



# Getting Glucose to Goal in the Hospital Setting 2022

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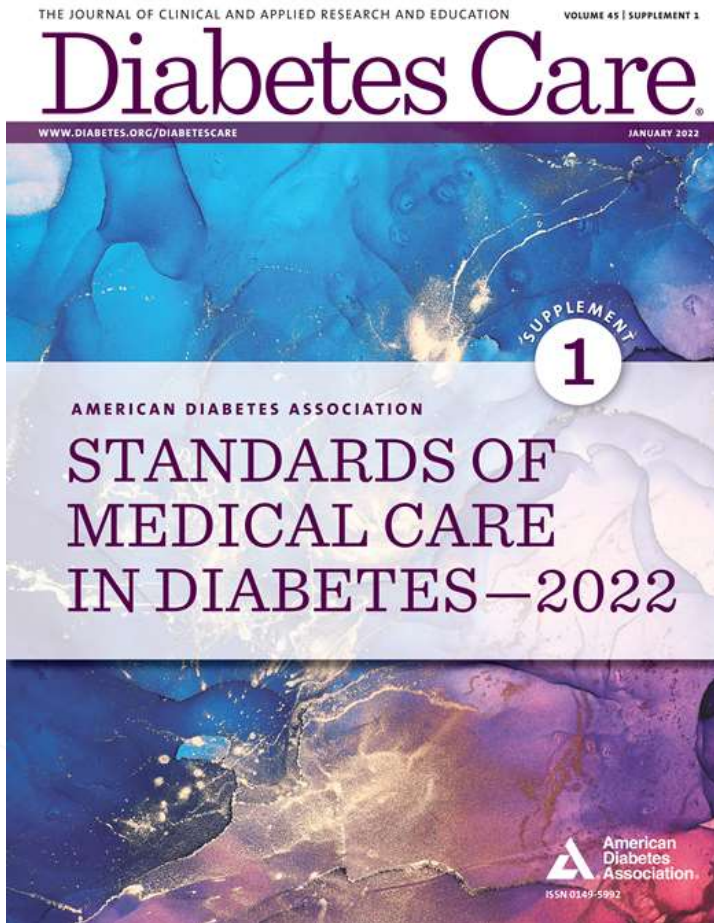
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# Coach Bev has no conflict of interest

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- ▶ Gathers information from reading package inserts, research and standards



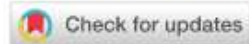
# References



STANDARDS OF CARE | DECEMBER 16 2021

## 16. Diabetes Care in the Hospital: *Standards of Medical Care in Diabetes—2022* **FREE**

American Diabetes Association Professional Practice Committee



*Diabetes Care* 2022;45(Supplement\_1):S244–S253

<https://doi.org/10.2337/dc22-S016>

*Position Statement*

## The Role of the Diabetes Care and Education Specialist in the Hospital Setting

The Association of Diabetes Care & Education Specialists

The Science of Diabetes  
Self-Management and Care  
2022, Vol. 48(3) 184–191  
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- ▶ **Level 4 |  
Basal Bolus Therapy in  
Hospitals | 1.5 CEs**
- ▶ **Level 2 |  
Hyperglycemic Crisis,  
DKA & HHS  
Standards | 1.0 CE**



# Getting Glucose to GOAL In the Hospital

## Objectives:

- ▶ Discuss the importance of inpatient glucose management
- ▶ Describe the goals of care
- ▶ Describe basal bolus insulin therapy
- ▶ Discuss management considerations for a variety of situations.



# Glucose Management and Hospitalized Patients



- ▶ 23.8% of Diabetes Care and Education Specialists work in the hospital setting
- ▶ People hospitalized with critical illness and hyperglycemia warrants our attention.
- ▶ “Body on FIRE”



# Hospitals and Hyperglycemia- What's the Big Deal?

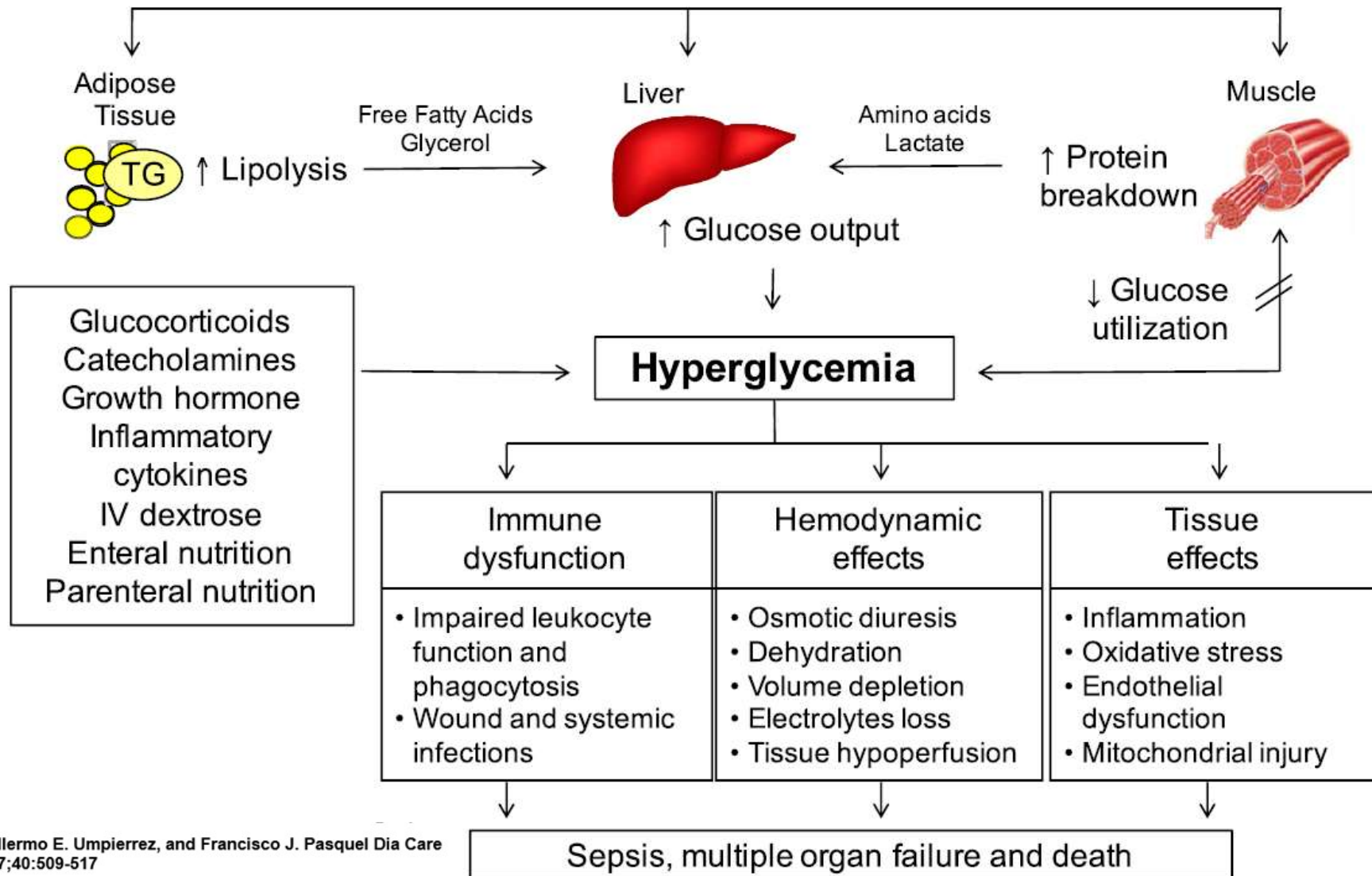
- ▶ Hyperglycemia is associated with increased morbidity and mortality in hospital settings.
  - ▶ Acute Myocardial Infarction
  - ▶ Stroke
  - ▶ Cardiac Surgery
  - ▶ Infection
  - ▶ Longer lengths of stay





# Stress response and hyperglycemia

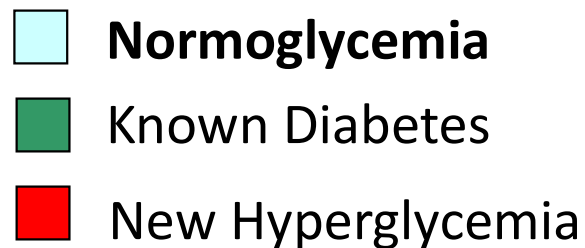
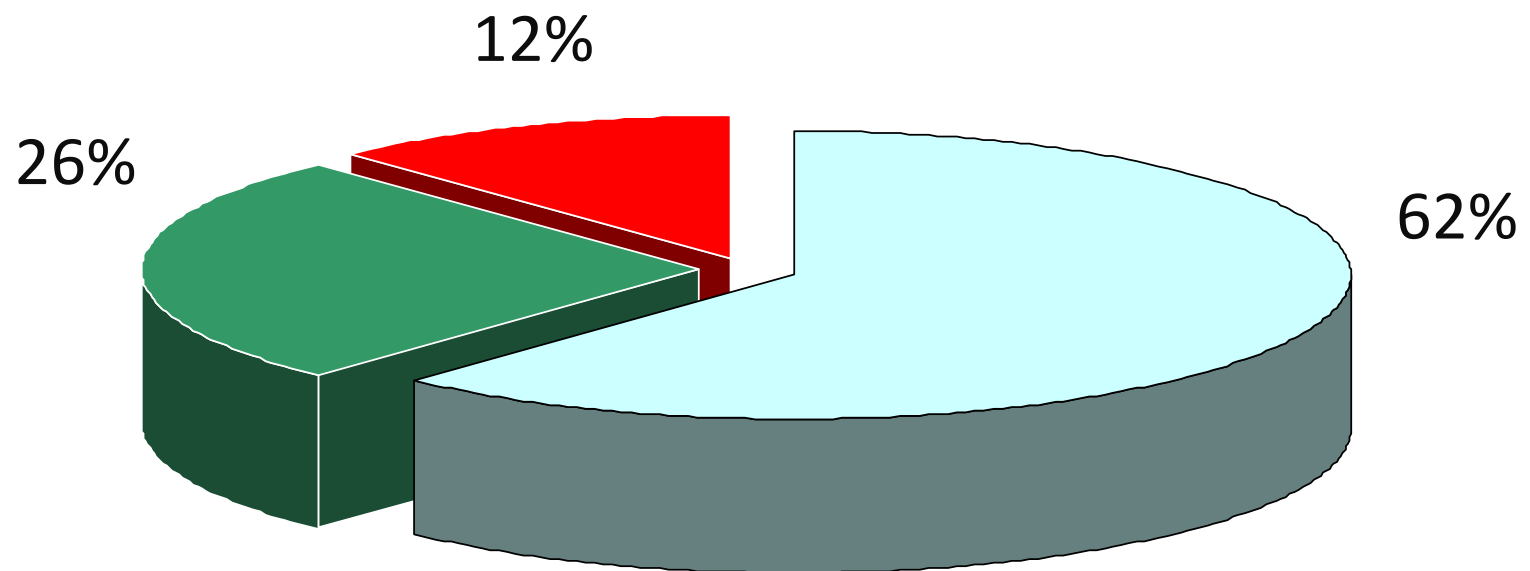
## Metabolic and Hormonal Changes Leading to Stress Hyperglycemia



Guillermo E. Umpierrez, and Francisco J. Pasquel *Care* 2017;40:509-517



# Hyperglycemia\*: A Common Comorbidity in Medical-Surgical Patients in a Community Hospital



**n = 2,020**

\* Hyperglycemia: Fasting BG  $\geq$  126 mg/dl  
or Random BG  $\geq$  200 mg/dl X 2

# Hyperglycemia in Patients With Undiagnosed Diabetes

Hyperglycemia in 38% of pts admitted to hospital

- 26% had known history of diabetes
- 12% had no history of diabetes

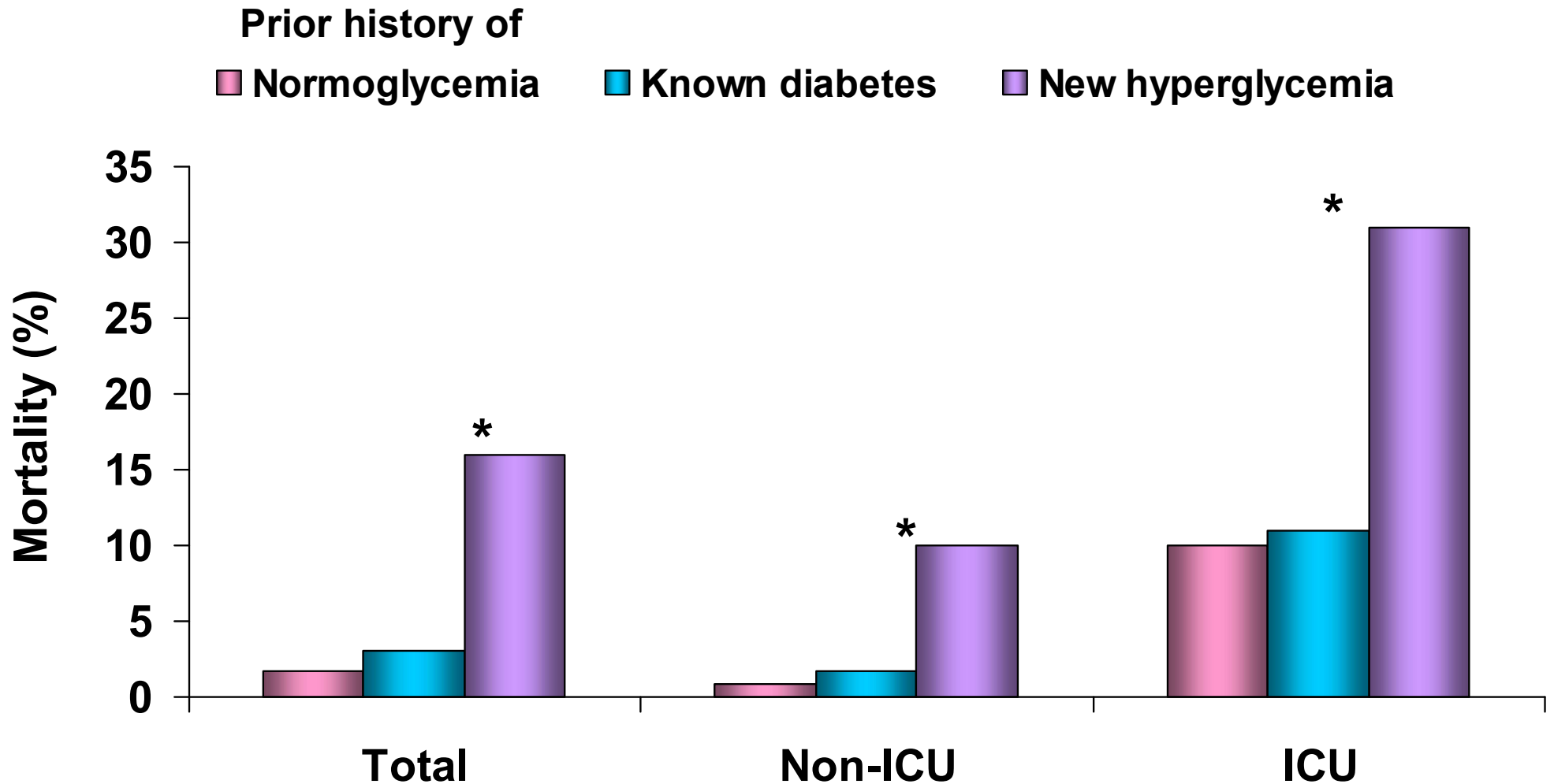
Mortality rate – non dx, dx and no diabetes

- 1.7% - pts without diabetes
- 3% - pts dx with diabetes
- 16% - hyperglycemia, undiagnosed or treated

All hospital patients screened for hyperglycemia?



# Effect of Hyperglycemia on Hospital Mortality



\* $P < .01$  compared with normoglycemia and known diabetes.

Umpierrez GE et al. *J Clin Endocrinol Metab.* 2002;87:978-982.



# Why Does JS Have A Longer Length Of Stay? Poll 1.

JS has type 2 diabetes, with glucose levels in the 300s who is admitted to the hospital to treat a severe case of cellulitis. JS asks the nurse how long they will be in the hospital. The nurse knows JS will probably have an extended stay due to diabetes coupled with an infection. What is the best physiologic explanation for JS's increased risk of a complicated and lengthy hospital stay.



- A. Decreased insulin resistance, increased glucagon secretion and increased counterregulatory hormones.
- B. Increased nitric oxide levels coupled with less effective immune response.
- C. Decreased risk of acidosis due to a surge of cortisol, adrenaline and growth hormone.
- D. Increased free fatty acids, ketones, lactate and an excess of inflammatory cytokines.



# 7.8 Million Hospital Discharges with Diabetes

1.7 million due to CV Disease

- Ischemic heart disease and stroke

130,000 due to lower extremity amputations



209,000 due to hyperglycemic crisis

57,000 due to hypoglycemia

Early and aggressive intervention matters

*Position Statement*

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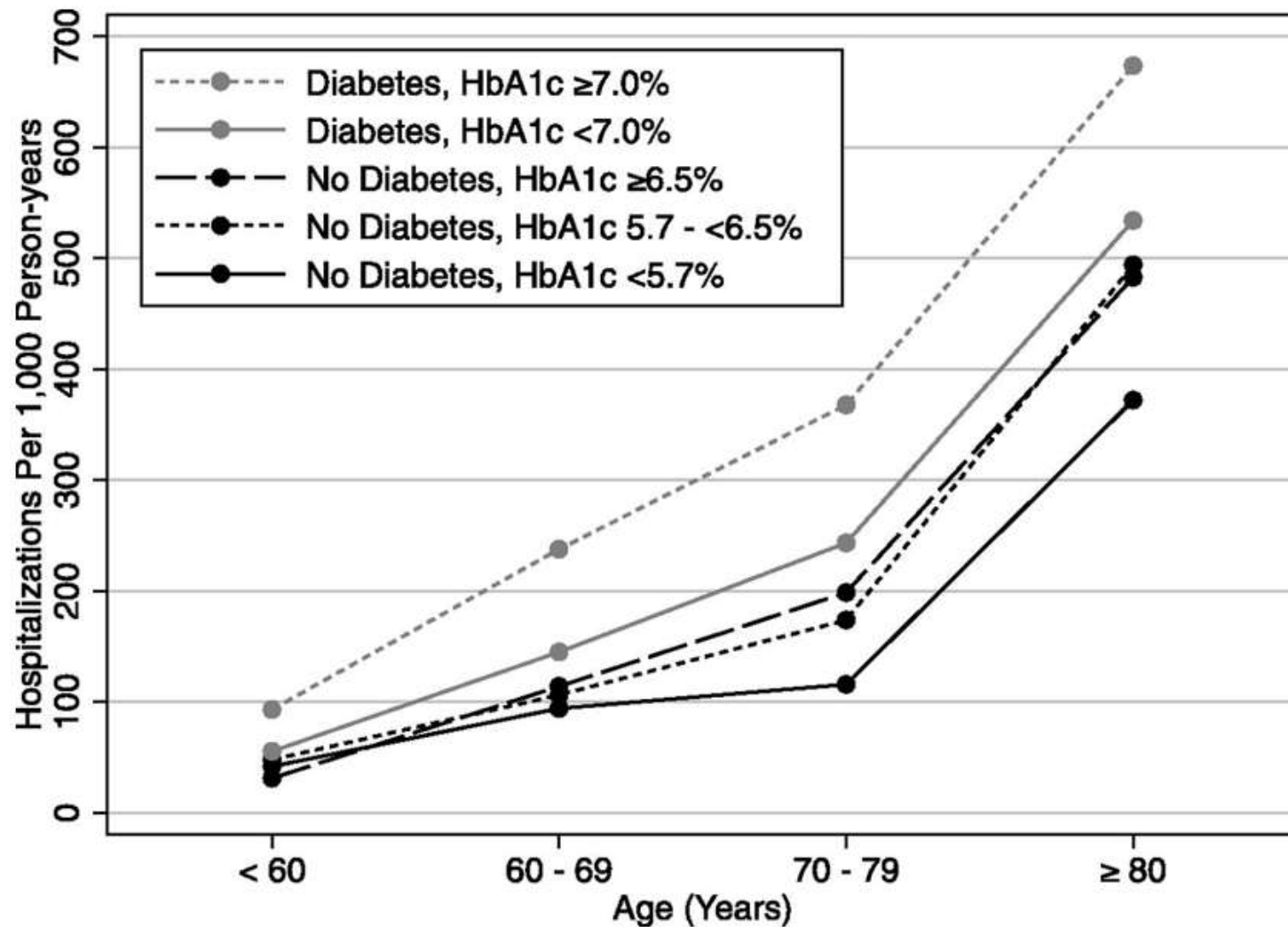
# Inpatient Hyperglycemia and Diabetes in Older Adults

- ▶ Hospitalization 3.1 times higher for all people with diabetes (compared to those without)
- ▶ Diabetes increases with age:
  - ▶ 65-75 yrs, 20% with diabetes
  - ▶ 80 yrs plus, 40% with diabetes
- ▶ Inpatients over the age of 65
  - ▶ 70% in critical care and cardiac surgery are hyperglycemic (BG > 140)
  - ▶ 30% of general medicine and surgery are hyperglycemic



# Management of Inpatient Hyperglycemia and Diabetes in Older Adults

Longitudinal data on all-cause hospitalizations in the ARIC Study (15).



Guillermo E. Umpierrez, and Francisco J. Pasquel *Diabetes Care* 2017;40:509-517





# Hospital Readmissions with Diabetes

ADA Standards

- ▶ Readmission rates of 14% and 20%
  - ▶ nearly 2xs that those without diabetes
- ▶ If diabetes and hospitalized
  - ▶ 30% have two or more hospital stays
  - ▶ Hospitalization accounts for 60% of diabetes direct medical costs
- ▶ Factors contributing to readmission include
  - male sex
  - longer duration of prior hospitalization,
  - number of previous hospitalizations,
  - number and severity of comorbidities,
  - lower socioeconomic and/or educational status;
- ▶ *Scheduled home health visits and timely outpatient follow-up reduce rates of readmission*

# We can make a difference



# Role of Inpt Diabetes Specialist

Delivery of and/or oversight for person-centered patient and family education;

Oversight and assistance in creating education materials and resources;

Care coordination and transitional care support;

Provision of nutrition therapy;

Implementation of glycemic management best practices, including medication therapy and hyperglycemia/

Hypoglycemia prevention and treatment;

Identification of quality improvement opportunities and coordination of projects;

Provision of care during natural disasters and/or pandemics;

Other role expectations, including professional education and professional advancement

*Position Statement*

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The Association of Diabetes Care & Education Specialists

# Causes of Inpatient Hyperglycemia

- ▶ Pre-existing Type 1 or Type 2
- ▶ Discovered diabetes / prediabetes
- ▶ Holding of usual diabetes med(s)
- ▶ Infection, Cardiac events
- ▶ Admin of agents that cause hyperglycemia
  - ▶ Steroids
  - ▶ Enteral or parenteral nutrition
  - ▶ Vasopressors (epi)



# BR Says “Where Is My Insulin?”

BR has type 1 diabetes and takes takes 1 unit of bolus insulin for every 15 gms of carbohydrate. A 60 gm carb breakfast tray arrives. BR’s blood sugar is 93 and BR let’s the nurse know they need 4 units of insulin. Nurse informs BR that the orders say BR only gets insulin if glucose is 150 or greater.

**BR states, I need my insulin.**

What’s the best action?



# Poll question 2

- ▶ PZ is 61, admitted for CHF. Fasting blood glucose 157. What is the next step according to ADA Standards?
  - A. Start insulin drip
  - B. Initiate basal bolus therapy
  - C. Evaluate A1c
  - D. Order sliding scale insulin



# On Admission

- ▶ Any blood glucose above 140
  - ▶ Check A1c (if no documented result over past 3 months)
  - ▶ If A1c 6.5% or more, preexisting diabetes
- ▶ If BG  $\geq$  180 – start insulin therapy
  
- ▶ Pre Diabetes criteria:
  - ▶ Fasting Glucose = 100-125mg/dl
  - ▶ A1c 5.7 – 6.4%
- ▶ Diabetes criteria:
  - ▶ Fasting Glucose = 126 mg/dl +
  - ▶ Random Glucose = 200 mg/dl +
  - ▶ A1c 6.5% +



# ADA Goals and Treatments For Hospitalized Patients

## Blood glucose goal 140-180

- ▶ Individualize based on status
- ▶ Avoid hypo and hyper
- ▶ Goal of 110 -140 for selected ind's
- ▶ Start subq insulin if BG > 180
  - ▶ Stop oral meds (most of time)
  - ▶ Basal bolus therapy if eating
  - ▶ Basal + correction scale if higher risk for hypo
- ▶ Critical Care:
  - ▶ Basal bolus or Insulin drip



ADA Standards  
2022





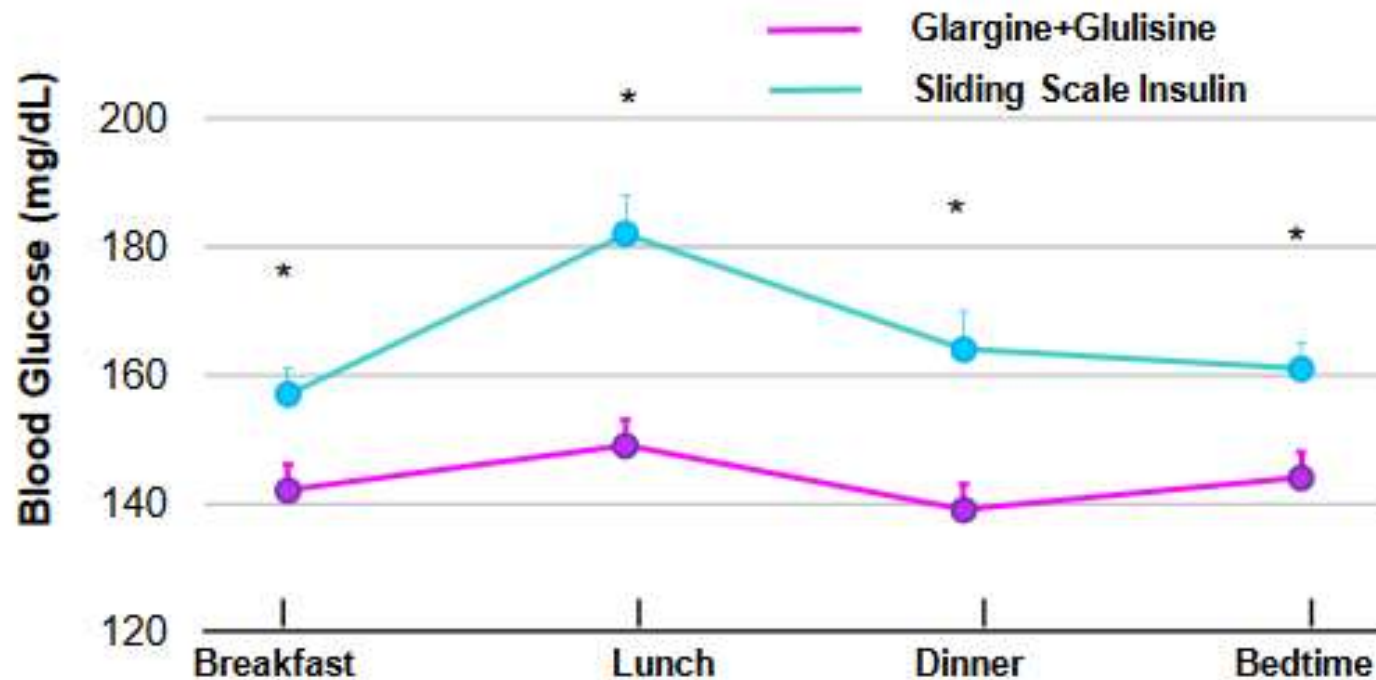
# Diabetes Med Management in Hospital - ADA

- ▶ Incorporate electronic / standardized insulin order sets
- ▶ The sole use of Sliding Scale insulin is discouraged
- ▶ Monitor BG
  - ▶ Before meal and hs if eating
  - ▶ Q 4-6 hours if on TPN or tube feeding
- ▶ Hypoglycemia prevention protocol



# RABBIT 2 Trial

## Mean BG before meals and at bedtime during basal bolus and SSI therapy

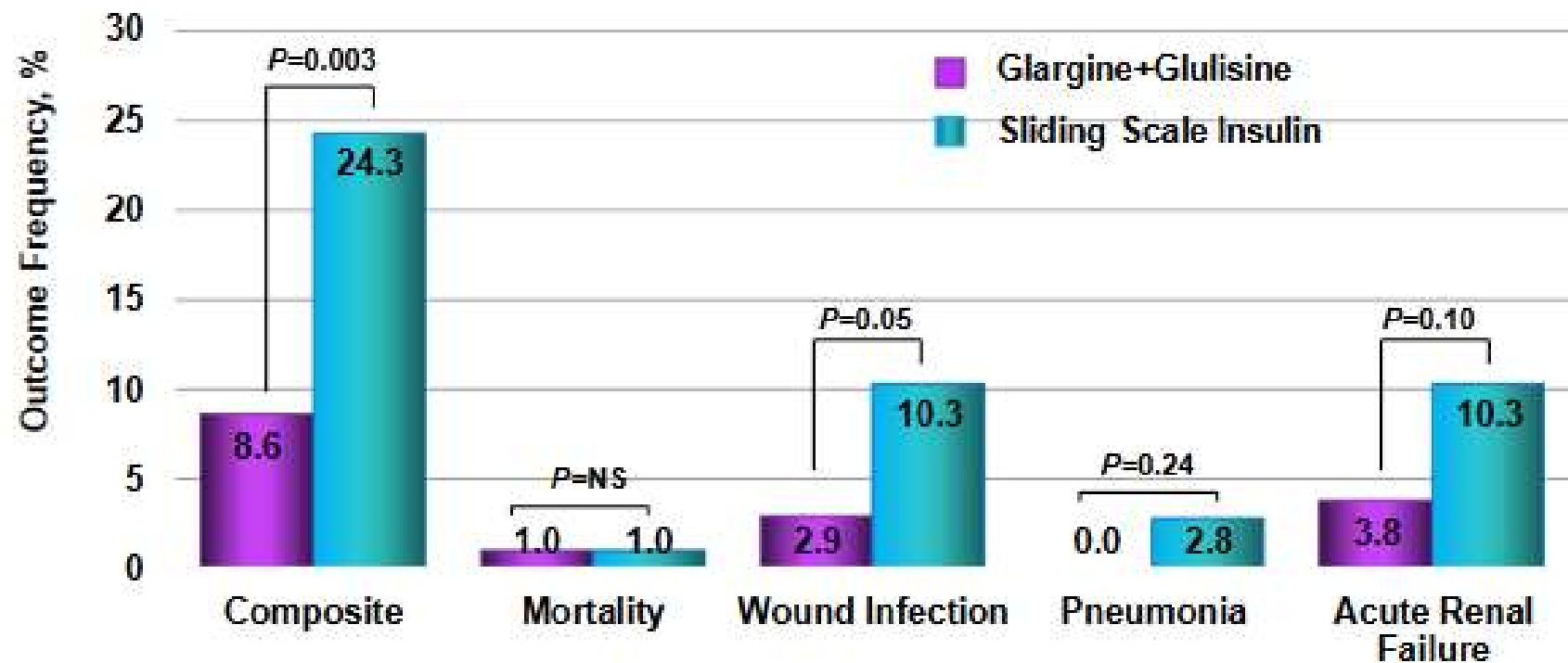


\*p<0.001.

Umpierrez GE, et al. Diabetes Care. 2011;34(2):256-261.

# RABBIT 2 Trial

## Postoperative Complications



\* Composite of hospital complications: wound infection, pneumonia, respiratory failure, acute renal failure, and bacteremia. Umpierrez GE, et al. Diabetes Care. 2011;34(2):256-261.

# Glucose Goals – Clinical judgement required

## More relaxed BG goals

- At risk of hypo due to other health issues (up to 250)
- Terminally ill
- In setting where intensive checks not feasible



## When setting goals consider:

- Clinical status especially renal function
- Severity of illness
- Nutritional status
- Glucose variability and trends
- Usual management plan and ind's expertise

# Recommendations for Managing Patients With Diabetes in the Hospital Setting

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## Antihyperglycemic Therapy

**Insulin**  
Recommended

**Some Oral DM Meds**  
May be okay

**IV Insulin or Basal  
Bolus Insulin**

Critically ill patients  
in the ICU

**SC Basal Bolus  
Insulin or  
Basal + Correction**

Non-critically ill  
patients

*[Umpierrez et al](#)*



# Hospital Care of Diabetes and COVID

- ▶ Sitagliptin and Metformin
  - ▶ Sitagliptin decreases inflammatory response
  - ▶ Metformin decreases COVID severity
- ▶ Basal bolus insulin or drips
- ▶ Own Insulin pump, CGM and or meter may be used for non-intensive care settings if pt is alert and functional
  - ▶ Need hospital policy and procedure
- ▶ Close monitoring of blood glucose
- ▶ Watch for DKA



# Meds for Diabetes PocketCards from [www.DiabetesEd.net](http://www.DiabetesEd.net)

## Common Oral Diabetes Meds



Class/Main Action	Name(s)	Daily Dose Range	Considerations
<b>Biguanides</b> <ul style="list-style-type: none"> <li>Decreases hepatic glucose output</li> <li>First line med at diagnosis of type 2</li> </ul>	metformin (Glucophage)	500 - 2550 mg (usually BID w/ meal)	<b>Side effects:</b> nausea, bloating, diarrhea, B12 deficiency. To minimize GI Side effects, use XR and take w/ meals. <b>Obtain GFR before starting.</b> <ul style="list-style-type: none"> <li>If GFR &lt;30, do not use.</li> <li>If GFR &lt;45, don't start Meformin</li> <li>If pt on Metformin and GFR falls to 30-45, eval risk vs. benefit; consider decreasing dose.</li> </ul> <b>For dye study,</b> if GFR <60, liver disease, alcoholism or heart failure, restart metformin after 48 hours if renal function stable. <b>Benefits:</b> lowers cholesterol, no hypo or weight gain, cheap. Approved for pediatrics, 10 yrs + Lowers A1c 1.0%-2.0%.
	Riomet (liquid metformin)	500 - 2550 mg 500mg/5mL	
	Extended Release XR (Glucophage XR) (Glumetza) (Fortamet)	(1x daily w/dinner) 500 – 2000 mg 500 – 2000 mg 500 – 2500 mg	
<b>Sulfonylureas</b> <ul style="list-style-type: none"> <li>Stimulates sustained insulin release</li> </ul>	glyburide: (Diabeta) (Glynase PresTabs)	1.25 – 20 mg 0.75 – 12 mg	Can take once or twice daily before meals. Low cost generic. <b>Side effects:</b> hypoglycemia and weight gain. Eliminated via kidney. <b>Caution:</b> Glyburide most likely to cause hypoglycemia. Lowers A1c 1.0% – 2.0%.
	glipizide: (Glucotrol) (Glucotrol XL)	2.5 – 40 mg 2.5 – 20 mg	
	glimepiride (Amaryl)	1.0 – 8 mg	

All PocketCard content is for educational purposes only. Please consult prescribing information for detailed guidelines.

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# Meds for Diabetes PocketCards from [www.DiabetesEd.net](http://www.DiabetesEd.net)

## Common Oral Diabetes Meds

Class/Main Action	Name(s)	Daily Dose Range	Considerations
<b>SGLT2 Inhibitors</b> "Glucoretic" <ul style="list-style-type: none"> <li>Decreases glucose reabsorption in kidneys</li> </ul> <p>Stopped during hospital stay and during acute illness.</p>	Canagliflozin* (Invokana)	100 - 300 mg 1x daily	<b>Side effects:</b> hypotension, UTIs, genital infections, increased urination, weight loss, ketoacidosis. <b>Heart Failure, CV &amp; Kidney Protection:</b> 1st line therapy for Heart Failure (HF), Kidney Disease (CKD), Cardiovascular Disease, before or with metformin. <b>Considerations:</b> See Package Insert (PI) for GFR cut-offs, dosing. Limited BG lowering effect if GFR < 45, still benefits kidneys & heart at lower GFR. For renal protection, use SGLT-2 therapy if eGFR ≥ 25 & UACR ≥ 300 (ADA). <b>Benefits:</b> SGLT-2s* reduce BG, CV death & HF, slow CKD. Lowers A1c 0.6% -1.5%.
	Dapagliflozin* (Farxiga)	5 - 10 mg 1x daily	
	Empagliflozin* (Jardiance)	10 - 25 mg 1x daily	
	Ertugliflozin (Steglatro)	5 - 15 mg 1x daily	
<b>DPP - 4 Inhibitors</b> "Incretin Enhancers" <ul style="list-style-type: none"> <li>Prolongs action of gut hormones</li> <li>Increases insulin secretion</li> <li>Delays gastric emptying</li> </ul>	sitagliptin (Januvia)	25 - 100 mg daily – eliminated via kidney*	*If creat elevated, see med insert for dosing. <b>Side effects:</b> headache and flu-like symptoms. <b>Can cause severe, disabling joint pain.</b> Contact MD, stop med. Report signs of pancreatitis. †Saxagliptin and alogliptin can increase risk of heart failure. Notify MD for shortness of breath, edema, weakness, etc. No wt gain or hypoglycemia. Lowers A1c 0.6%-0.8%.
	saxagliptin (Onglyza)†	2.5 - 5 mg daily – eliminated via kidney*, feces	
	linagliptin (Tradjenta)	5 mg daily – eliminated via feces	
	alogliptin (Nesina)†	6.25 - 25 mg daily – eliminated via kidney*	

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# DKA – What Is The Cause? Poll 3

A 29-year-old arrives in the emergency room in DKA. She has a known history of type 1 diabetes. Her BMI is 23.9 and she is on intensive insulin therapy and an oral medication to help “clear extra sugar”.

On admission, her blood glucose is 149, her pH is 7.2 and she is ketone positive. What is the most likely cause?

- A. She is taking a SGLT-2 Inhibitor
- B. She is omitting her insulin to lose weight
- C. There is a lab error in the glucose reading
- D. New onset celiac disease



# Oral Meds PocketCard

## Common Oral Diabetes Meds

Class/Main Action	Name(s)	Daily Dose Range	Considerations
<b>SGLT2 Inhibitors</b> "Glucretic" <ul style="list-style-type: none"> <li>Decreases glucose reabsorption in kidneys</li> </ul>	Canagliflozin* (Invokana)	100 - 300 mg 1x daily	<b>Side effects:</b> hypotension, UTIs, genital infections, increased urination, weight loss, ketoacidosis. <b>Heart Failure, CV &amp; Kidney Protection:</b> 1st line therapy for Heart Failure (HF), Kidney Disease (CKD), Cardiovascular Disease, before or with metformin. <b>Considerations:</b> See Package Insert (PI) for GFR cut-offs, dosing. Limited BG lowering effect if GFR < 45, still benefits kidneys & heart at lower GFR. For renal protection, use SGLT-2 therapy if eGFR ≥ 25 & UACR ≥ 300 (ADA). <b>Benefits:</b> SGLT-2s* reduce BG, CV death & HF, slow CKD. Lowers A1c 0.6% -1.5%.
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# Bedside Glucose Monitoring

- ▶ Point of Care (POC) monitoring used to guide insulin dosing.
- ▶ POC monitors not as accurate as lab
- ▶ Do not share finger-stick lancing devices.
- ▶ Eval pts symptoms and/or recheck may be necessary if BG result in question.



# Poll Question 4

- ▶ You walk into RLs room (14 yr old with Type 1 diabetes) at 7am and notice they are pale and sweaty, but talking. The fingerstick BG is 58 mg/dl. What is the first action?
  - ▶ A. Recheck BG to confirm reading
  - ▶ B. Call lab stat to get more accurate result
  - ▶ C. Give glucagon or ½ amp of D50
  - ▶ D. Give 4-8 ounces of juice



# Continuous Glucose Monitoring Inpt

- ▶ Not officially FDA approved
- ▶ Many people with diabetes chose to use their own CGM during hospital stay
  - ▶ Bring ample supplies
  - ▶ Results less reliable in critical care setting
- ▶ Hospital needs protocol on safe use
- ▶ Insulin treatment based on hospital glucose monitor results



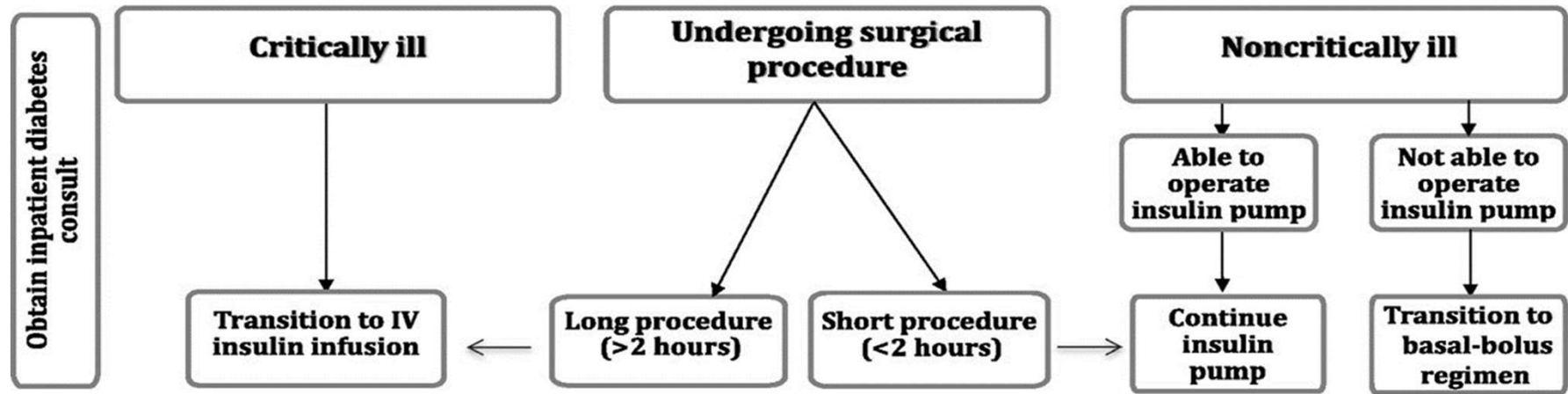
# Insulin Pump Use in Hospitals

- ▶ Many people with diabetes chose to use during hospital stay
  - ▶ Bring ample supplies
  - ▶ Will need to stop if not able to self manage
- ▶ Hospital needs protocol on safe use
- ▶ Insulin treatment plan needs to be documented
  - ▶ Insulin sensitivity, insulin to carb ratio, basal rate and bolus amounts



# Considerations for Inpt Pumps

## Patient With Insulin Pump Admitted to Hospital



### Changes to Pump Therapy With Imaging Studies

<b>X-ray/CT</b>	<b>Pump should be covered by lead apron</b>
<b>MRI</b>	<b>Pump and metal infusion set should be removed</b>
<b>Ultrasound</b>	<b>No need to remove pump but transducer should not be pointed directly at the pump</b>
<b>Cardiac catheterization</b>	<b>Pump should be covered by lead apron</b>
<b>Pacemaker/automatic implantable cardioverter defibrillator (AICD)</b>	<b>Pump should be covered by lead apron</b>
<b>Colonoscopy/EGD</b>	<b>Pump can remain in place</b>
<b>Laser surgery</b>	<b>Pump can remain in place</b>

# Poll Question 5

- ▶ Nurse walks into room to give AR, a Type 2, 10 units of regular insulin. Pt weighs 70 kg and is almost 6 feet tall. Pre meal BG is 88. What is AR at risk of?
  - A. infection due to chronic hyperglycemia
  - B. hyperglycemia since there is no basal insulin
  - C. severe stress response
  - D. hypoglycemia due to over insulinization





# Hypoglycemia – Focus on Prevention

- ▶ Stage 1 Hypoglycemia: BG < 70
  - ▶ Stage 2 Hypo: BG < 54
  - ▶ Stage 3 Hypo: Needs assistance
- 
- ▶ If BG < 100, consider adjusting insulin / meds
  - ▶ If BG < 70, insulin change required
- 
- ▶ Need hypoglycemia treatment policies / action
  - ▶ Need hypo *Prevention Policies*.



# Morning Hypoglycemia – Question 6



LS has type 2 diabetes in the hospital and is ordered for 60 units glargine at bedtime and lispro insulin sliding scale coverage with meals. LS is eating 30-45g of carb with each meal. The am blood glucose levels have been below 70 mg/dL two days in a row. Which of the following changes is most needed to prevent future morning hypoglycemia?

- A. Give the lispro after meals
- B. Make sure LS is on a high carbohydrate meal plan
- C. Reduce glargine insulin dose
- D. Switch LS to oral diabetes medications



# Steps to Prevent Hypo

- ▶ Prior episode predicts future episode
- ▶ Hypo is a sign of metabolic dysregulation
- ▶ Basal insulin causes 78% of hypo.
  - ▶ Need action to decrease basal dose
- ▶ If fasting BG < 100, lower basal insulin
- ▶ If renal failure, conservative insulin dose
- ▶ Patient has N/V or not consistent eater?
  - ▶ Give bolus insulin after meals or use hs scale

DIABETES



# Steps to Prevent Hypo

Anticipate events that put pt at risk of hypo:

- NPO for surgery
- decreasing steroid dose,
- improving infection,
- recovering after cardiac event

Strive to admin the least amount of insulin necessary to reach glycemic targets



# Life Study - MS

74 year old admitted with a foot infection.

WBC is 12.3, glucose 237.

GFR 48 and UACR 212 mg/g

MS has HTN and history of stroke.  
No ketones in urine.

What kind of education would we provide?

How would we manage her BG in hospital?



# Is Inpatient Diabetes Education Realistic?

- ▶ Unique opportunity to address urgent learning needs
- ▶ Brief and targeted education effective
- ▶ Strategies
  - ▶ Empathic listening and open ended questions
  - ▶ “What are you most worried about when it comes to taking care of your diabetes.
- ▶ Assist w/ needed supplies and referrals



Look for  
“teaching moment”  
opportunities



# MNT In Hospital Setting

- ▶ Goal of MNT
  - ▶ Optimize glycemic control
  - ▶ Adequate calories for metabolic demands
  - ▶ Create meal plan guidelines for post discharge
- ▶ Consistent Carb Meal plan most common
- ▶ RD responsible for integrating pts clinical condition to determine a realistic plan for MNT
- ▶ RD referral inpt > outpt



# Provide training to others

- ▶ Diabetes Specialist can extend their reach by training colleagues on provision of best diabetes care.
  - ▶ Assess staff diabetes knowledge and skill;
  - ▶ Enhance staff competencies;
  - ▶ Provide education in a variety of settings, including staff orientation, clinical areas, and grand rounds;
  - ▶ Develop curricula to share with other members of the team;
  - ▶ Utilize a variety of learning tools such as case studies, self-learning modules, journal clubs, simulation,
  - ▶ Create survival skills toolkits, and pocket cards to accommodate all settings and learners' needs and preferences.



*Position Statement*

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The Association of Diabetes Care & Education Specialists





# How Much Insulin Does a Patient Need?

- ▶ It depends, based on:
  - ▶ Body weight
    - ▶ BMI < 25 or more than 25
  - ▶ Frail, elderly
  - ▶ Eating status
    - ▶ Normal, poor intake or NPO
  - ▶ Renal or hepatic insufficiency
  - ▶ Type of Diabetes
  - ▶ Current meds; steroids, insulin, oral DM agents
  - ▶ Infected or Septic



# Insulin Therapy Components

- ▶ **Basal insulin** – long acting insulin covers between meals and through night
- ▶ **Prandial or meal insulin** – a *bolus* insulin that covers food, IV dextrose, enteral nutrition, TPN or other nutritional supplements
- ▶ **Correction insulin** – *bolus* insulin dosed to correct for hyperglycemia that occurs despite use of basal and prandial insulin
  - ▶ Usually given before meals w/ prandial insulin



# Getting Glucose to Goal – How?

## Subq insulin therapy (oral agents stopped)

- ▶ Determine insulin needs based on wt/BG
  - 0.3 units kg/day if insulin naïve or GFR less than 60
  - 0.4 units kg/day if BG 140-200mg/dl
  - 0.5 units kg/day if BG 201-400mg/dl
  
- 50% of total dose - Basal Insulin (eg glargine, NPH)
  - Increase by 20% if fasting BG elevated
  - Reduced for fasting BG <70mg/dl
  
- 50% of total dose Bolus Insulin (eg Reg, Lispro) divided evenly into 3 meals
  - If premeal BG elevated, increase bolus dose

RABBIT 2 Trial - Umpierrez



# Ms. Jones is 60kg – What insulin dose? Basal/Bolus Insulin Dosing Strategy

## 50/50 Rule

- ▶ 0.3-1.0 units/kg day
- ▶ Basal = 50% of total
- ✿ Bolus = 50% of total
  - usually divided into 3 meals

## Example – You Try

- ▶ Wt 60 kg x 0.3 = \_\_\_\_\_ units of insulin/day
- ▶ Basal dose: \_\_\_\_\_ units
- ▶ Bolus dose: \_\_\_\_\_ units  
\_\_\_\_\_ units Reg, NovoLog, Apidra, Humalog each meal



# Poll Question 7

Based on MS's body wt of 60kg, how much bolus insulin would she need per meal?

- ▶ A. 3 units per meal
- ▶ B. 5 units per meal
- ▶ C. 15 units at hs
- ▶ D. 4-5 units per meal



# Basal/Bolus Insulin Dosing Strategy 0.3u/kg

## 50/50 Rule

- ▶ 0.3-1.0 units/kg day
- ▶ Basal = 50% of total
- ✱ Bolus = 50% of total
  - usually divided into 3 meals

## Example – MS

- ▶ Wt 60 kg x 0.3 = 18 units of insulin/day
- ▶ Basal dose: 9 units
- ▶ Bolus dose: 9 units
  - 3 units NovoLog, Apidra  
Humalog, Reg each meal



# Now that we covered food, what about BG > 150?

- ▶ That's where the Correction Bolus comes into play.



# Sample Correction Bolus

Rapid/Fast Acting Insulin (1 unit:50 mg/dl>150)

70 or less	Treat for Hypo, hold dose
71-150 mg/dl	0 units
151-200 mg/dl	1 unit
201-250 mg/dl	2 units
251-300 mg/dl	3 units
301-350 mg/dl	4 units
351-400 mg/dl	5 units



# Poll Question 8

- ▶ MS is about to eat lunch. She is scheduled to get 3 units lispro plus correction based on previous scale. Her BG is 68. What is the best action?



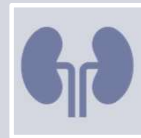
Administer 2 units lispro



Inject 3 units and make sure she eats right away.



Give the insulin after the meal.



Hold the insulin



# Important Insulin Concepts

- ▶ **Basal Plus trial<sup>34</sup>**
- ▶ Daily dose of glargine plus *correction* doses of bolus insulin had same benefit and risk of hypoglycemia when compared with standard basal-bolus regimen.
- ▶ Basal-plus-correction regimen may be preferred for patients with poor or no oral intake
- ▶ Insulin regimen with basal, nutritional (basal-bolus), and correction preferred for patients with good intake

Umpierrez and Lansang, Cleveland Clinic 2016  
**Inpatient hyperglycemia management: A practical review for primary medical and surgical teams**



# Question 9 - MS

- ▶ MS keeps experiencing hypoglycemia in-between breakfast and lunch. She takes 9 units Levemir in am and 3 units lispro + correction with meals. Which of the following is most likely causing hypo?
- ▶ A. Basal insulin in morning
- ▶ B. Bolus insulin post meals
- ▶ C. Walking in halls
- ▶ D. Excess bolus insulin



# Changes to insulin orders 10

- ▶ Due to hypoglycemia, MD changes insulin order to:
  - ▶ 9 units Levemir in am
  - ▶ Correction insulin only at meals and bedtime
  - ▶ The next morning her morning BG is 167. What is best action?
- ▶ A. Increase Levemir by 20%
- ▶ B. Increase correction scale
- ▶ C. Continue with same dose
- ▶ Ask Mrs. J what she ate last night.



# Important Insulin Concepts

- ▶ **Persons treated with insulin prior to admission**
- ▶ Take total daily insulin dose at home:
  - ▶ Reduce dose by 20% to 25% to prevent hypoglycemia, particularly in those with poor or uncertain caloric intake.<sup>31</sup>
  - ▶ Give half as long-acting basal insulin
  - ▶ Give half as prandial insulin.



Umpierrez and Lansang, Cleveland Clinic 2016



# Quick Question 11

- ▶ LS is admitted with UTI. BG on admission 283, A1c 9.8%. Wt is 90kg. Current insulin dose at home:
  - ▶ 80 units glargine hs
  - ▶ 20 units aspart with breakfast and dinner.
  - ▶ What dose for hospital?
- ▶ A. Continue with current regimen
- ▶ B. Reduce basal to 50 units and bolus to 15 units
- ▶ C. Use weight to calculate new basal bolus dose
- ▶ D. Use basal plus correction for safety





# Inpatient hyperglycemia management: A practical review for primary medical and surgical teams

Cleveland Clinic Journal of Medicine 2016 May; 83 Suppl 1(5):S34-S43

Diabetes with glucose > 140 mg/dL (7.7 mmol/L)

Nothing by mouth  
Uncertain oral intake  
Poor oral intake

Adequate oral intake

**Basal insulin**

- Start at 0.2–0.25 U/kg/day<sup>a</sup>
- Correction doses with rapid-acting insulin before meals
- Adjust basal as needed

**Basal-bolus<sup>b</sup>**

Total daily dose: 0.4–0.5 U/kg/day

- 1/2 basal, 1/2 bolus
- Adjust as needed

<sup>a</sup>Reduce total daily dose to 0.15 U/kg in patients ≥ age 70 or with serum creatinine ≥ 2.0 mg/dL.

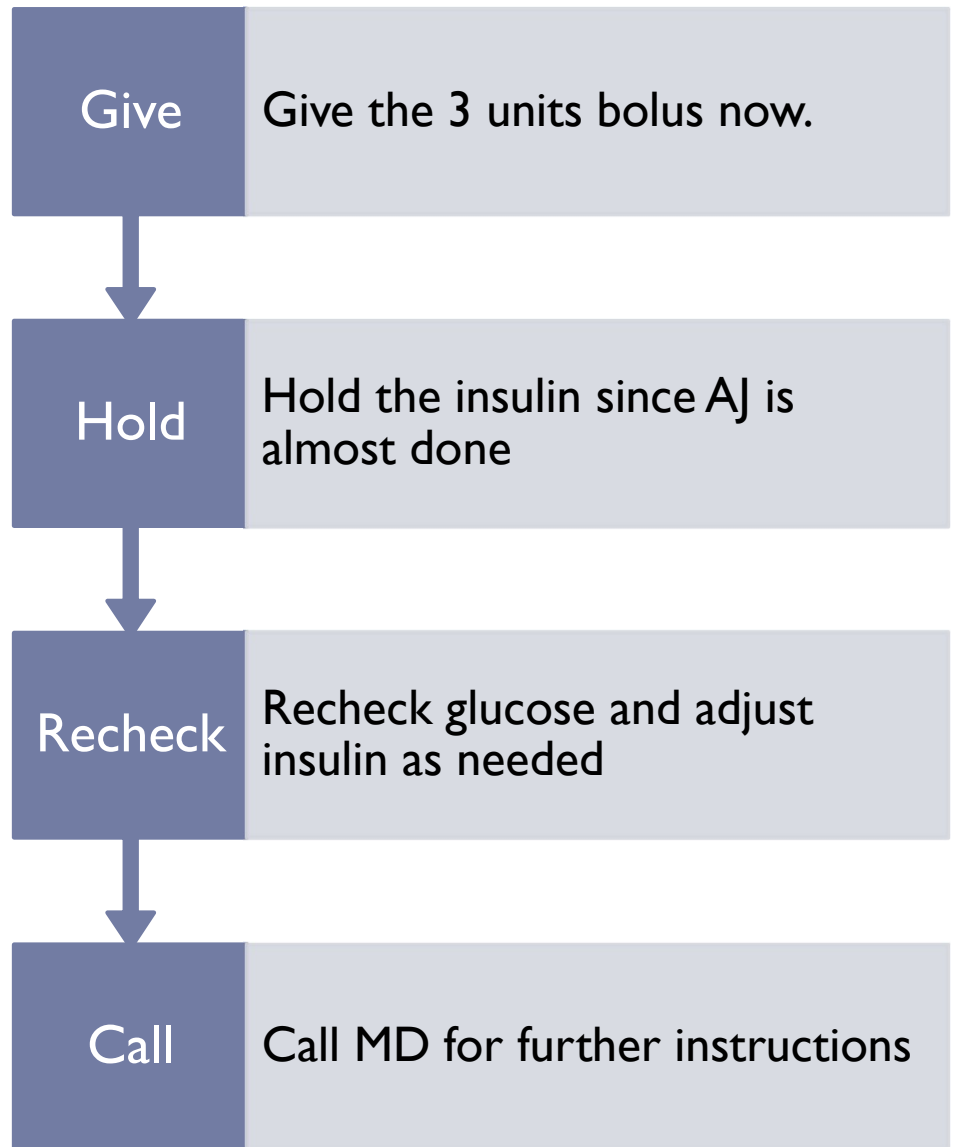
<sup>b</sup>In patients already on basal-bolus at home, decrease insulin dose by 25%.

Umpierrez and Lansang, Cleveland Clinic 2016



# Poll Question 12

- ▶ AJ is due for 3 units of bolus insulin for lunch. His blood glucose before lunch (20 minutes ago) was 153. You walk in room and AJ is almost done with lunch. What is best action?





# Mrs. Jones needs to go to surgery

- ▶ In spite of antibiotics, her foot ulceration isn't improving.



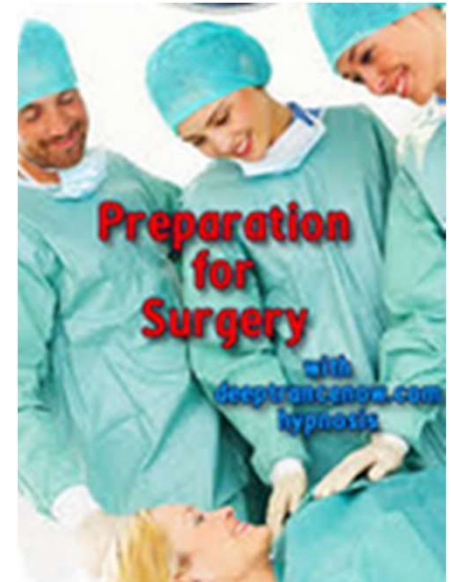
# Poll Question 13

- ▶ MS woke up in the morning with a fasting glucose of 72 and pt needs to go to OR now! Best action?
  - ▶ A. Call OR and tell them to postpone surgery
  - ▶ B. Give the patient 4 ounces of juice
  - ▶ C. Push 1 amp of D50
  - ▶ D. Hang IV of 5-10% Dextrose and alert anesthesia



# Perioperative Care

- ▶ **Target BG in perioperative period 80–180.**
- ▶ Perform preoperative risk assessment if:
  - ▶ at high risk for ischemic heart disease and
  - ▶ those with autonomic neuropathy or renal failure.
- ▶ Metformin - hold on the day of surgery.
- ▶ **SGLT2 inhibitors – discontinue 3–4 days before surgery.**
- ▶ Withhold any other oral glucose-lowering agents the morning of surgery or procedure
- ▶ Give half of NPH dose or 75–80% doses of long-acting analog or pump basal insulin.
- ▶ Monitor BG every 2–4 h while NPO and dose with short- or rapid-acting insulin as needed.
- ▶ No data on use of GLP-1 RA or ultra-long-acting insulin analogs in perioperative care.



# Prep for Surgery – Poll 14

AR is living with type 2 diabetes, has an A1c of 7.4% and takes metformin 1000 BID and 60 units of glargine at bedtime. AR is admitted to the hospital overnight for early morning surgery. According to ADA Guidelines, what adjustment in his diabetes medications are needed to prepare for a safe surgery?

- A. Hold evening metformin and glargine night before surgery to prevent perioperative hypoglycemia.
- B. Hold morning metformin the day of surgery and give about 45 units of bedtime glargine the night before surgery.
- C. Hold metformin 3 days before surgery and give 60 units of bedtime glargine the night before surgery.
- D. Hold the metformin the day before surgery and give the glargine the morning of surgery to prevent perioperative hyperglycemia.



# BG Too High?

## Insulin Adjustment Strategies

Meal Blood glucose too high?

- Increase preprandial dose by 10-20% units and /or
- Increase correction scale by 1-2 units

Morning blood glucose > 140?

- Increase evening basal by 10%

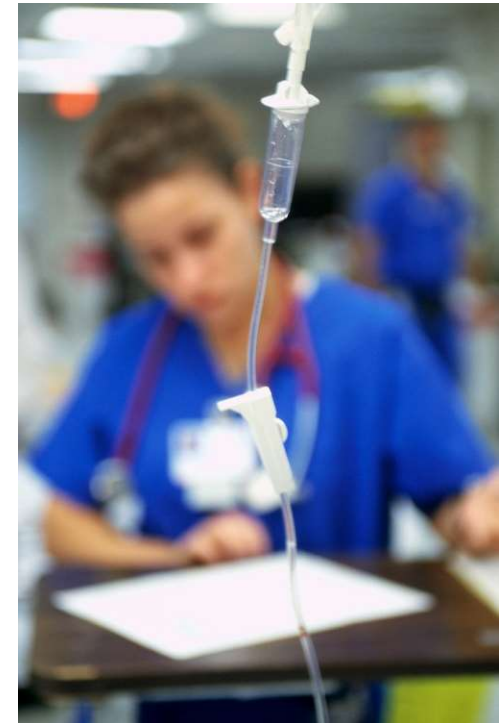
Identify cause

Consider insulin drip



# BG Levels Too High Insulin Drip Started

- ▶ 100 units insulin in 100 cc NS Bag
- ▶ 1 cc = 1unit of insulin
  - ▶ Rate based on body wt:
    - ▶ 0.05 units/kg per hour
    - ▶  $100\text{kg} \times 0.05 = 5 \text{ units insulin /hr}$
- ▶ Monitor BG q 1-2 hr and adjust per protocol
- ▶ Before stop, give subq insulin 2 hours prior.



For Mild to Moderate DKA, sub-q insulin is an option

# Insulin Delivery Standards

- ▶ Insulin administered using validated written or computerized protocols
- ▶ Allow for predefined adjustments in insulin dosage based on glycemic fluctuations



# Most Important Action? Poll 15

RT is a 49-year-old with type 1 diabetes, admitted to a local hospital to treat Diabetes Ketoacidosis (DKA). RT is on an insulin drip, fluids and potassium replacement therapy and is getting hungry. The IV insulin is running at 2 units an hour. Before stopping the IV insulin, what is the most important action?

- A. Maintenance of glucose less than 200 for at least 4 hours
- B. Give 3 units of bolus insulin via IV and at least 6 units of glargine
- C. Evaluate labs to make sure that RT is ketone negative
- D. Determine if potassium replacement is still needed





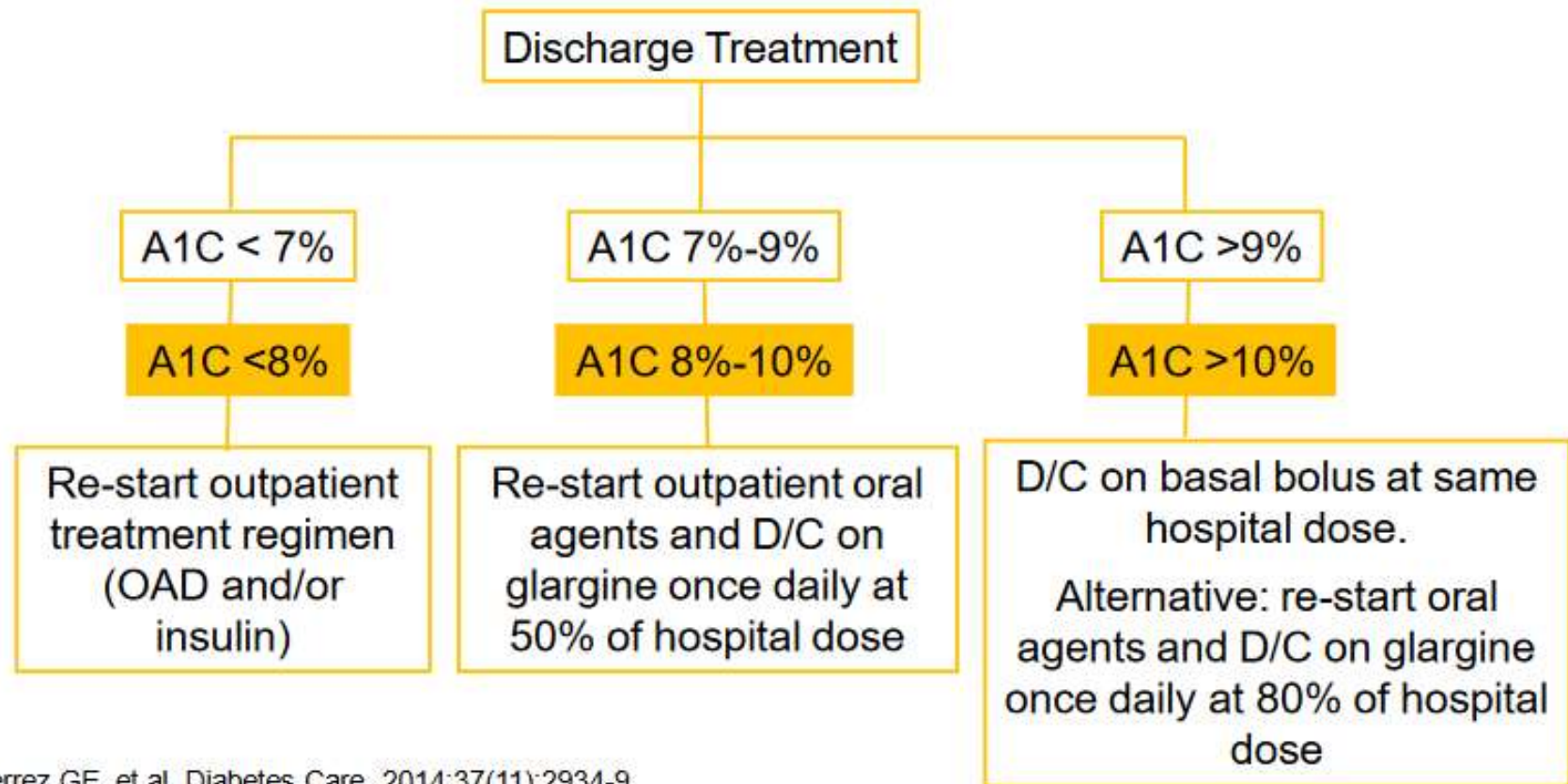
# Getting Mrs. Jones Ready for Discharge

- ▶ Mrs. Jones is improved and ready to go home.
- ▶ What glucose management strategies for home?
- ▶ Her A1c = 7.9%



# Discharge plan

## Revised Discharge Insulin Algorithm



Umpierrez GE, et al. Diabetes Care. 2014;37(11):2934-9.



# General Recommendations

- ▶ Diabetes discharge planning starts on admit
- ▶ Type of DM clearly identified / documented
- ▶ People with new hyperglycemia need appropriate follow-up



# Structure Discharge Communication

- Communicate medication changes, pending tests and studies, and follow-up needs with outpatient providers.
- Transmit discharge summaries to the primary care provider as soon as possible after discharge.
- Schedule follow-up appointments prior to discharge increases the likelihood that patients will attend.



# Topics to cover before discharge

- Identification of the health care provider who will provide diabetes care after discharge.
- Level of understanding related to the diabetes diagnosis, self-monitoring of blood glucose, home blood glucose goals, and when to call the provider.
- Definition, recognition, treatment, and prevention of hyperglycemia and hypoglycemia.
- Information on making healthy food choices at home and referral to an outpatient RD/RDN
- If relevant, when and how to take blood glucose-lowering medications, including insulin administration.
- Sick-day management.
- Proper use and disposal of needles and syringes.



# Medication Reconciliation

- ▶ Cross-check meds to make sure no chronic meds were stopped
- ▶ Ensure the safety of new prescriptions
- ▶ New or changed prescriptions reviewed with pt/ family before discharge
- ▶ Avoid complex insulin regimens for those with limited cognition
  - ▶ As pt heals, remind them that they may need less insulin / diabetes meds to control BG
  - ▶ Supplies for insulin administration



Pharmacists are a critical part of the diabetes team



# Summary



- ▶ Hyperglycemia is a marker of metabolic dysregulation and deserves our attention.
- ▶ Glucose control improves outcomes.
- ▶ Insulin management to improve glucose.
- ▶ Inpatient glucose control is cost effective.
- ▶ We can make a difference.



# Thank You



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