Simple steps to Meet Inpatient Glycemic Control Goals

Cheryl W. O’Malley, MD, FACP, FHM
1. Know the blood glucose targets for hospitalized adults with hyperglycemia.

2. Explain the reasons why basal/bolus/correction insulin is the preferred inpatient regimen for hospitalized adults.

3. Know the different types of insulin and their time of onset and action.

4. Calculate a patient’s initial doses of basal/bolus insulin and know how to make daily adjustments based on their blood sugar values.

5. Know how to manage a patient’s blood sugars while they are NPO or when tube feeds are initiated.

6. Know when and how to make adjustments to the home regimen based on their blood glucose control prior to admission, resources and hospital requirements.
Know the blood glucose targets for hospitalized adults with hyperglycemia.
RCT Glycemic Control Targets in Critically Ill Patients

Intensive Target Range: Mean achieved
103

“Conventional” Target Range: Mean = yellow bar

Leuven SICU
VISEP
Glucontrol
NICE SUGAR

BG <40 70 100 130 140 160 180 200 250 299 400

*References on final slide
NICE-SUGAR Study: Design

6104 ICU patients

“Conventional”
IV insulin if BG >180 mg/dL
Target: 140-180 mg/dL

69% insulin
BG = 144 mg/dL

“Intensive”
IV insulin if BG >108 mg/dL
Target: 81-108 mg/dL

97% insulin
BG = 115 mg/dL

NICE-SUGAR

- Intensive control vs conventional control
  - Mortality 27.5% vs 24.9%; $P = 0.02$
  - ARR = 27.5% - 24.9% = 2.6% \(\Rightarrow\) NNH = 38
  - Severe hypoglycemia (BG ≤40 mg/dl) 6.8% vs 0.5%; $P<0.001$

- No significant difference between the two treatment groups in the median number of days in the ICU or hospital

Current Recommended Targets for ICU = 140-180 mg/dL
“For the majority of noncritically ill patients treated with insulin, the premeal BG target should generally be <140 mg/dl in conjunction with random BG <180 mg/dl.

—DIABETES CARE, VOLUME 32, NUMBER 6, JUNE 2009
—J Clín Endocrinol Metab 97: 16–38, 2012
Recommendations for Managing Inpatient Hyperglycemia

Antihyperglycemic Therapy

- Insulin
  - Recommended
  - IV Insulin: Critically ill ICU patients
  - SC Insulin: Non-critically ill patients

- Oral Agents
  - Not Generally Recommended

Does this look familiar?
• Non-critically ill patients: “Scheduled subcutaneous administration of insulin, with basal, nutritional, and correction components, is the preferred method for achieving and maintaining glucose control.”

—DIABETES CARE, VOLUME 32, NUMBER 6, JUNE 2009
Know the different types of insulin and their time of onset and action.
# Human Insulins and Analogs

<table>
<thead>
<tr>
<th>Insulin type</th>
<th>Onset</th>
<th>Peak</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rapid acting:</strong></td>
<td>~15 minutes</td>
<td>1-2 hours</td>
<td>4-6 hours</td>
</tr>
<tr>
<td>Lispro (humalog)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aspart (novolog)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glulisine (apidra)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Short acting:</strong></td>
<td>30-60 minutes</td>
<td>2-4 hours</td>
<td>6-8 hours</td>
</tr>
<tr>
<td>Human regular novolin-R</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human regular humulin-R</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Intermediate:</strong></td>
<td>2-4 hours</td>
<td>8 hours</td>
<td>12-20 hours</td>
</tr>
<tr>
<td>Human NPH novolin-N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human NPH humulin-N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Long acting</strong></td>
<td>2-4 hours</td>
<td>minimal peak</td>
<td>~24 hours</td>
</tr>
<tr>
<td>Glargine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detimir*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Human Insulins and Analogs
#### Typical Times of Action

<table>
<thead>
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<th>Duration</th>
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</tr>
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<td>1-2 hours</td>
<td>4-6 hours</td>
</tr>
<tr>
<td>Human regular novolin-R</td>
<td>60 minutes</td>
<td>2-4 hours</td>
<td>6-8 hours</td>
</tr>
<tr>
<td>Human regular humulin-R</td>
<td>60 minutes</td>
<td>2-4 hours</td>
<td>6-8 hours</td>
</tr>
<tr>
<td>Human NPH novolin-N</td>
<td>4 hours</td>
<td>4-10 hours</td>
<td>12-20 hours</td>
</tr>
<tr>
<td>Human NPH humulin-N</td>
<td>4 hours</td>
<td>4-10 hours</td>
<td>12-20 hours</td>
</tr>
<tr>
<td>Glargine Detemir</td>
<td>2-4 hours</td>
<td>minimal peak</td>
<td>~24 hours</td>
</tr>
</tbody>
</table>

- 70% = 30% + 70%
Explain the reasons why basal/bolus/correction insulin is the preferred inpatient regimen for hospitalized adults.
Physiologic Insulin Replacement: Basal – Bolus Regimens

- **Breakfast**: Insulin (µU/mL) 50% Bolus Insulin
- **Lunch**: Insulin (µU/mL) 50% Basal Insulin
- **Dinner**: Insulin (µU/mL) 0

**Total Daily Dose (TDD)**

- **Aspart**
- **Lispro**
- **Glulisine**
- **Regular**

- **50% Basal Insulin**
- **50% Bolus Insulin**

**Physiologic Insulin Replacement:**
- Basal – Bolus Regimens

**Insulin (µU/mL)**

- **Breakfast**
- **Lunch**
- **Dinner**
RABBIT-2 Trial: Basal / Bolus arm

- **Patients:** Type 2 DM, non-surgical X at least 3 months on diet or orals (aka “insulin naïve”)
- **Regimen:** D/C oral antidiabetic drugs on admission
- Starting total daily dose (TDD):
  - 0.4 U/kg/d x BG between 140-200 mg/dL
  - 0.5 U/kg/d x BG between 201-400 mg/dL
- TDD adjusted daily +/- 20% for BG >140 or < 70
- 50% of TDD as insulin glargine and half as rapid-acting insulin (glulisine)

Umpierrez et al, Diabetes Care 30:2181–2186, 2007
211 Patients with type 2 DM Who underwent general surgery

OPEN- LABELED RANDOMIZATION

Glargine + Glulisine
N= 104

: 0.5 U/kg
Half as glargine once daily
Half as glulisine before meals

Sliding scale insulin
N= 107

4 times/day for BG >140 mg/dl

Umpierrez et al, Diabetes Care 34 (2):1–6, 2011
Postoperative Complications

* Composite of hospital complications: wound infection, pneumonia, respiratory failure, acute renal failure, and bacteremia.

Umpierrez et al, Diabetes Care 34 (2):1–6, 2011
Correction only:
• Controlled BG on admit with:
  • Low dose oral agents at home
  • Hypoglycemia at home
  • Worsening liver and renal function.

OR

Basal + bolus
(Nutrition + correction):
1. On insulin at home
2. Uncontrolled DM (admission BG, history at home OR HgbA1c
3. Not at goal on sliding scale
Calculate a patient’s initial doses of basal/bolus insulin and know how to make daily adjustments based on their blood sugar values.
3 Steps to using basal/bolus insulin in the hospital

1. Determine total daily insulin dose
2. Divide up to 50% basal insulin, 50% bolus
3. Adjust daily
Step 1: Calculate Starting total daily dose (TDD):

1. IV requirements
2. Home dose— (consider reduction by 25%)
3. Weight based 0.2-0.5 units/kg/day
   1. Most recent guides say 0.2-0.5
   2. Rabbit trials 0.3-0.5
      - 0.3 ESRD or elderly (>70 y.o.)
      - 0.4 units/kg/day if admit BG 140-200
      - 0.5 units/kg/day if admit BG >200

***Do not use “sliding scale” as a dose finding strategy***
Step 2: Divide into Scheduled Basal vs. Nutritional Insulin

• 40-50% should generally be basal

• Remaining 50-60% divided evenly and given to cover nutritional intake
Steroids

• If IV continuous will be high all day, once a day PO, high late afternoon/evening
• Keep thinking TDD
  – Cause more post prandial hyperglycemia
  – Change ratio to 30% basal/70% nutritional
Step 3: Adjust Doses Daily

- Blood glucose targets can only be achieved via continuous management of the insulin program.
- *There is no “autopilot” insulin regimen for a hospitalized patient!*
**RABBIT 2 Surgery Titration**

<table>
<thead>
<tr>
<th>Fasting BG</th>
<th>Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-140 mg/dL</td>
<td>No change</td>
</tr>
<tr>
<td>140-180 mg/dl</td>
<td>Increase TDD by 10% daily</td>
</tr>
<tr>
<td>&gt;180 mg/dl</td>
<td>Increase TDD by 20% daily</td>
</tr>
<tr>
<td>70-99 mg/dl</td>
<td>Decrease TDD by 10%</td>
</tr>
<tr>
<td>&lt;70 mg/dl</td>
<td>Decrease by 20%</td>
</tr>
</tbody>
</table>

* Note: only increase the doses if NONE were <100mg/dl.
My Suggestions for Daily Adjustment

1. Any less than 100 mg/dL or > 180?
2. Add up previous day’s TDD
   - Include amount given as supplemental insulin
   - Adjust up or down by depending on degree of hypo- and hyperglycemia
   - Adjust for other factors (renal function, steroid dose, nutritional intake, severity of illness)
3. Divide new TDD into basal and nutritional components
   - Split 50/50 OR
   - Adjust basal and nutritional separately, depending on AM fasting vs. late day sugars
   - Watch out for too much basal
Case 1

- 72 y.o. woman admitted with pneumonia. BMI 23, weight 57 kg Cr 2.7. BG high at home, no lows. At home on Glargine 5 units q hs admission BG 267 mg/dL (didn’t take her insulin today) with recent HbA1c 10.9. What are your admission orders?

A. sliding scale
B. TDD of 5, glargine 3 units and humalog 1 with meals
C. Glargine 5 units + ss
D. Weight based 0.3 units/kg/day = TDD 17 units a day with 8 glargine and 3 humalog with meals
Step 1: Calculate Starting total daily dose (TDD):

1. IV requirements
2. Home dose— (consider reduction by 25%)
3. Weight based 0.2-0.5 units/kg/day
   1. Most recent guides say 0.2-0.5
   2. Rabbit trials 0.3-0.5
      - 0.3 ESRD or elderly (>70 y.o.)
      - 0.4 units/kg/day if admit BG 140-200
      - 0.5 units/kg/day if admit BG >200

***Do not use “sliding scale” as a dose finding strategy***
<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>07/30/2011</td>
<td>11:17 MST</td>
<td>43.6</td>
</tr>
<tr>
<td>07/30/2011</td>
<td>7:09 MST</td>
<td>11</td>
</tr>
<tr>
<td>07/30/2011</td>
<td>3:15 MST</td>
<td>206 *</td>
</tr>
<tr>
<td>07/29/2011</td>
<td>21:00 MST</td>
<td>167 '</td>
</tr>
<tr>
<td>07/29/2011</td>
<td>20:31 MST</td>
<td>167 '</td>
</tr>
<tr>
<td>07/29/2011</td>
<td>17:32 MST</td>
<td>310</td>
</tr>
<tr>
<td>07/29/2011</td>
<td>16:16 MST</td>
<td></td>
</tr>
</tbody>
</table>

**INSULIN ADMINISTERED**

- Humalog: 9 unit(s) *
- Insulin regular: 5 unit(s)
Sliding scale + 5 units glargine for 5 days.
Case 1 Learning points

• If the home TDD is really only 5, ok to start there
• Use HbA1c to know if home dose was right
• Increase the doses daily!
• $0.3 \times 57 = 17 \rightarrow 8$ glargine, 3 lispro with each meal
Know how to manage a patient’s blood sugars while they are NPO or when tube feeds are initiated.
Notes on being NPO

• If NPH is your basal, need to reduce dose by 50% to avoid hypoglycemic from the insulin peak
• If glargine is your basal AND it is dosed at 50% of the TDD then NO NEED TO ADJUST for NPO
• Meal insulin orders instruct RN to hold if eating <50% of the meal or on full liquids. No need to hold back ordering.
### Diagnosis (Problem) being Addressed this Visit

<table>
<thead>
<tr>
<th>Code</th>
<th>Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>789.00</td>
<td>Abdominal Pain, Unspecified</td>
</tr>
<tr>
<td>43F64C53-C1BB</td>
<td>Breast cancer</td>
</tr>
<tr>
<td>493289014</td>
<td>Chest pain - Pleuritic</td>
</tr>
<tr>
<td>929566C3-D38A</td>
<td>CHF - Congestive heart failure</td>
</tr>
</tbody>
</table>

### Problems

<table>
<thead>
<tr>
<th>Code</th>
<th>Name of Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>110628016</td>
<td>Alcohol dependence</td>
</tr>
<tr>
<td>121589010</td>
<td>Diabetes mellitus</td>
</tr>
<tr>
<td>1228478017</td>
<td>Cancer</td>
</tr>
</tbody>
</table>

### Search Results

- **Consult NP/Insulin Protocol**
  - Critical Care Insulin Transition Eating [cs]
  - Critical Care Insulin Transition Tube Feeding/TPN [cs]
  - Critical Care IV Insulin [cs]
  - INSULIN
  - insulin-Reg Human (Neonate)
  - insulin-Reg Human 0.05 Unit/mL Infusion (Neonate)
  - insulin-Reg Human 0.1 Unit/mL Infusion (Neonate)
  - insulin-Reg Human 0.5 Unit/mL Syr Infusion (Neonate)
  - insulin-Reg Human infusion (Peds)
  - Insulin Antibodies
  - insulin aspart-insulin aspart protamine 70/30
  - insulin detemir
  - Insulin Diluting Medium for Novolog
  - insulin glargine

- **insulin infusion**
  - insulin isophane
  - insulin isophane-insulin regular 70/30
  - Insulin Level
  - insulin lispro
  - insulin lispro-insulin lispro protamine 75/25
  - Insulin Lispro 10 units/mL
  - Insulin Lispro 25 units/mL
  - Insulin NPH
  - Insulin Orders [cs]
  - Insulin Pump - Patient's Own [cs]
  - insulin regular
  - insulin zinc
  - NPH Insulin

### Additional Information

- **Age:** 61 years
- **DOB:** 01/01/1953
- **MR#:** 11111
- **Enc Type:** No - Encounter class...
- **Preferred Communication Language:**
- **Fin#:** 123456789

### Action

- **Done**
<table>
<thead>
<tr>
<th>Component</th>
<th>Order Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Click here or on this icon to provide feedback on this order set. (General order set comments only - no patient-specific comments.)</td>
<td></td>
</tr>
<tr>
<td>Dosing Recommendations</td>
<td></td>
</tr>
<tr>
<td>Lower Resistance</td>
<td>Higher Resistance</td>
</tr>
<tr>
<td>Type 1 diabetes</td>
<td>Obese</td>
</tr>
<tr>
<td>Renal Insufficiency</td>
<td>Type 2 diabetes</td>
</tr>
<tr>
<td>Insulin naive</td>
<td>Acutely ill</td>
</tr>
<tr>
<td>On dialysis</td>
<td>Receiving steroids</td>
</tr>
<tr>
<td>Newly diagnosed diabetes</td>
<td>and blood sugar over 300 mg/dL</td>
</tr>
</tbody>
</table>

INSULIN CARE SETS

- [ ] Subcutaneous Higher Resistance Insulin [cs]
- [ ] Subcutaneous Lower Resistance Insulin [cs]
- [ ] Subcutaneous Tube Feed Insulin Orders [cs]
- [ ] TPN Labs and Meds [cs]
- [ ] Critical Care IV Insulin [cs]
- [ ] Critical Care IV Insulin 80-110 Range [cs]
- [ ] Critical Care IV Insulin 110-180 Range [cs]
- [ ] Careset Utilized

Inulin Orders [cs], T;N

No Results
### Physicists
Recommend inpatient management of hyperglycemia with insulin only. Recommend discontinuation of all oral hypoglycemic agents prior to use of this care set.

### Nursing
- **Conditional Order**: T;N, FOR ICU PATIENTS ONLY: If patient becomes critical (mech ventilation, IV pressors) d/c use of SubQ
- **POCT by Nursing Glucose (cont)**
- **POCT by Nursing Glucose (cont)** QIDACHS, (Additional check at 0200 if correction insulin dose given at HS.) When patient tolerating greater
- **Labs**
  - **Glyco Hgb (Hgb A1C)** Routine, RT, T;N, 1 time(s)
- **SubQ Insulin Dosing**
  - Dosing recommendations for insulin are guidelines only.
  - In general, patients who require higher doses of insulin are:
    - Obese
    - Type 2 diabetics
    - Acutely Ill
    - Receiving steroids and with blood sugar over 300 mg/dL
- **Long Acting (Basal) Insulin Glargine Dose (Lantus)**
  - Home dose of insulin may indicate dosing in the hospital. In general, the dosing for Lantus is 0.2 to 0.3 units per kg per day or more.
  - A simple calculation for Lantus starting dose is to divide the patient’s body weight in

### BMI
<table>
<thead>
<tr>
<th>BMI</th>
<th>Date/Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>23.44</td>
<td>11/12/2010 12:0...</td>
</tr>
<tr>
<td>26.12</td>
<td>08/08/2010 04:4...</td>
</tr>
<tr>
<td>Component</td>
<td>Order Details</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Home dose of insulin may indicate dosing in the hospital. In general, the dosing for Lantus is 0.2 to 0.3 units per kg per day or more. A simple calculation for Lantus starting dose is to divide the patient's body weight in kilograms by 4 and use that number as the number of units to dose. Adjust according to patient need.</td>
<td></td>
</tr>
<tr>
<td><strong>insulin glargine (Lantus)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Nutritional (Mealtime) Fixed Insulin Lispro Dose (HumaLOG)</strong></td>
<td></td>
</tr>
<tr>
<td>If on rapid acting insulin lispro (HumaLOG/Novolog/Apidra) at home, may start at or near home insulin dose. Otherwise, a simple calculation for insulin lispro (HumaLOG) dose is to divide the insulin glargine (Lantus) dose by 3 for the number of units insulin lispro (HumaLOG) per meal. Adjust according to patient need.</td>
<td></td>
</tr>
<tr>
<td><strong>insulin lispro (HumaLOG)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Correction Insulin Lispro Dose (HumaLOG)</strong></td>
<td></td>
</tr>
<tr>
<td>Adjust insulin dosing and blood glucose intervals based on insulin requirements. This dosing is used when the patient is hyperglycemic before meals, before bedtime, and when NPO.</td>
<td></td>
</tr>
<tr>
<td><strong>insulin lispro (insulin lispro correction dose (HumaLOG))</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Conditional Order</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Conditional Order</strong></td>
<td></td>
</tr>
<tr>
<td><strong>INSULIN ADJUSTMENT INSTRUCTIONS</strong></td>
<td></td>
</tr>
<tr>
<td>Recommend increasing Lantus dose by 20% if:</td>
<td></td>
</tr>
<tr>
<td>- nausea (or mild headache, dry mouth) increase nausea episodes (12+ mg/d)</td>
<td></td>
</tr>
</tbody>
</table>

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</tr>
<tr>
<td>26.12</td>
<td>08/08/2010 04:43PM</td>
</tr>
</tbody>
</table>
Much easier to order initial meal doses at time of order set initiation:

**Doses held if NPO or eating <50% meal (order comments)
Glargine full dose given if NPO
Standing orders to adjust if NPO

Details for insulin lispro (Humalog)

Order comments:
Give Humalog insulin within 15 minutes of the start of the meal.

HOLD if:
1. NPO
2. on clear or full liquids
3. eating <50% of the meal

If blood sugar <70:
1. Follow nursing hypoglycemia protocol orders.
Case 6

- 59 y.o. 90 kg, BMI 39, s/p renal transplant admitted with emesis, diarrhea and sepsis from a urinary source. BG 230. Admitted to med-surg.
- Home med: 70/30 50 units qam and qpm. Well controlled, no lows. Last HbA1c 7
  A. sliding scale for high resistance for 24 hours
  B. Glargine 50 units + high resistance
  C. TDD 100 units → 50 glargine 16 humalog AC
  D. Continue 70/30 50 units bid
Step 1: Calculate Starting total daily dose (TDD):

1. IV requirements
2. Home dose— (consider reduction by 25%)
3. Weight based 0.2-0.5 units/kg/day
   1. Most recent guides say 0.2-0.5
   2. Rabbit trials 0.3-0.5
      - 0.3 ESRD or elderly (>70 y.o.)
      - 0.4 units/kg/day if admit BG 140-200
      - 0.5 units/kg/day if admit BG >200

***Do not use “sliding scale” as a dose finding strategy***
Case 7: How many units of rapid acting insulin did he get at bedtime?
Insulin types and action

- **Rapid-Acting**: Humalog®
- **Short-Acting**: Humulin®
- **Intermediate-Acting**: Humulin®
- **Premixed**: Humalog Mix 75/25
- **Premixed**: Humulin 70/30
- **Premixed**: Humulin 50/50
Insulin types are confusing

- Look them up
- Verify the name with the pharmacy
- Does it make sense
- Don’t use them in the hospital…use the ones the nurses know
- Think about the discharge plan for discharge, NOT for there regimen inpatient!
Take home points

- DO NOT USE split mixed insulins in the hospital!
- DO NOT use regular insulin subcutaneous here at BGSMC (probably not at the VA either)
- If you EVER use anything other than glargine + humalog you better have a plan, know the action
Know when and how to make adjustments to the home regimen based on their blood glucose control prior to admission, resources and hospital requirements

But my patient won’t be able to afford/manage/comply/etc with basal/bolus as an outpatient
Achieving safe and effective transitions to home

- The admission HbA1c to indicate the patient’s glycemic status before they became ill
  - \( \leq 5.7 \) = normal glucose metabolism
  - \( 5.7 - 6.4 \) = ‘pre-diabetes’ (high risk for DM)
  - \( \geq 6.5 \) = diabetes
  - \( \geq 8.0 \) = poorly controlled diabetes
Factors Used for Selecting Discharge Therapy for Patients with Known Diabetes

- Control at home and admission HbA$_1^c$
- Home regimen prior to admission
- Admission reason: Hypoglycemia, Acute MI, Related to hyperglycemia (DKA, HHS, etc.)
- Physical limitations
- New co-morbidities that may limit prior oral therapy
- Hypoglycemia risk factors
- Treatment goals (i.e. hospice)
- Frequency of self monitoring
- Financial $$$$
Discharge Treatment Algorithm: AACE

Discharge Treatment

A1C < 7%
- Re-start outpatient treatment regimen (OAD and/or insulin)

A1C 7%-9%
- Re-start outpatient oral agents and D/C on glargine once daily at 50-80% of hospital dose

A1C >9%
- D/C on basal bolus at same hospital dose.
  - Alternative: re-start oral agents and D/C on glargine once daily at 50-80% of hospital dose

http://resources.aace.com/pages.asp.29.html
Case 8

Admission:
sliding scale high resistance

Post op:
Insulin gtt

Transition to subcut:
glargine 36+ scheduled lispro 12 tid AC

Discharge
Case 8 Follow Up

- HgbA1c 13.4%
- Discharged on
  - Metformin 500 mg bid, instructed to increase to 1000 mg bid in one week if not too much GI side effects
  - Glipizide 5 mg bid
  - Glargine 30 units q hs
  - Diabetes education given
- HgbA1c 6.8% 2.5 months later!
Selecting Discharge Therapy
Take Home Messages

• Good to do something but don’t get too
taggressive because the time after discharge is
high risk for hypoglycemia
• Once daily basal insulin with or without oral
agents is a good initial strategy
• Keep metformin and get to goal dose unless
contraind
• Tailor glycemic target to individual
• Endocrine is a great help
Why basal/bolus/correction?

• Achieves better glycemic control than sliding scale (RABBBIT trials) → Improved surgical outcomes

• More flexible for
  – Rapid changes in eating status
  – Varying insulin resistance

• Order sets can/are built to improve safety

• Nurses and staff will know 2 types of insulin really well

• We aren’t using their d/c regimen while inpatient anyway
Additional Resources for Physician Education

- American Association of Clinical Endocrinology Inpatient glycemic control resource center: https://www.aace.com/education/igrc
- Johns Hopkins Consultative Medicine Essentials for Hospitalists: http://www.jhcape.com or shmconsults.com
- Quantia MD **What is involved in the practical management of blood sugars postoperatively?**
- Quantia MD **What is involved in the practical management of insulin preoperatively?**
  - http://quantiamd.com/player/rumyejs?cid=53
Questions

Cheryl.OMalley@bannerhealth.com
Case 2

- 46 y.o. 95 kg, BMI 35, Admitted for diabetic foot ulcer, Cr 1.5, no recent hypoglycemia at home, no recent HgbA1c. Admit BG 215 didn’t take meds today
- Home med: glargine 52 units daily + Glipizide 10 mg daily. Hold glipizide and ....

A. Sliding scale for BMI >30 until determine his dose
B. Glargine 52 units + ss high resistant
C. TDD 52 units → 25 glargine 8 humalog AC
D. TDD 18 units (0.2 units/kg) → glargine 9, 3 humalog AC
E. Glargine 10 units + ss high resistant
Answer

- Answer c.
- Her home TDD is 52 units and she has no risk factors for hypoglycemia.
- By doing 50/50 you will build in a cushion in case the 52 is an overestimate.
Sliding Scale
### Basal/Bolus

#### Navigator

- LABS
- INSULIN ADMINISTERED

#### DIABETIC FLOW SHEET

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<thead>
<tr>
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<th>18:14 MST</th>
<th>17:15 MST</th>
<th>16:15 MST</th>
<th>15:15 MST</th>
<th>14:15 MST</th>
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<td>Hct</td>
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</tr>
<tr>
<td>Anion Gap</td>
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<tr>
<td>POC Additional Comment</td>
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</tr>
<tr>
<td>POC Glucose Glucometer Capillary</td>
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</tr>
<tr>
<td>Glucose Level</td>
<td>130°</td>
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<td>Glucose POC</td>
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<tr>
<td><strong>INSULIN ADMINISTERED</strong></td>
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</tr>
<tr>
<td>Humalog</td>
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</tr>
<tr>
<td>NPH/Regular 70/30</td>
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</table>
Basal/Bolus

### Diabetic Flowsheet

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<th>Reason For Test</th>
<th>POC Additional Comment</th>
<th>POCT Glucose Glucometer Capillary</th>
<th>Glucose Level</th>
<th>Glucose POC</th>
<th>Insulin Administered</th>
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<tr>
<td>05/28/2011</td>
<td></td>
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<td></td>
<td>87'</td>
<td>117'</td>
<td>Humalog 7 unit(s)</td>
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<tr>
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<td>insulin regular 7 unit(s)</td>
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<td>Lantus 21 unit(s)</td>
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<td>NPH/Regular 70/30</td>
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</tbody>
</table>
What do you think happened here?
Answer

• Scheduled nutritional insulin was held inappropriately
• Based on this review, you wouldn’t want to increase the insulin the next day, just to reinforce why we are giving it in a scheduled rather than reactive manner.
Case 2.5

• 46 y.o. 95 kg, BMI 35, “placed in obs” for Chest pain.
• Cr 1.5, no recent hypoglycemia at home, no recent HgbA1c. Admit BG 215 didn’t take meds today
• Home med: glargine 52 units daily + Glipizide 10 mg daily. Hold glipizide and ....

A. Sliding scale for BMI >30 until determine his dose
B. Glargine 52 units + glipizide 10 + ss high resistant
C. TDD 52 units → 25 glargine 8 humalog AC
D. Glargine 10 units + ss high resistant
Answer

• B or C are acceptable with the plan to resume home regimen at d/c. Since very short stay with obs, is eating and no new contraindication, can keep home regimen
Case 3

• 55 y.o.
• 50 kg, BMI 20, Cr 3.5
• Home med glipizide 5 mg po daily no hypoglycemia, BG running high
• Admitted for renal transplant rejection and planning on treatment with solumedrol
Answer

- Recommended starting dose would be 0.2-0.3 units/kg, she weighs 50 kg → 10-15 units TDD
- 50/50 basal/nutritional = 5-7 unit glargine + 2 units with meals
- 30% basal/70% meal → for hyperglycemia with steroids this is an option
Sliding Scale only for 4 days with BG 400s
Sulfonylurea + ss

<table>
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</tr>
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<td>Insulin regular</td>
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<td>Lantus</td>
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Anion Gap
Reason For Test
POCT Glucose Glucometer Capillary
Glucose Level
Glucose POC

295' 208'
5 glargine + ss
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<tr>
<th>Insulin Type</th>
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<tr>
<td>insulin regular</td>
<td>8 unit(s)*</td>
</tr>
<tr>
<td>Lantus</td>
<td>10 unit(s)</td>
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</table>
Kept lantus 10 and added regular insulin with meals + lispro ss

<table>
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<tr>
<th>Navigator</th>
<th>LABS</th>
<th>INSULIN ADMINISTERED</th>
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**DIABETIC FLOWSHEET**

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<th>Date</th>
<th>Humalog</th>
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<th>Lantus</th>
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<tr>
<td>07/27/2011</td>
<td>4 unit(s)</td>
<td>Not Done: Not A</td>
<td>12 unit(s)</td>
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<tr>
<td>07/27/2011</td>
<td>4 unit(s)</td>
<td>Not Done: Not A</td>
<td>6 unit(s)</td>
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**Glucose Level**

- **Glucone POC**: 256'247'

**23 July 2011 6:01 MST - 04 August 2011 23:21 MST**

[Screen shot of the medical record system showing the insulin administration details]
Steroids

• If IV continuous will be high all day, once a day po, high late afternoon/evening

• Keep thinking TDD
  – Cause more post prandial hyperglycemia
  – Change ratio to 30% basal/70% nutritional
Case 4 - why low?
Answer

• Low because all insulin (TDD) was given as basal and she likely had unpredictable po
## Last 1000 Results

### DIABETIC FLOWSHEET

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<tr>
<th>Test</th>
<th>Units</th>
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<tr>
<td>Reason For Test</td>
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</tr>
<tr>
<td>POCT Glucose Glucometer Capillary</td>
<td></td>
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<tr>
<td>Glucose Level</td>
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<tr>
<td>Glucose POC</td>
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<tr>
<td><strong>INSULIN ADMINISTERED</strong></td>
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</tr>
<tr>
<td>Humalog</td>
<td>7 unit(s)</td>
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<tr>
<td>Apidra</td>
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<tr>
<td>insulin regular</td>
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<tr>
<td>Insulin Regular - units/hr</td>
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</tr>
<tr>
<td>Lantus</td>
<td>40 unit(s)</td>
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### Dates and Times

- 03/21/2011 22:03 MST
- 03/21/2011 21:14 MST
- 03/21/2011 21:07 MST
- 03/21/2011 21:00 MST
- 03/21/2011 18:50 MST
- 03/21/2011 18:20 MST
- 03/21/2011 18:18 MST
Do you see a pattern?

### DIABETIC FLOWSHEET

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<th>Level: DIABETIC FLOWSHEET</th>
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<th>Glucose Level</th>
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</table>

**INSULIN ADMINISTERED**

- Humalog
- Apidra
- insulin regular
- Insulin Regular - units/hr
- Lantus

**Units Administered:** 7 units
Repeat X 12 days

<table>
<thead>
<tr>
<th>Date</th>
<th>Hct</th>
<th>Anion Gap</th>
<th>Reason For Test</th>
<th>POCT Glucose Glucometer Capillary</th>
<th>Glucose Level</th>
<th>Glucose POC</th>
<th>Insulin Administered</th>
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<td>64'</td>
<td>90'</td>
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</table>

| Humalog    | 4 unit(s) |
| Apidra     |           |
| insulin regular |     |
| Insulin Regular - units/hr |     |
| Lantus     | 40 unit(s) |
Reduce Basal + nutritional
Same problem, different year…

---

**Diabetic Flowsheet**

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<th>01/14/2012 6:49 MST</th>
<th>01/14/2012 5:31 MST</th>
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<td>Glucose Level</td>
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<tr>
<td>Glucose POC</td>
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</tr>
</tbody>
</table>

**Insulin Administered**

- Humalog
- Apidra
- Insulin regular
- Insulin Regular - units/hr
- Lantus

**Values**

- 201
- 74
- 27
- 21
- 29
- 133

**Insulin**

- 40 unit[s]
Case 5

- 47 y.o. admitted with pyelonephritis and perinephric abcess. Wt 140 kg. Cr 1.5. doesn’t check BG at home, no hypoglycemia symptoms
- Home meds: metformin 500 bid.
- BG at transferring facility 323 and then 280 What do you want to order?

A. sliding scale because only on one oral agent
B. TDD 70, glargine 35, humalog 12 tidac + correction
C. Glargine 10 units + sliding scale
Answer

• B based on 0.5 units/kg X 140 kg= TDD of 70 units and then 50/50.

• If he has poor po then the order set includes to hold if eat < 50% of meal or nPO
Case 5

- 47 y.o. admitted with pyelonephritis and perinephric abcess. you start: TDD 70, glargine 35, humalog 12 tidac + correction

- All doses given and 20 extra units of correctional → TDD 90 units in the last 24 h and BG 240-400

- What are your new insulin orders?
  A. TDD 90 with 45 glargine, 15 humalog with meals
  B. TDD 108 (90 + 20%) = 54 glargine +18 humalog with meals.
  C. No change, it has only been 24 h
Answer

• A or B would be acceptable. BG are still very high, no lows
• Either increase TDD by 20% (option A)
• Add all that needed yesterday (new TDD) and then add another 20% (option B)
Case 5

Glucose Level

Glargine 35 units, Humalog 12 units with meals

Glargine 64 units, Humalog 20 units with meals
# RABBIT 2 Surgery Titration

* Note: only increase the doses if NONE were <100mg/dl.

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<th>Adjustment</th>
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<tr>
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<td>No change</td>
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<tr>
<td>140-180 mg/dl</td>
<td>Increase TDD by 10% daily</td>
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<tr>
<td>&gt;180 mg/dl</td>
<td>Increase TDD by 20% daily</td>
</tr>
<tr>
<td>70-99 mg/dl</td>
<td>Decrease TDD by 10%</td>
</tr>
<tr>
<td>&lt;70 mg/dl</td>
<td>Decrease by 20%</td>
</tr>
</tbody>
</table>
My Suggestions for Daily Adjustment

1. Any less than 100 mg/dL or > 180

2. Add up previous day’s TDD
   - Include amount given as supplemental insulin
   - Adjust up or down by depending on degree of hypo- and hyperglycemia
   - Adjust for other factors (renal function, steroid dose, nutritional intake, severity of illness)

3. Divide new TDD into basal and nutritional components
   - Split 50/50 OR
   - Adjust basal and nutritional separately, depending on AM fasting vs. late day sugars
   - Watch out for too much basal
Case 6

• 59 y.o. 90 kg, BMI 39, s/p renal transplant admitted with emesis, diarrhea and sepsis from a urinary source. BG 230. Admitted to med-surg.

• Home med : 70/30 50 units qam and qpm. Well controlled, no lows. Last HbA1c 7

• What will your admit orders be
  A. sliding scale for high resistance for 24 hours
  B. Glargine 50 units + high resistance
  C. TDD 100 units → 50 glargine 16 humalog AC
  D. Continue 70/30 50 units bid
Answer

- C add together all of the home insulin to determine TDD (70/30 50 units bid = TDD of 100)
- 50% basal and 50% nutritional (will be held if doesn’t eat)
- Note- since patient has good control at home and no new contraindication, can go back to 50 units bid of 70/30 at d/c.
- Should not use fixed split in hospital because of variable oral intake and lack of familiarity by nursing.
Case 7: How many units of rapid acting insulin did he get at bedtime?
Answer

• About 12 units. If he would have had a normal BG going in, then would be low unless eating a meal
References

• Intensive versus Conventional Glucose Control in Critically Ill Patients, N Engl J med 360;13 march 26, 2009
• Queale WS et al, Ann Int Med, 1997; 157
• Becker T et al., Clinical outcomes associated with the use of subcutaneous insulin-by-glucose sliding scales to manage hyperglycemia in hospitalized patients with pneumonia Diabetes Research and Clinical Practice 78 (2007) 392–397
• Umpierrez GE, et al, Randomized Study of Basal-Bolus Insulin Therapy in the Inpatient Management of Patients With Type 2 Diabetes (RABBIT 2 Trial), Diabetes Care 30: 2007