Getting Glucose to GOAL In the Hospital – Frontline Nursing Training

Beverly Thomassian
President, Diabetes Educational Services
www.DiabetesEd.net

Getting Glucose to GOAL In the Hospital

Objectives:

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

Glucose Management and Hospitalized Patients

In hospitalized patients with critical illness, hyperglycemia is a signal that warrants our attention.

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

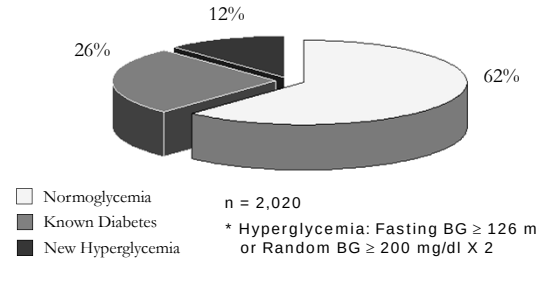
Stress response and hyperglycemia

- Decreased WBC's
- Catabolism
- Abnormal inflammatory response
- Endothelial cell dysfunction
- Increased clotting, blood viscosity
- Tissue breakdown
- Inflammatory changes
- Increased blood pressure, pulse

Leads to: Longer lengths of stay, complications, death

Diabetes Care, v. 27, #2, Feb 2004

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



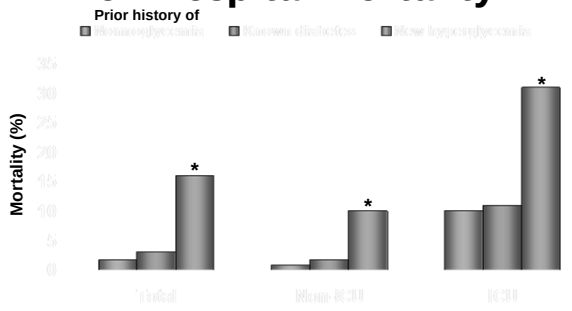
n = 2,020

* Hyperglycemia: Fasting BG ≥ 126 mg/dl or Random BG ≥ 200 mg/dl X 2

Umpierrez G et al, J Clin Endocrinol Metabol 87:978, 2002

Umpierrez et al

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.

Blood Glucose Above Normal = Trouble

- Pre Diabetes
  - Fasting Glucose = 100-125mg/dl
  - A1c 5.7 – 6.4%
- Diabetes
  - Fasting Glucose = 126 mg/dl +
  - Random Glucose = 200 mg/dl +
  - A1c 6.5% +

Any blood glucose above 140 requires treatment
Umpierrez et al

A1c and Estimated Avg Glucose (eAG) 2008

A1c (%)	eAG
5	97
6	126
7	154
8	183
9	212
10	240
11	269
12	298

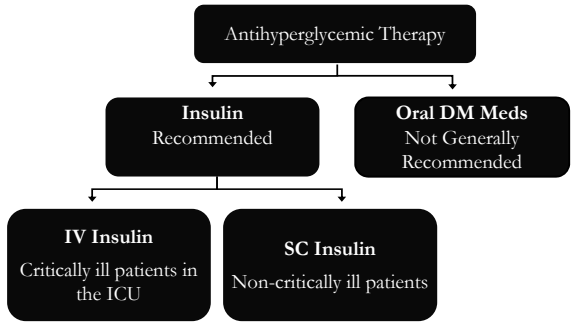
Order teaching tool kit free at diabetes.org

eAG = 28.7 x A1c-46.7 ~ 29 pts per 1%

Translating the A1c Assay Into Estimated Average Glucose Values – ADAG Study

Diabetes Care: 31, #8, August 2008

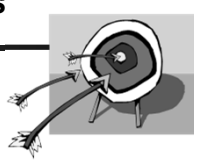
Recommendations for Managing Patients With Diabetes in the Hospital Setting



1. ACE/ADA Task Force on Inpatient Diabetes. *Diabetes Care*. 2006 & 2009
2. *Diabetes Care*. 2009;31(suppl 1):S1-S110..

Umpierrez et al

Management of Hyperglycemia and Diabetes



- Non-ICU
  - Basal/bolus therapy (MDI)
    - NPH and Regular insulin
    - Long-acting and rapid-acting insulin
    - Premixed insulin
- ICU and Critical Care
  - Insulin Drips
  - Basal /Bolus

ADA / AACE Goals and Treatments For Hospitalized Patients

Critically Ill pts

- Start insulin therapy no later than BG 180
- Once insulin started, glucose goal 140-180
- Insulin drip preferred treatment

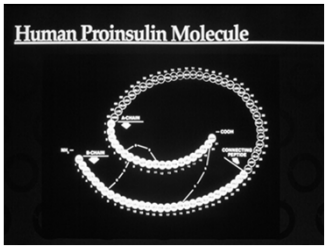
Non Critically Ill patients

- Blood glucose goals:
  - Premeal <140
  - Post meal <180
- Basal /bolus Insulin preferred treatment

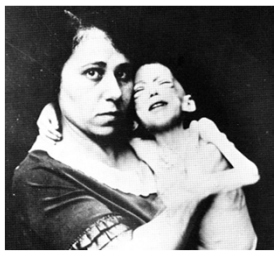
Consensus: Inpt Hyperglycemia, Endocr Pract. 2009;15 (No.4)

Insulin – the Ultimate Hormone Replacement Therapy

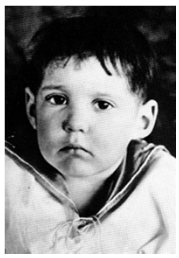
Objectives:
- Discuss the actions of different insulins
- Describe using pattern management as an insulin adjustment tool



The Miracle of Insulin



Patient J.L., December 15, 1922



February 15, 1923

Type 1 in Hospital

- 43 yr old admitted to evaluate angina.
- Morning blood sugar is 142.
- You walk in with his insulin dose.
- The patient says, "I will bottom out if I take that much insulin."
- "That dose won't touch my blood sugar"
- **What do you say?**

Life Study – Mrs. Jones

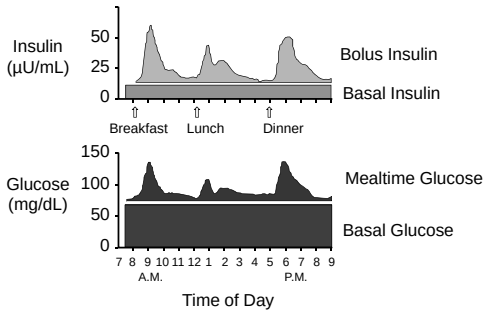
Mrs. Jones is 62 years old, a little heavy and complains of feeling tired and urinating several times a night. She is admitted with a urinary tract Infection. Her WBC is 12.3, glucose 237. She is hypertensive with a history of gestational diabetes. No ketones in urine.

- What risk factors and signs of diabetes does she have?
- What type of diabetes does she have?

Life Study – Mrs. Jones

- How would we manage her BG in hospital?

Physiologic Insulin Secretion: 24-Hour Profile



Insulin Action Teams

- Bolus: lowers after meal glucose levels
  - Rapid Acting
    - Aspart, Lispro, Glulisine
  - Short Acting
    - Regular

- Basal: controls glucose between meals, hs
  - Intermediate
    - NPH
  - Long Acting
    - Detemir (Levemir)
    - Glargine (Lantus)

Bolus Insulins (½ of total daily dose ÷ meals)

Name	Onset	Peak Action
Lispro (Humalog)	5-15 min	0.5 -1.5 hrs
Aspart (NovoLog)		
Glulisine (Apidra)		
Regular	30 -60 min	2 - 3 hrs

Bolus Insulin Summary

- Regular, Novolog, Humalog, Apidra,
- Starts working fast (15-30 mins)
- Gets out fast (3-6 hours)
- Post meal BG reflects effectiveness
- Should comprise about ½ total daily dose
- Covers food or hyperglycemia.
  - 1 unit
    - Covers ≈ 10 -15 gms of carb
    - Lowers BG ≈ 30 – 50 points

Bolus Insulin Timing

- How is the effectiveness of bolus insulin determined?
  - Before next meal blood glucose
- Inpt Glucose goals (ADA) – may be modified by provider/pt
  - 1-2 hours post meal <180
  - Before next meal – 70 - 140

Bolus – Insulin Sliding Scale

Starts at 150, 2 units for every 50 mg/dl >150

	Break	Lunch	Dinner	HS
Day 1	94 no insulin	212 4 uR	148 no insulin	254 6 uR
Day 2	243 4uR	254 6 uR	201 4uR	199 2 uR
Day 3	189 2uR	243 4uR	162 2uR	244 4uR
Day 4	194 2uR	287 6uR	144 none	272 6uR

Bolus Basics

- Carbohydrate/ Prandial Coverage
  - Match the insulin to the carbohydrates
  - 1 unit for 15 gms - Common starting point
  - Usual meal 45 – 60gms = 3-4 units insulin
- Correction Bolus - targets hyperglycemia
  - 1 unit for every 30-50 points over target
- Adjust ratios depending on sen and response

Now What?

- Nurse had an emergency and pt already ate lunch?

- Nurse administered insulin and pt only ate a few bites of turkey and drank non sugar tea?
- You just gave 3 units of Novolog and patient needs to go to OR NOW!

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

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

General Correction Bolus

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

70 or less	Subtract 1 unit
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

Basal Insulins
(½ of total daily dose)

Intermediate Acting	Peak Action	Duration
NPH	4-10 hrs	10-16

Long Acting	Peak Action	Duration
Detemir (Levemir)	No peak	6 - 24 hrs
Glargine (Lantus)	No peak	20- 24 hrs

Fasting BG reflects efficacy of basal

Basal Insulin Summary

- NPH, Levemir, Lantus
- Covers in between meals, through night
- Starts working slow (4 hours)
- Stays in long (12-24 hours)
  - NPH 12 hrs
  - Levemir, Lantus 20-24 hrs
- Fasting blood glucose reflects effectiveness

Combination SQ Insulin

Insulin Type	Onset	Duration
Humalog Mix 75/25: 75% NPL, 25% lispro 50/50: 50% NPL, 50% lispro	5-15 min	10-16 hrs
NovoLog Mix 70/30: 70% NPA, 30% aspart	5-15 min	10-16 hrs
NPH + Reg Combo 70/30: 70%N /30%R 50/50: 50%N /50%R	30 – 60 min	10-16 hrs

Considerations:
- Pre-mixed, difficult to fine tune therapy

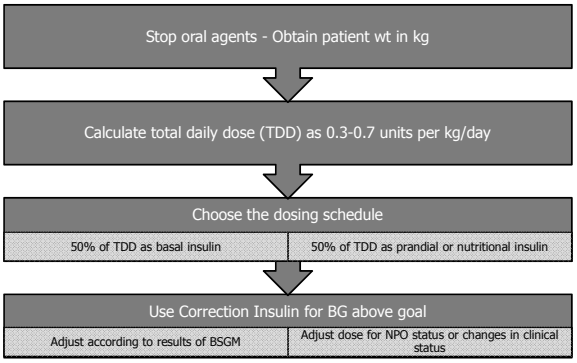
Insulin Therapy Components

- 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 nutritional insulin
  - Usually given before meals w/ prandial insulin

How Much Insulin Does a Patient Need?

- It depends, based on:
  - Body weight
    - Overwt, normal wt, or thin
  - 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

Initiating Insulin in Hospital

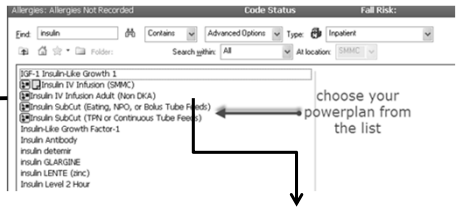


Provider Assessments

- **Nutritional Status**
  - Eating, NPO, or Bolus Tube Feeds
  - TPN or Continuous Tube Feeds
- **Insulin Sensitivity**
  - Resistant
  - Sensitive
  - Usual/Moderate

Dignity Health.
Formerly Catholic Healthcare West

Using the New Insulin Power Plans-



Patients that require intermittent insulin are grouped together. This includes orders that are appropriate for NPO patients

Patients that have a continuous supply of nutrition are grouped together

Cerner PowerPlans Proposed

- Provider picks the correct PowerPlan based on the patient's nutritional status.
  - Insulin SubCut (Eating, NPO, or Bolus Tube Feeds).
  - Insulin Subcut (TPN or Continuous Tube Feeds).

Insulin SubCut (Eating, NPO, or Bolus Tube Feeds)
Insulin SubCut (TPN or Continuous Tube Feeds)

- Each PowerPlan has sections for each insulin sensitivity state
  - Sensitive
  - Usual/Moderate
  - Resistant

Dignity Health.
Formerly Catholic Healthcare West

36

INSULIN SENSITIVITY

SENSITIVE: 0.3u/kg/day

- Total Daily Dose of insulin < 40 units/day, frail, thin, elderly, eating < 50%, with hepatic or renal insufficiency (CrCl < 30 ml/min)

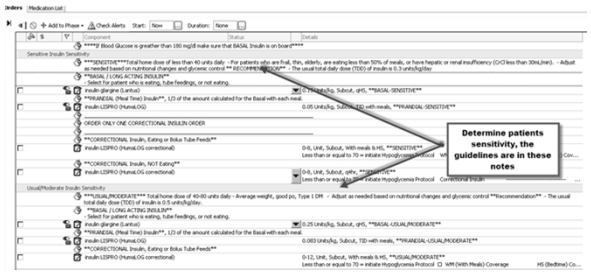
MODERATE/USUAL: 0.5 u/kg/day

- Total Daily Dose of Insulin 40-80 units/day, average wt, good PO intake, DM Type 1

RESISTANT: 0.7 u/kg/day Total Daily Dose of Insulin > 80 units/day, obese, on steroids, or septic

Dignity Health.
Formerly Catholic Healthcare West

Determining Sensitivity



Inpt Study – Mrs. Jones

Mrs. Jones is 62 years old, a little heavy and complains of feeling tired and urinating several times a night. She is admitted with a urinary tract Infection. Her WBC is 12.3, glucose 237. She is hypertensive with a history of gestational diabetes. No ketones in urine. A1c 8.9%

- What insulin dose would we start Mrs. Jones on?

Insulin Dose – Mrs. Jones

- Moderate
  - Why?
    - Average weight, good oral intake

Basal/Bolus Insulin Dosing Strategy

50/50 Rule

- 0.3-1.0 units/kg day
- Basal = 50% of total
  - Glargine at HS
  - NPH or Detemir BID
- Bolus = 50% of total
  - usually divided into 3 meals

Example

- Wt 50kg x 0.5 = 25 units of insulin/day
- Basal dose: 13 units
  - Glargine 13 units at HS
  - NPH/Detemir 6u BID
- Bolus dose: 12 units
  - 4 units NovoLog, Apidra Humalog each meal

Basal/Bolus Insulin Dosing Strategy 0.5u/kg

50/50 Rule

- 0.3-1.0 units/kg day
- Basal = 50% of total
  - Glargine at HS
  - NPH or Detemir BID
- Bolus = 50% of total
  - usually divided into 3 meals

Example – You Try

- Wt 60 kg x 0.5 = ___ units of insulin/day
- Basal dose: ____ units
  - Glargine ____ units HS
  - NPH/Detemir ____ BID
- Bolus dose: ____ units

___units NovoLog, Apidra Humalog each meal

Basal/Bolus Insulin Dosing Strategy 0.5u/kg

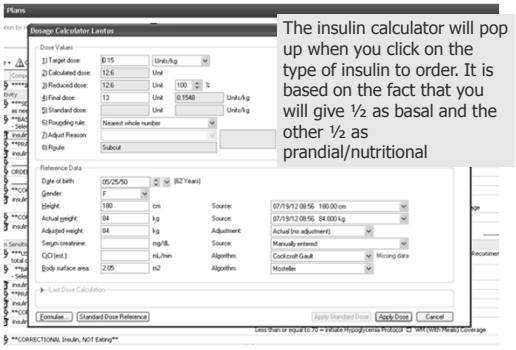
50/50 Rule

- 0.3-1.0 units/kg day
- Basal = 50% of total
  - Glargine at HS
  - NPH or Detemir BID
- Bolus = 50% of total
  - usually divided into 3 meals

Example – You Try

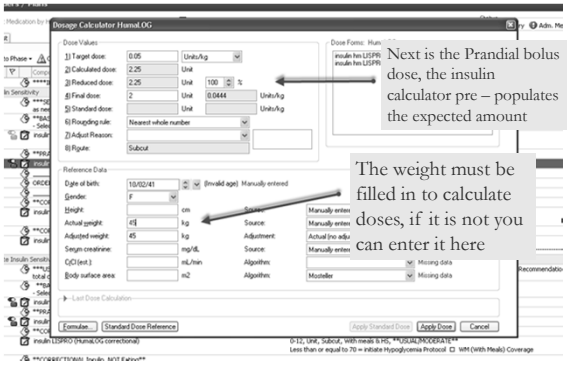
- Wt 60 kg x 0.5 = 30 units of insulin/day
- Basal dose: 15 units
  - Glargine 15 units HS
  - NPH/Detemir 7 BID
- Bolus dose: 15 units
  5 units NovoLog, Apidra Humalog, Reg each meal

PowerPlan Insulin Calculator



The insulin calculator will pop up when you click on the type of insulin to order. It is based on the fact that you will give ½ as basal and the other ½ as prandial/nutritional

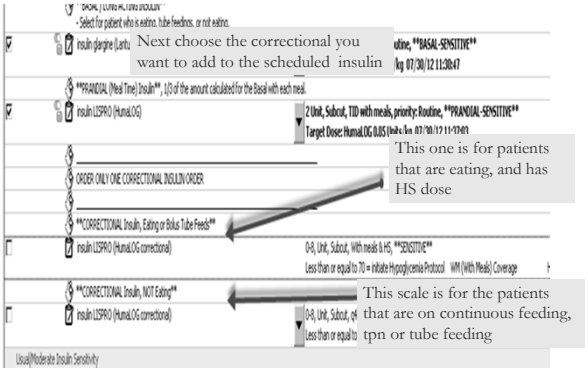
Calculating Prandial Dose



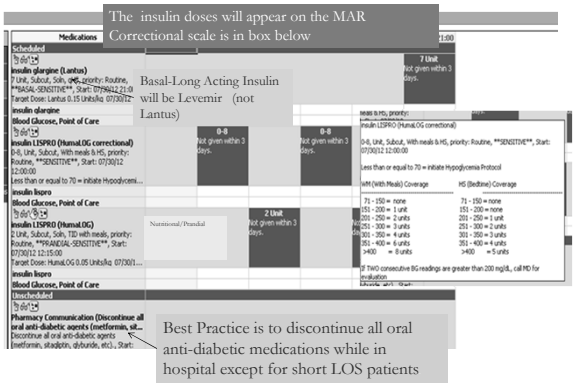
Next is the Prandial bolus dose, the insulin calculator pre – populates the expected amount

The weight must be filled in to calculate doses, if it is not you can enter it here

Correctional Scale

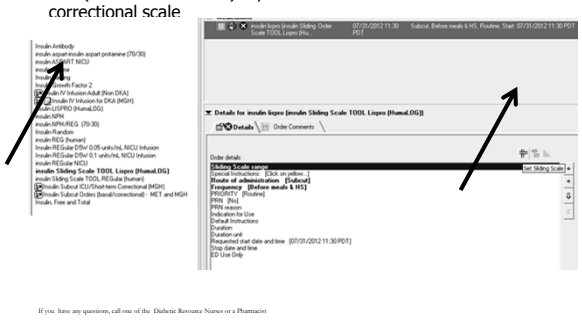


Basal Bolus



Custom Scale

You can still 'add to phase' the order for the insulin sliding scale tool (with the calculator) if you want to build a customized correctional scale



If you have any questions, call one of the Diabetic Resource Nurses or a Pharmacist

Usual Correction Bolus

Rapid/Fast Acting Insulin

70 or less	Treat for hypo, hold dose
71-150 mg/dl	0 units
151-200 mg/dl	1 unit
201-250 mg/dl	4 units
251-300 mg/dl	6 units
301-350 mg/dl	8 units
351-400 mg/dl	10 units

Dignity Health.
Formerly Catholic Healthcare West

Mrs. Jones - Pattern
5 unit meal bolus + Correction
15 unit Lantus hs

	Break	Lunch	Dinner	HS
Day 1	admit	219	243	219
Day 2	129	197	184	195 - NPO
Day 3	67	gone	119 clear liquids	104
Day 4	73	81	119	d/c

Preparation for Surgery

- Try to schedule surgery in am, resume meds/insulin when eating and stable.
- Oral medications: In am, hold all diabetes oral medications
- Basal Insulin: Night before
  - type 2s, give 50% of usual am basal dose for
  - type 1s give up to 100% of basal dose.
- Bolus insulin: may need mild insulin bolus coverage for type 1 and type 2's
- Have D5 or D10 IV bags available in case of hypo

BG Running Low?

- Possible Causes
  - Too much insulin
    - Premeal bolus
    - HS basal
  - Glucose toxicity improving
  - Infection improving
  - Stopped/lowered steroids
  - Poor kidney function
  - Skipped meal, poor PO intake
  - Not eating enough carbs

Hypoglycemia Symptoms

- Autonomic
  - Anxiety
  - Palpitations
  - Sweating
  - Tingling
  - Trembling
  - Hypoglycemic Unawareness
- Neuroglycopenia
  - Irritability
  - Drowsiness
  - Dizziness
  - Blurred Vision
  - Difficulty with speech
  - Confusion
  - Feeling faint

BG Too Low? Insulin Adjustment Guidelines

- Before meal Blood glucose <70?
  - Implement hypoglycemia protocol
  - Evaluate cause and make needed adjustments
    - Missed meal?
    - Too much insulin?
- Morning blood glucose < 90?
  - Decrease evening Lantus by 10%
- Evaluate trends, provide feedback

Dignity Health.
Formerly Catholic Healthcare West

HS Correction Bolus for ALL levels – Prevents HS Hypo

Rapid/Fast Acting Insulin

Less than 70	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

Dignity Health. Formerly Catholic Healthcare West

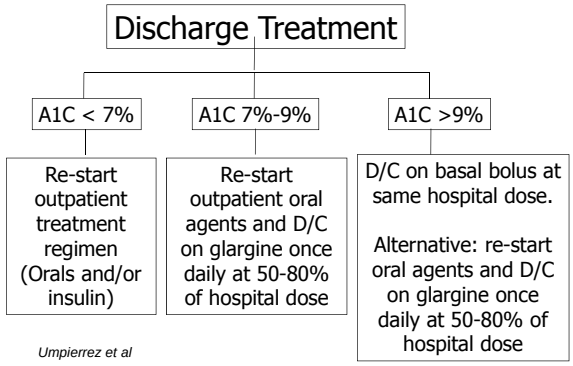
Treatment of Hypoglycemia

- If BG **70**mg/dl or less and pt is eating:
  - 15 gms of carb (gel, glucose tabs)
- If BG **70**mg/dl or less, pt is NOT eating
  - D50 if IV access
  - Glucagon if no IV access
- Recheck BG every 15 minutes
- Hold next correction insulin dose
- Give next meal insulin and Lantus Dose

Dignity Health. Formerly Catholic Healthcare West

- Mrs. Jones is improved and ready to go home.
- What glucose management strategies for home?
- Her A1c = 8.9%

Discharge insulin Algorithm



Umpierrez et al

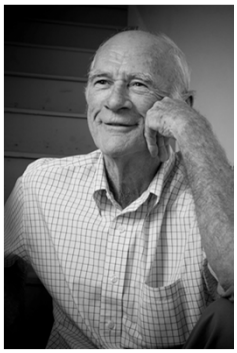
Discharge Teaching

- What supplies will she need?
- What top 3 things do we need to teach her?
- What resources can we provide?
- What referrals?

Top 4 Discharge Questions

1. Can patient perform self blood glucose monitoring? Do they need meter?
2. Can pt safely take meds / insulin?
3. Does the pt know how to treat hypo and hyper glycemia?
4. Does the patient know what to do on sick days?

Mr. R has Pneumonia
How Much Insulin Needed?



- Creatinine 1.6
- 76 years old
- Not very hungry
- BMI 22
- Weighs 70kg
- Glucotrol 5mg at home
- A1c 7.2%

Basal/Bolus Insulin Dosing Strategy 0.3u/kg

50/50 Rule

- 0.3-1.0 units/kg day
- Basal = 50% of total
  - Glargine at HS
  - NPH or Detemir BID
- Bolus = 50% of total
  - divided into 3 meals

Example – You Try

- Wt 70kg x 0.3 = ___ units of insulin/day
- Basal dose: ___ units
  - Glargine __ units HS or
  - NPH/Detemir **__u** BID
- Bolus dose: ___ units
  - **___** NovoLog, Apidra Humalog Reg w/meal

Basal/Bolus Insulin Dosing Strategy 0.3u/kg

50/50 Rule

- 0.3-1.0 units/kg day
- Basal = 50% of total
  - Glargine at HS
  - NPH or Detemir BID
- Bolus = 50% of total
  - divided into 3 meals

Example – You Try

- Wt 70kg x 0.3 = 21 units of insulin/day
- Basal dose: 11 units
  - Glargine **11** units HS or
  - NPH/Detemir **5u** BID
- Bolus dose: 10 units
  - **3** NovoLog, Apidra Humalog Reg w/meal

Sensitive Correction Bolus

Rapid/Fast Acting Insulin

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	6 units

Dignity Health. Formerly Catholic Healthcare West

3 days poor intake, pt started on Tube Feeding

- If on continuous tube feeding, how would this change his insulin regimen?
- If on intermittent tube feeding, how would this change his insulin regimen?
- If patients tube feeding is interrupted, what precautions would you take?

Glycemic Management of the Patient Receiving Enteral Nutrition

Continuous enteral nutrition (EN)
- Basal insulin: 50% of daily dose twice daily
- Prandial bolus insulin: 50% given q6h

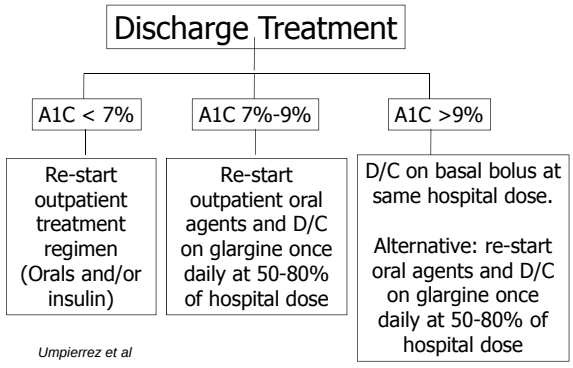
Cycled enteral nutrition
- Combination basal/bolus insulin (ie 70/30) given at the start of each tube feeding
- Bolus insulin administered q4 to 6 hours for duration of EN administration
- Correctional insulin given for BG above goal

Bolus enteral nutrition
- Rapid acting analog or short acting insulin given prior to each bolus

Mr. R- Pattern
3 unit meal bolus + Correction
11u Lantus hs

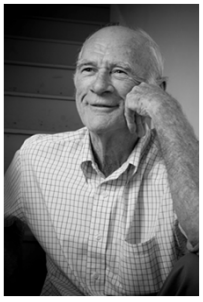
	Break	Lunch	Dinner	HS
Day 1		admit	381	198
Day 2	98	127	69	98 RN Held Lantus
Day 3	137	67	72 tube feeding 4 times a day	207
Day 6	142	129 NG Tube pulled	Pt feels funny BG 63	184

Discharge insulin Algorithm



Umpierrez et al

Mr. R after 9 days feeling better. Eating again, regaining strength. DC today.



- What glucose mgmt strategy?
- What supplies will he need?
- What top 3 things do we need to teach him?
- What resources and referrals?

Top 4 Discharge Questions

1. Can patient perform self blood glucose monitoring? Do they need meter?
2. Can pt safely take meds / insulin?
3. Does the pt know how to treat hypo and hyper glycemia?
4. Does the patient know what to do on sick days?

How Much Insulin Needed? Mr. K

- Waistline 46"
- Creat 0.9
- Infected Foot Ulcer
- Asthma
- Meds
  - Metformin
  - Exenatide (ran out)
  - Actos (worried about ankles swelling)
- A1c 10.8%

Basal/Bolus Insulin Dosing Strategy 0.7u/kg

50/50 Rule

- 0.3-1.0 units/kg day
- Basal = 50% of total
  - Glargine at HS
  - NPH or Detemir BID
- Bolus = 50% of total
  - divided into 3 meals

Example – You Try

- Wt 100 kg x 0.7 = __ units of insulin/day
- Basal dose: ____ units
  - Glargine ____ units HS
  - NPH/Detemir ____ BID
- Bolus dose: ____ units
  ___units NovoLog, Apidra Humalog each meal

Basal/Bolus Insulin Dosing Strategy 0.7u/kg

50/50 Rule

- 0.3-1.0 units/kg day
- Basal = 50% of total
  - Glargine at HS
  - NPH or Detemir BID
- Bolus = 50% of total
  - divided into 3 meals

Example – You Try

- Wt 100 kg x 0.7 = 70 units of insulin/day
- Basal dose: 35 units
  - Glargine 35 units HS
  - NPH/Detemir 17 BID
- Bolus dose: 35 units
  11 units NovoLog, Apidra Humalog each meal

Resistant Correction Bolus

Rapid/Fast Acting Insulin

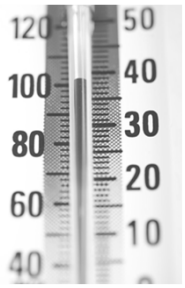
70 or less	Treat for hypo, hold dose
71-150 mg/dl	0 units
151-200 mg/dl	3 unit
201-250 mg/dl	6 units
251-300 mg/dl	9 units
301-350 mg/dl	12 units
351-400 mg/dl	15 units

Dignity Health. Formerly Catholic Healthcare West

Started on Prednisone 60mg qd for Asthma

- Blood glucose levels running 300-500.

BG Running High?



- Possible Causes
  - Glucose Toxic
  - Infection
  - Started on steroids
  - Physical stress
  - Insulin dose too low

BG Too High? Insulin Adjustment Guidelines

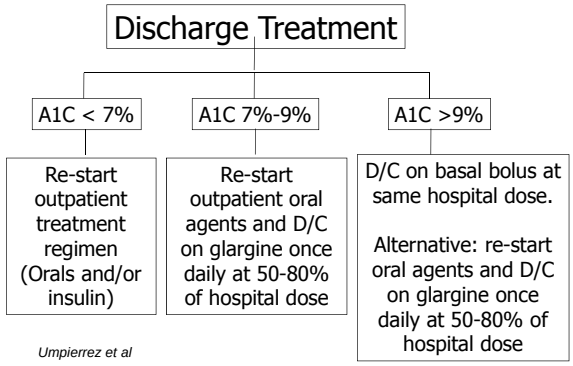
- Meal Blood glucose too high?
  - If BG increases by 50 points from meal A to meal B
  - Increase meal A rapid acting insulin dose by 1 unit
- Morning blood glucose > 140?
  - Increase evening Lantus by 10% every second day
- If 2 consecutive BG > 200, call MD

Dignity Health.
Formerly Catholic Healthcare West

Mr. K BG Levels Too High Insulin Drip Started

- 100 units insulin in 100 cc NS Bag
- 1 cc = 1unit of insulin
- Started on Algorithm 2 – at 7.5 units /hr for BG of 347

Discharge insulin Algorithm



Umpierrez et al

What Glucose Mgmt Strategy for Discharge?

- Waistline 46"
- Infected Foot Ulcer
- Asthma (on pred)
- Meds
  - Metformin
  - Exenatide (ran out)
  - Actos (worried about ankles swelling)
- A1c 10.8%

MR K. Stable, ready for discharge.

- What is your biggest concern?
- What supplies will he need?
- What top 3 things do we need to teach him?
- What resources and referrals?

Top 4 Discharge Questions

1. Can patient perform self blood glucose monitoring? Do they need meter?
2. Can pt safely take meds / insulin?
3. Does the pt know how to treat hypo and hyper glycemia?
4. Does the patient know what to do on sick days?