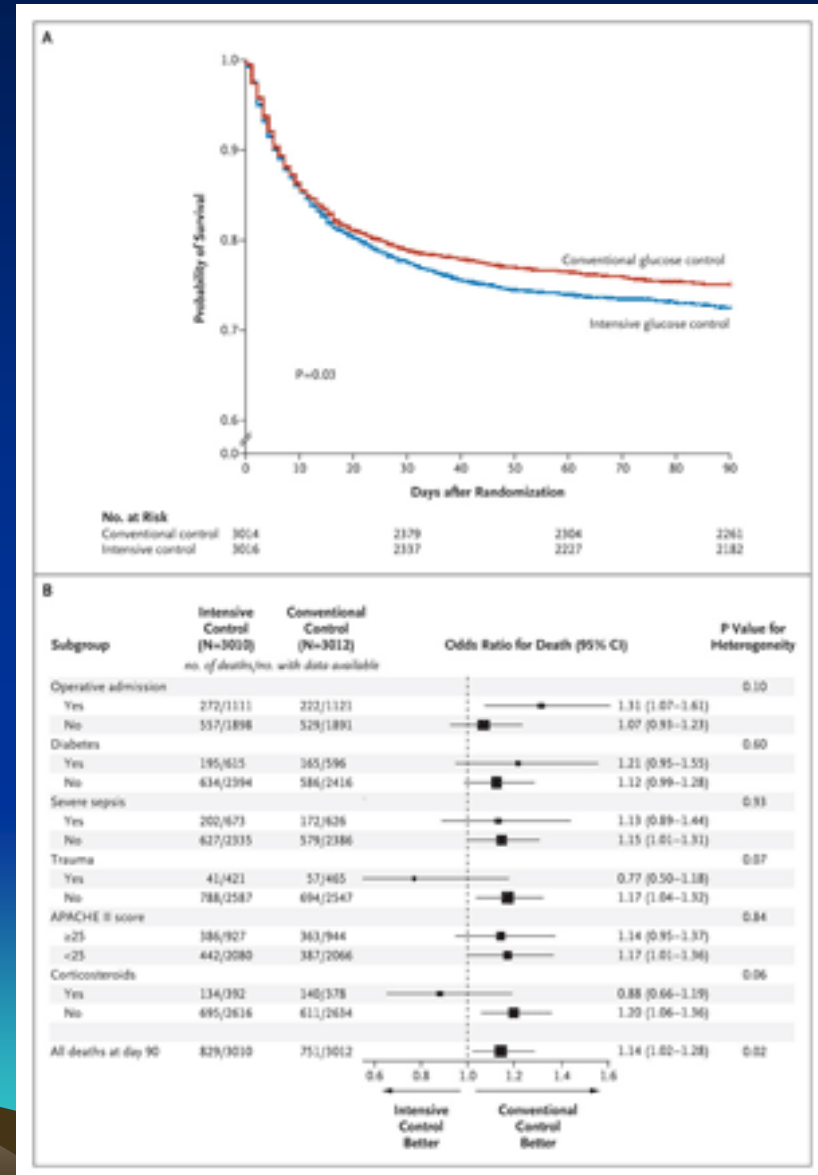
- Critically ill **surgical** pts
  - Close to 110mg/dl, generally < 140mg/dl
- Critically ill **nonsurgical** pts
  - <140mg/dl
- Non-critically ill pts
  - Fasting < 126mg/dl
  - Random <180-200mg/dl



# NICE-SUGAR:



- **Conventional Glucose Control**
  - *Target:* < 180 mg/dl
  - *Mean:* 144 +/- 23 mg/dl
  - *Death:* 24.9%
- **Intensive Glucose Control**
  - *Target:* 81-108 mg/dl
  - *Mean:* 115 +/- 18 mg/dl
  - *Death:* 27.5%



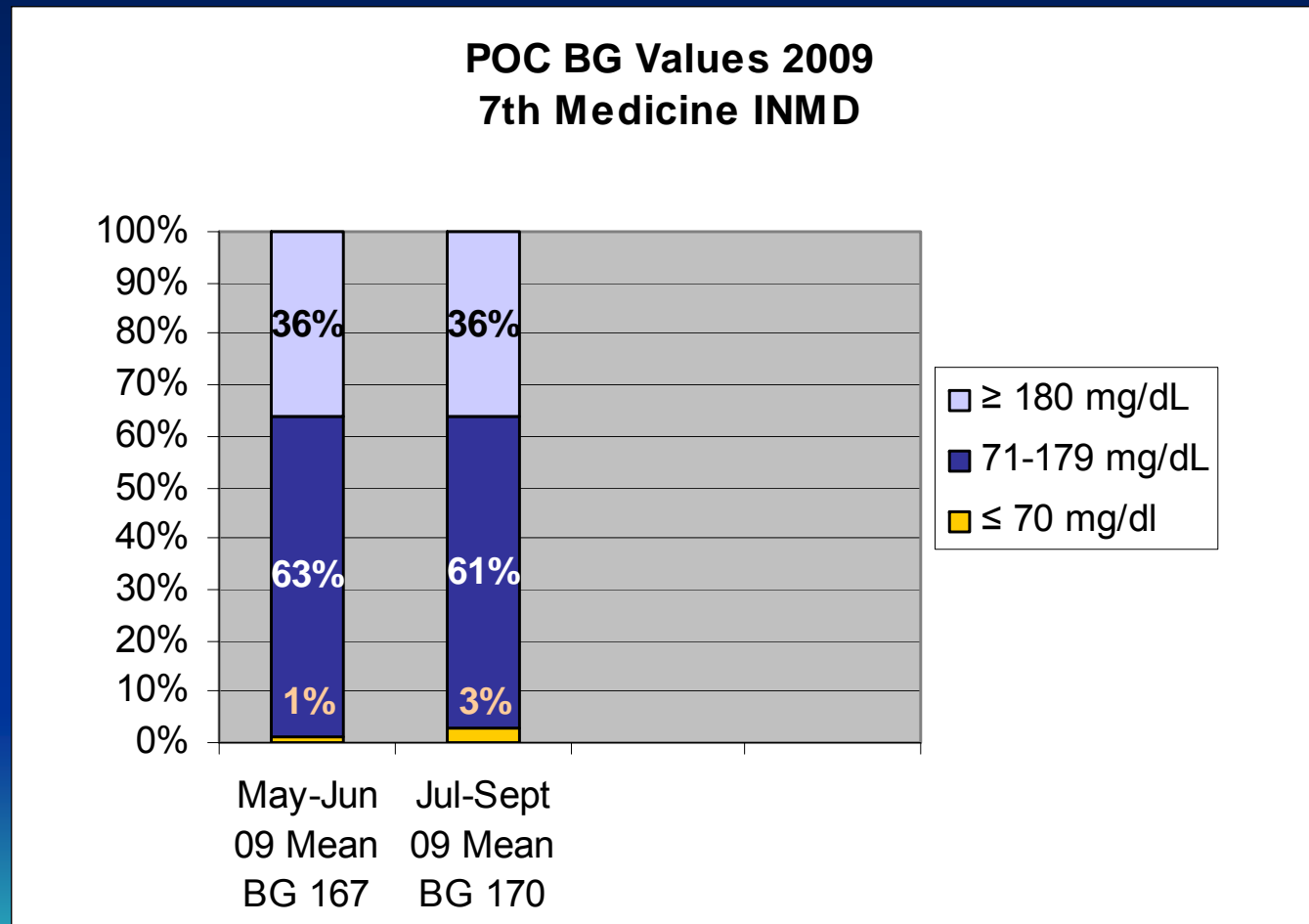
# ADA & AACE Joint Statement:

- **NICE-SUGAR**

- *“....should NOT lead to an abandonment of the concept of good glucose management in the hospital setting.”*
- *“..compared to a control group whose glucose control was good (average glucose 144 mg/dl).”*
- *“....reasonable for clinicians to treat critical care patients with the less intensive, yet good-glucose control strategies used in the conventional arm....”*

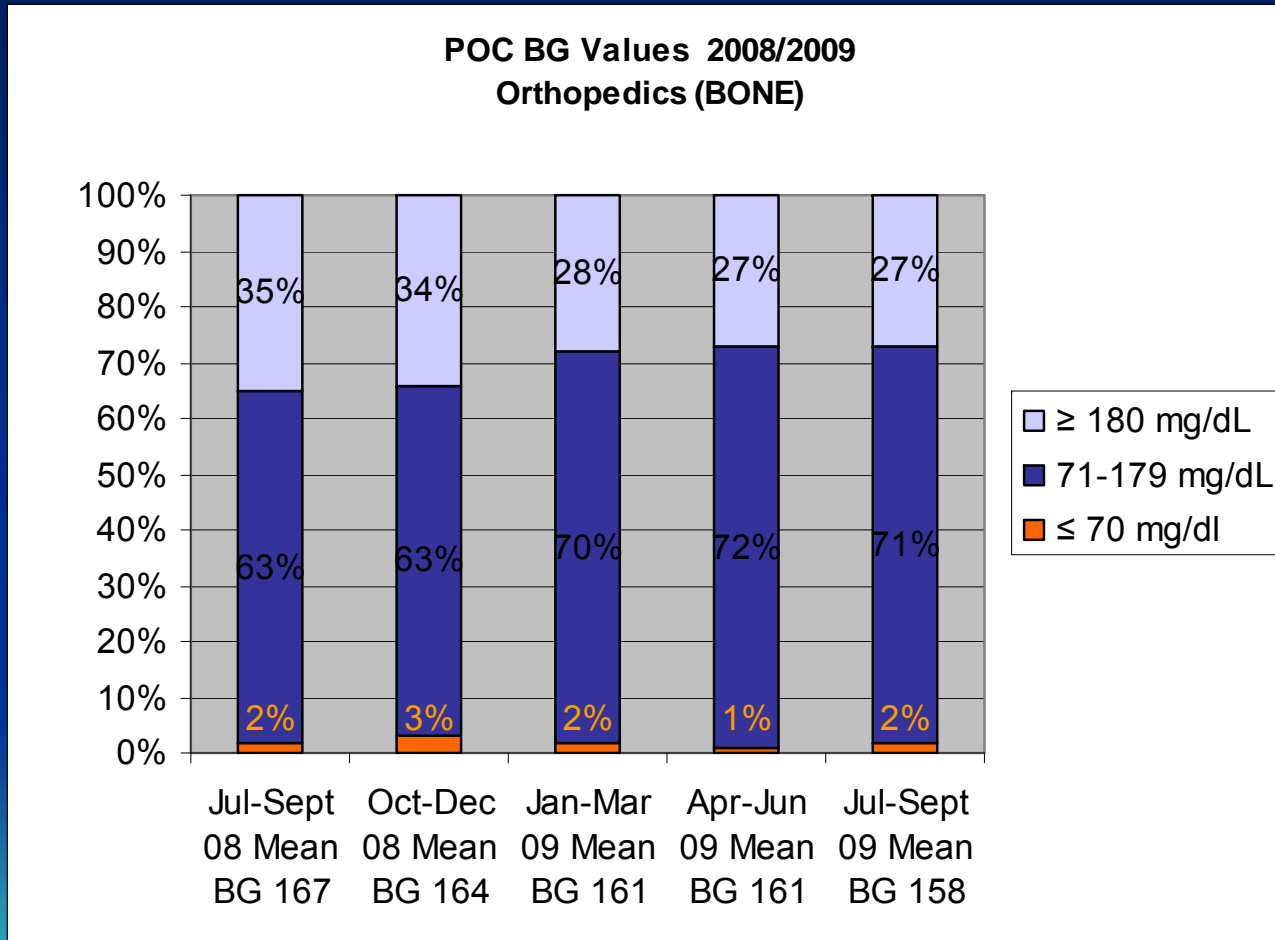


# How are we doing at UCH?



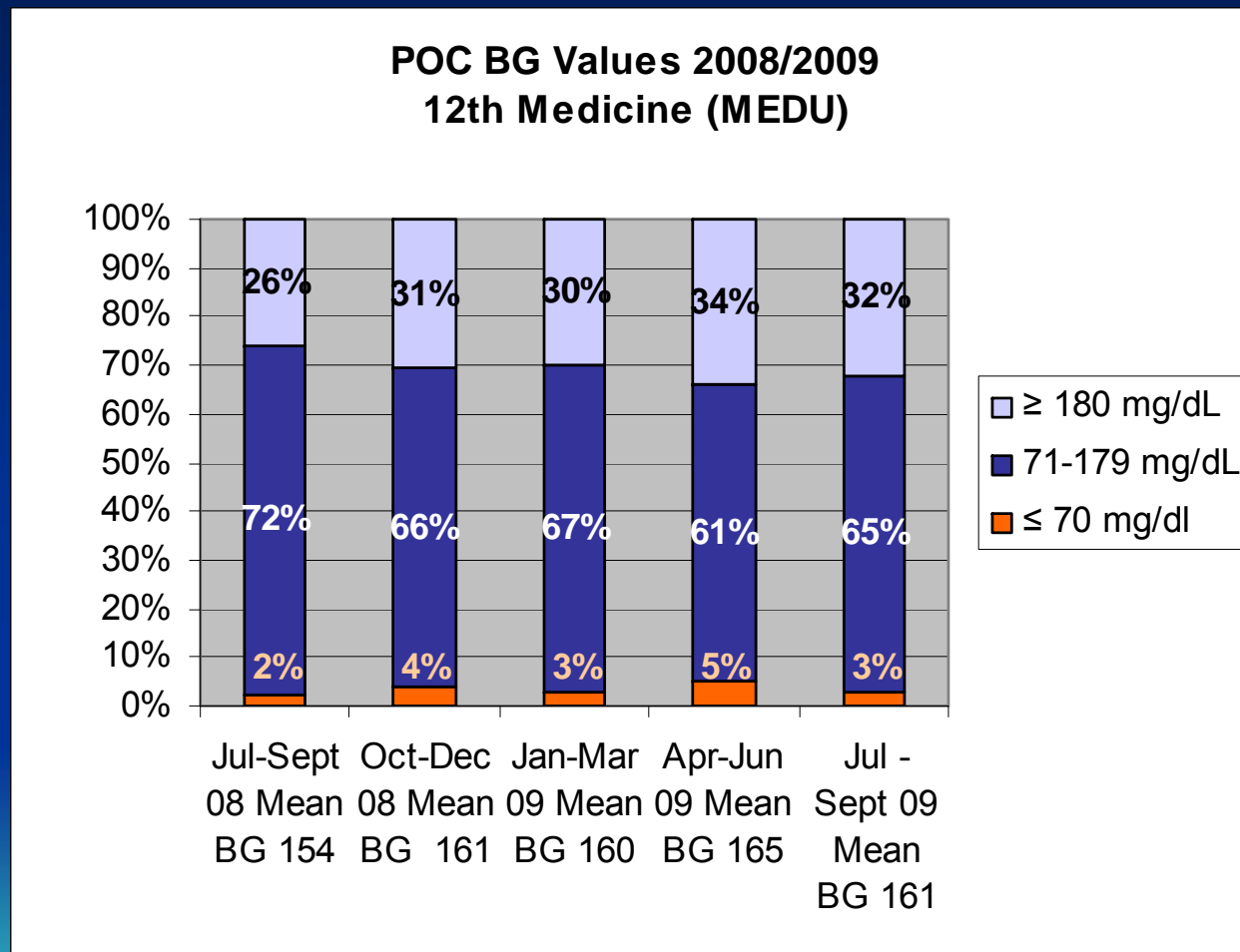
• Inpatient Floors - POC Blood Glucose Values. Quarterly Report CY 2008/2009. Data Source: Care Manager The Diabetes Program

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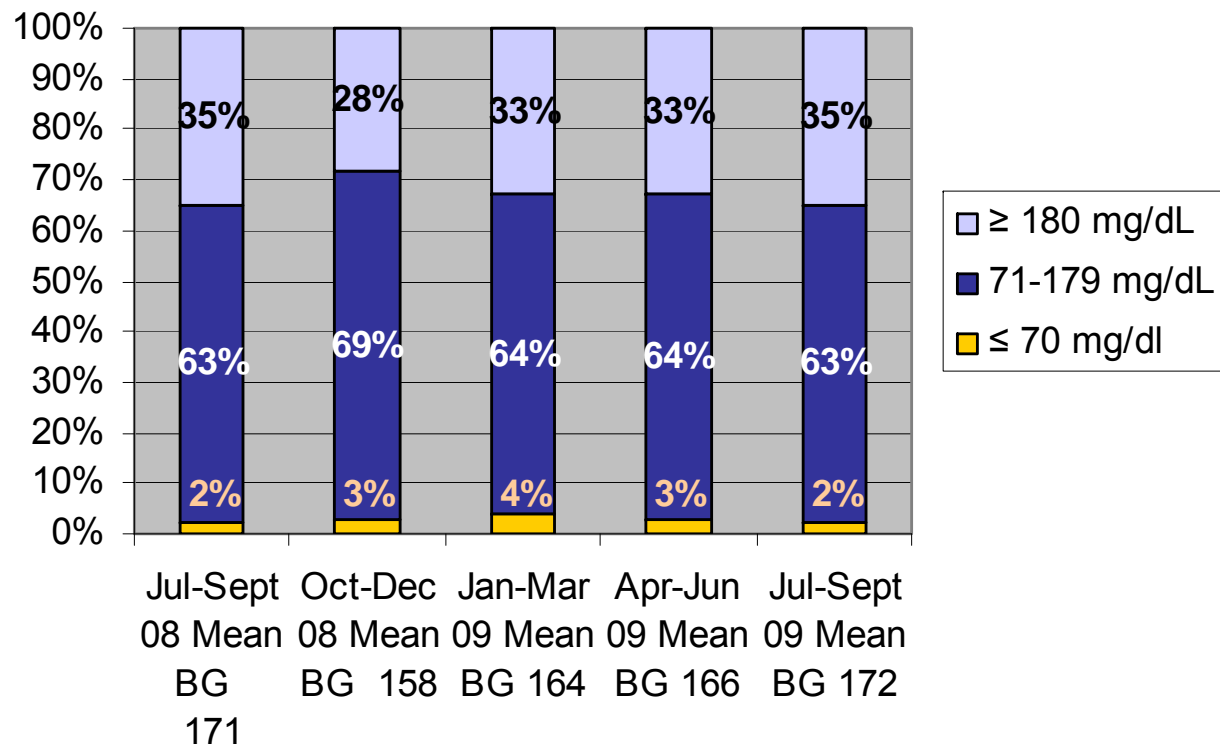
# How are we doing at UCH?



• Inpatient Floors - POC Blood Glucose Values. Quarterly Report CY 2008/2009. Data Source: Care Manager The Diabetes Program

# How are we doing at UCH?

**POC BG Values 2008/2009  
6th Medicine (MDSS)**



# How are we doing?

## *UCH vs Nationally*

- UCH Trends

- Hyperglycemia: ~1/3rd of all POC values
- Euglycemia: ~2/3rds of all POC values
- Hypoglycemia: ~1-3% of all POC values

- National Trends

- Hyperglycemia: 31% of all POC values, 31% of pts
- Euglycemia: ~2/3rds of all POC values
- Hypoglycemia: 1.2% of all POC values, 11% of pts

# Inpatient Hyperglycemia: *Current Treatment Guidelines*

- Critically ill **surgical** pts
  - IV insulin protocols
- Critically ill **nonsurgical** pts
  - IV insulin protocols
- Non-critically ill pts
  - Insulin preferred drug of choice
  - ISS not recommended as monotherapy




# Physiological Insulin: Components

- **Basal:**
  - Targets *fasting* hyperglycemia
- **Nutritional:**
  - Targets IV dextrose, TPN, enteral feeds, nutritional supplements, or meals (prandial)
- **Correction:**
  - “supplemental” insulin for hyperglycemia

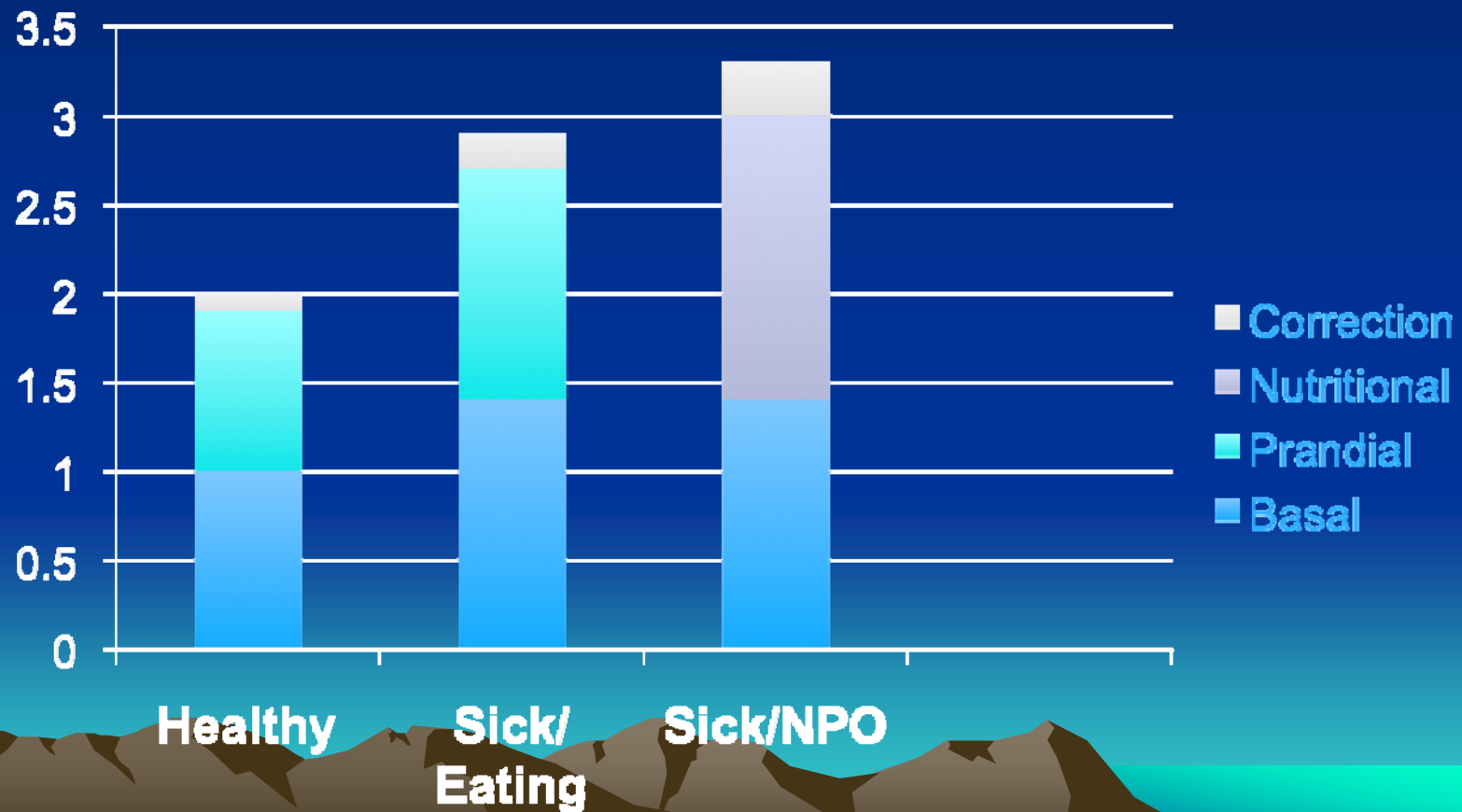
~~SSI~~



# Inpatient Hyperglycemia: *Current Treatment Guidelines*

- **Diabetes Dx**
  - Basal/Bolus + correction dose insulin
- **Nondiabetic Hyperglycemia**
  - Glucose monitoring
  - Initially correction insulin
  - Transition to basal/bolus + correction w/ persistent hyperglycemia
  - Documented in D/C summary w/ appropriate f/u w/ testing
- **Inpatient Hyperglycemia**
  - A1c
  - DMSE  “survival skills” education
  - F/u plan clearly documented

# Insulin Requirements In Health and Illness:



# RABBIT 2 Trial:

*Randomized Study of Basal-Bolus Insulin Therapy in the Inpatient Management of Patients with Type 2 Diabetes*

- Prospective, multicenter, randomized trial
- **Insulin-naive** type 2 diabetic pts on general medicine
- Compared **basal-bolus** vs. **SSI**
- **Primary end point:** mean daily blood glucoses
- **Secondary outcomes:** # hypoglycemic events, # events severe hyperglycemia, LOS, & mortality rate

# RABBIT 2 Trial

- Basal-bolus

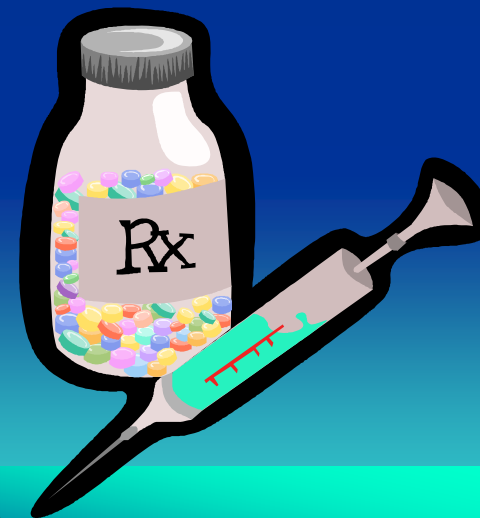
**Total Daily Dose=0.4 or 0.5 u/kg x pt's wt (kg)**  
*Basal:bolus=50:50*

*e.g. Wt=70kg*

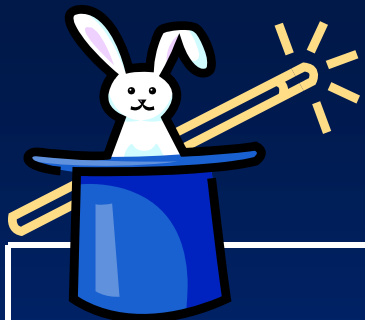
*TDD=0.4u/kg x 70kg = 28 units*

*Basal dose=14 units*

*Bolus dose=14 units (~5 units AC)*



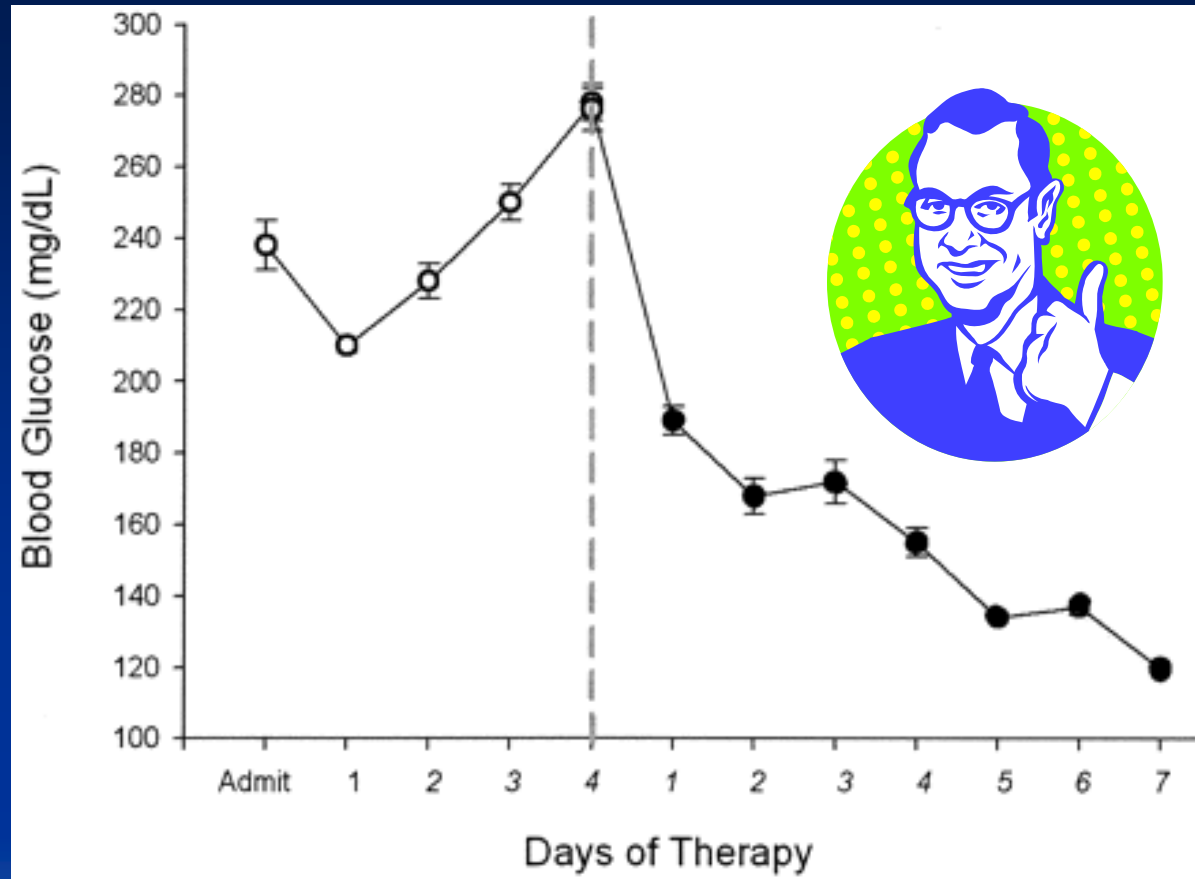
*Umpierrez et al. Diabetes Care 30(9): 2181-2186, 2007.*



# RABBIT 2 Trial

	<b>Basal-bolus</b>	<b>SSI</b>
<b>TDD</b>	22+/-2 (basal) 20+/-1 (bolus)	12.5+/-2*
<b>Goal Mean Glc</b>	66%	38%*
<b>Mean Glc</b>	166+/-32 147+/-36 164+/-35	193+/-54* 165+/-41* 188+/-45*
<b>Hypoglycemia</b>	3%(0.4%)	3%(0.2%)
<b>Hyperglycemia</b>	0%	14%*

# Rabbit 2 Trial



*Glycemic control rapidly improved after switching to basal-bolus regimen after persistent severe hyperglycemia despite increasing doses of RISS.*

# ***Breaking News.....***

- **RABBIT 2 SURGERY**
  - Basal-bolus in surgical pts resulted in improved glycemic control vs SSRI
  - Lower rates of ARF & nonwound infections (UTI, PNA, bacteremia)
  - Safe; no sign differences in mild or severe hypoglycemia vs SSRI



# UCH SQ Insulin Order Set

## *Glargine & Lispro*

### *Insulin Sensitive*

	<b>PO</b>	<b>NPO</b>
<b>71-124</b>	3 units	No Insulin
<b>125-149</b>	3 units	No Insulin
<b>150-199</b>	4 units	1 unit
<b>200-249</b>	5 units	2 units
<b>250-299</b>	6 units	3 units
<b>300-349</b>	7 units	4 units
<b>350-399</b>	8 units	5 units
<b>&gt;/- 400</b>	Call MD	Call MD

- **Teaching Points**
  - Not only “SSI”
  - Prandial insulin + correction factor

# UCH SQ Insulin Order Set

## *Glargine & Lispro*

### *Insulin Resistant*

	PO	NPO
71-124	6 units	No Insulin
125-149	7 units	1 unit
150-199	8 units	2 units
200-249	10 units	4 units
250-299	12 units	6 units
300-349	14 units	8 units
350-399	16 units	10 units
>/- 400	Call MD	Call MD

- Based on **6 units** prandial insulin + correction factor

# UCH SQ Insulin Order Set

## *Glargine & Lispro*

**Customized**

	PO	NPO
71-124	_ units	_ units
125-149	_ units	_ units
150-199	_ units	_ units
200-249	_ units	_ units
250-299	_ units	_ units
300-349	_ units	_ units
350-399	_ units	_ units
>/- 400	Call MD	Call MD

- Make your own!!!!

# Treatment Practices

## *UCH vs Nationally*

- UCH
  - Insulin order sets
    - Initiated if unknown PMH when POC > 170mg/dl
    - Adjusting insulin q2-3 days, 40% of pts had adjustments
    - < 25% use of basal insulin at admission
    - ~50% basal use during hospitalization, 3-4d lag time
    - < 20-40% of interns knew pt's POC or lispro doses
- Nationally
  - 90% use of POE ISS
  - 43% of pts w/ basal during hospitalization
  - Only 35% of pts w/ hyper/hypoglycemia had adjustments made to insulin orders

Austin, M. Glycemic Control and Clinical Inertia in the Inpatient Setting. QI Project, 9/08.

Schnipper et al. Inpatient Management of Diabetes and Hyperglycemia Among General Medicine Patients at a Large Teaching Hospital. *Journal of Hospital Medicine* 1(3): 145-150, 2006.

# Don't Fall for These Common Treatment Pitfalls

- Basal/bolus + correction
  - Using order set as “ISS”  $\Rightarrow$  Bolus + correction factor
  - Not using basal  $\Rightarrow$  Rabbit 2 trial
  - Converting “sensitive” to “resistant” for persistent hyperglycemia  $\Rightarrow$  Add Basal
  - Uptitrating basal w/o bolus  $\Rightarrow$  Basal: Bolus=50:50
  - Lispro standing order + order set  $\Rightarrow$  Customize



# Don't Fall for These Common Treatment Pitfalls

- Holding basal when NPO ➡ 50%-100% OK
- Adjusting insulin w/o discussing w/ nurse ➡ Team Work!

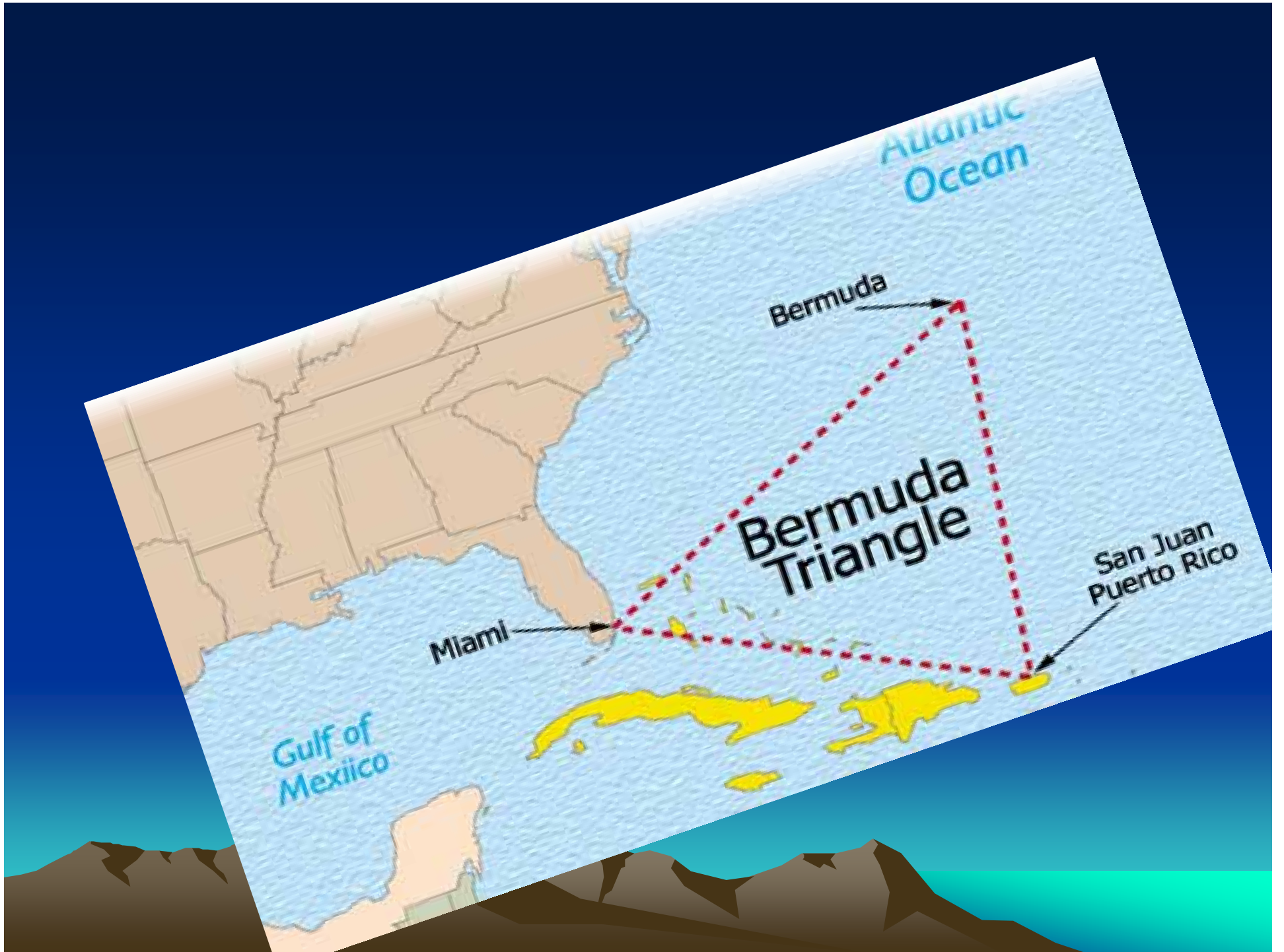


# Inpatient Hyperglycemia: *Transitions*

- D/c summaries for **36%** of hyperglycemic pts did NOT mention dx of DM or hyperglycemia despite 1/3<sup>rd</sup> having documentation in progress note
- **7 weeks** average time for post-hosp DM visit
- **16%** of DM pts w/o f/u visit

Clement et al. Management of Diabetes and Hyperglycemia in Hospital. Diabetes Care 27(2): 553-591, 2004.

Wheeler et al. Inpatient to Outpatient Transfer of Care in Urban Patients With Diabetes. Arch Intern Med 164: 447-453, 2004.



# Transitions

## Discharge Planning:

- **Starts at admission**
  - Prior Dx of DM/Hyperglycemia
  - Management of DM
  - Prior glycemic control (A1c)
  - Resource availability



# Outpatient DM Rx Costs:

## *Oral Agents*

- **Wal-Mart:**
  - Chlorpropamide
  - Glimepiride
  - Glipizide
  - Glyburide
  - Metformin
- **Walgreen's:**
  - Glimepiride
  - Glipizide
  - Glyburide
  - Glyburide/Metformin
  - Metformin

**\$4 RX**



# Outpatient DM Rx Costs:

## *Insulin Therapy*

- **Basal**
  - Glargine \$101.75
  - NPH \$48.15
- **Bolus**
  - Lispro \$101.75
  - Regular \$48.15

***Glargine & Lispro  
ARE covered  
under CICP!***





# Transitions

## Discharge Planning:

### *“Survival Skills” Education*

- 1. Level of understanding
- 2. Home BG goals & monitoring
- 3. S/Sx of hyper/hypoglycemia, prevention & treatment
- 4. Outpt MD
- 5. Eating patterns
- 6. Rx management
- 7. Sick-day management
- 8. Needle/syringe disposal

# Transitions

## Discharge Planning:

- PCP F/u w/in 1 month
- Communication w/ PCP



# What the heck is going on?

- **Clinical Inertia**

- *“not initiating or intensifying therapy when doing so is indicated”.*

## Main Causes

- 1). Overestimate of care provided
- 2). Use of “soft” reasons to avoid intensification
- 3). Lack of education, training and practice organization aimed at achieving specific goals



# Turning Clinical Inertia into Momentum



# Inpatient Hyperglycemia:

## *Standardized Patient Approach*

- *Identify reasons for hyperglycemia*
  - Dx of DM, stress-induced, iatrogenic
- *Identify clinical setting*
  - SICU, MICU, wards, stroke, etc
- *Identify treatment goals for clinical setting*
- *Implement treatment plan as a team approach (MD, RN, CNA, RD, patient, etc)*
- *Outline transition plan clearly for providers and patient*

# Case Presentation Revisted:

*Lets apply what we've learned*

- Admission
  - Primary Dx=Pyelonephritis
  - Secondary Dx=Hyperglycemia/ARF

*Why does B.S have hyperglycemia?*

*Presume underlying insulin resistance + stress hyperglycemia.*



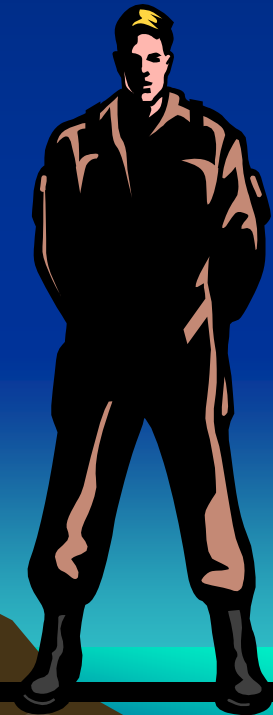
# Case Presentation Revisted:

*Lets apply what we've learned*

- *Identify clinical setting*
  - B.S. admitted to general medicine, “noncritically ill”
- *Identify treatment goals for clinical setting*
  - Non-critically ill pts
    - Fasting < 126mg/dl
    - Random <180-200mg/dl
- *Implement treatment plan as a team approach (MD, RN, CNA, RD, patient, etc)*
  - Basal/bolus + correction factor
  - Obtain A1c
  - “survival skills” diabetic education
  - Actively treat DM
- *Outline transition plan clearly for providers and patient*
  - Clearly document in D/C summary
  - Outpatient f/u plan
  - Determine D/C Rx

# ***Special Thanks!!!!***

- Bridget Everhart
- Carolee Whitehill



*Questions?*

