Management of diabetes in the hospitalized patient

Robert Lash, MD
University of Michigan
Oct 2016

Conflict of Interest:
Express Scripts – Consulting

Acknowledgements:
Roma Gianchandani, MD
Director, Hospital Intensive Insulin Program
University of Michigan Health System
Hyperglycemia in Hospitalized Patients

- Hyperglycemia occurred in 38% of hospitalized patients
  - 26% had known history of diabetes
  - 12% had no history of diabetes

- Newly discovered hyperglycemia was associated with:
  - Longer hospital stays
  - Higher admission rates to intensive care units
  - Less likely to be discharged to home (requiring transitional or nursing home care)


Hyperglycemia is an independent marker of inpatient mortality in patients with undiagnosed diabetes
Prevalence of hyperglycemia in 181 cardiac patients without known diabetes

66% of AMI patients have IGT or previously undiagnosed T2DM on 75 g OGTT (35% IGT; 31% DM)

Normoglycemic


Hospital costs account for majority of total costs of diabetes

Per capita healthcare expenditures (2002)
### Recommended glucose targets: ICU

- **ADA/AACE:**
  - Not recommended <110 mg/dL
  - Acceptable 110-140 mg/dL
  - Recommended 140-180 mg/dL
  - Not recommended >180 mg/dL
  - Starting threshold no higher than 180 mg/dL
  - Lower targets 110-140 mg/dL appropriate in select patients/institutions
  - Targets <110 mg/dL or >180 mg/dL not recommended

- **American College of Physicians:**
  - Recommended 140-200 mg/dL

- **Critical Care Society:**
  - Recommended <150 mg/dL

- **Society of Thoracic Surgeons:**
  - Recommended <180 mg/dL, <150 mg/dL (complications)

#### Target glucose levels: non-ICU patients

- **Floor setting:**
  - Pre-meal < 140 mg/dL
  - Postprandial < 180 mg/dL
  - Reassess regimen if BG < 100 mg/dL
  - OK to adjust target in setting of comorbidities
    - Renal, liver failure, hypoglycemia unawareness, heart failure

<table>
<thead>
<tr>
<th>Adjust therapy</th>
<th>Pre-meal 100-140 mg/dL</th>
<th>Postprandial 140-180 mg/dL</th>
<th>Adjust therapy &gt;180 mg/dL</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100 mg/dL</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**A1C and hospital admission**

- Implementation of A1C testing can be useful to:
  - Assess glycemic control prior to admission
  - Differentiate new diagnosis of DM from stress hyperglycemia
  - Design an optimal regimen at the time of discharge

- HbA1c $\geq 6.5\%$ very likely diabetes.

- Not valid with transfusions, anemia or hemolysis.

- A1C represents: 50% from last month, 25% from 2 months ago, 25% from 3 months ago.

Diagnosing diabetes in outpatient setting

Can A1c predict clinical outcomes?

The association between hemoglobin A1C values and deep sternal wound infections in diabetes patients undergoing cardiac surgery

Alexander L. Folk5, Simon O. Butler4, Preeti V. Patil6, Christina A. Zuffi6, Sue Kling-Colson6, Elizabeth Dubois4, Jennifer L. Sweeney7, Jonathan W. Haft7 and Roma Y. Gianchandani7

Incidence of DSWI by A1C Stratification

Data expressed as N (%). DSWI, Deep sternal wound infection.
Case 1

You are admitting a 54 year-old man for exacerbation of his congestive heart failure. He has type 2 diabetes with a recent A1c of 7.6%. At home, he takes metformin and glipizide. You’ve ordered a ‘diabetic diet’ for him. Glucose on initial labs is 200 mg/dl.

What should you order for his diabetes medications?
- A) Continue home metformin and glipizide
- B) Continue home metformin but discontinue glipizide
- C) Continue home glipizide but discontinue metformin
- D) Discontinue both metformin and glipizide

Guidelines recommend discontinuing oral antidiabetic agents (OADs) in the acute inpatient setting

- Oral Antidiabetic Agents
  - Generally NOT recommended
- Continuous IV insulin
  - For ICU and selected medical-surgical patients only
- Basal Bolus SC insulin
  - Recommended for most medical-surgical patients
Why not use oral agents in the inpatient setting?

<table>
<thead>
<tr>
<th>Class</th>
<th>Examples</th>
<th>Contraindications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biguanides</td>
<td>Metformin</td>
<td>• Small risk of lactic acidosis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• IV contrast common in hospital setting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fluctuating renal function also common</td>
</tr>
<tr>
<td>Sulfonylureas and other</td>
<td>Glyburide, Glimeperide</td>
<td>• Risk of hypoglycemia, esp. if NPO</td>
</tr>
<tr>
<td>insulin secretagogues</td>
<td>Glipizide, Repaglinide</td>
<td>• Avoid formulations with long ½ lives</td>
</tr>
<tr>
<td>Thiazoladinediones</td>
<td>Pioglitazone, Rosiglitazone</td>
<td>• Risk of fluid retention, worsening CHF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ~ 2 weeks to reach steady state</td>
</tr>
<tr>
<td>Alpha-glucosidase inhibitors</td>
<td>Acarbose</td>
<td>• No effect in fasting patient</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Need monosaccharides to Rx hypoglycemia</td>
</tr>
<tr>
<td>DPP-4 inhibitors</td>
<td>Sitagliptin, vildagliptin,</td>
<td>Two inpatient studies (alone and with basal glargine) – may replace mealtime</td>
</tr>
<tr>
<td></td>
<td>saxagliptin, linagliptin</td>
<td>insulin in pts requiring &lt; 0.5 units/day of total daily dose</td>
</tr>
<tr>
<td></td>
<td>alogliptin</td>
<td></td>
</tr>
</tbody>
</table>

Case 1a

You are admitting a 54-year-old man for left leg cellulitis. He has type 2 diabetes with a recent A1c of 7.9%. At home he takes metformin and glipizide. He notes that his glucoses have been higher for the last week.

You have ordered a ‘diabetic diet’ for him, and held his oral agents. His first BG is 265 mg/dl. What should you order for his diabetes treatment?

- A) Sliding scale only
- B) Basal insulin only
- C) Basal, bolus and correction insulin if eating
- D) Basal insulin plus metformin and glipizide
Pharmacologic treatment of inpatient hyperglycemia

**Antihyperglycemic Therapy**

- **SC Insulin via “Basal-Bolus”**
  Recommended for most medical-surgical patients

- **OADs**
  Not generally recommended

- **Continuous IV Infusion**
  Selected medical-surgical patients

RABBIT-2D trial:
In T2DM patients, how does treatment with sliding scale regular insulin compare with a basal-bolus insulin regimen (glargine daily plus glulisine before meals)?

**Inpatient management in non-ICU medical setting**

- Sliding scale regular insulin
- Basal bolus insulin regimen

Umpierrez et al, Diabetes Care 30:2181–2186, 2007
RABBIT 2: Superior glycemic control with basal-bolus vs sliding-scale insulin

Hypoglycemia rate:
- Basal bolus group:
  - BG < 60 mg/dL: 3%
  - BG < 40 mg/dL: none
- Sliding scale:
  - BG < 60 mg/dL: 3%
  - BG < 40 mg/dL: none

Mean fasting glucose (147 vs 165 mg/dL, \textit{P} < 0.01), lower mean random glucose (164 vs 188 mg/dL, \textit{P} < 0.01; \textit{\textless}P < 0.05; \textit{\textlesseq}Long-acting insulin (glargine) once daily + short-acting insulin (glulisine) before meals, total dose 0.4 U/kg (BG 140-200 mg/dL) or 0.5 U/kg (BG 201-400 mg/dL).


RABBIT-2 surgery trial:
In T2DM patients, how does treatment with a basal-bolus insulin regimen compare with a sliding scale of regular insulin in preventing in-hospital complications?

Inpatient management in general surgery

- Sliding scale regular insulin
- Basal-bolus insulin regimen

Umpierrez et al, Diabetes Care 34 (2):1–6, 2011
Composite Mortality Wound Infection Pneumonia Acute Renal Failure

Outcome Frequency, %

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composite</td>
<td>24.3</td>
</tr>
<tr>
<td>Glargine + Glulisine</td>
<td>8.6</td>
</tr>
<tr>
<td>Sliding Scale Insulin</td>
<td>1.0</td>
</tr>
</tbody>
</table>

* Composite- wound infection, pneumonia, respiratory failure, acute renal failure, and bacteremia.

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

RABBIT 2 surgery: postoperative complications

Recognition and diagnosis of hyperglycemia/DM in the hospital setting

Upon admission
- Assess all patients for a history of diabetes
- Obtain laboratory blood glucose testing

No h/o diabetes BG <140 mg/dL
- No POC BG monitoring
- Start monitoring when clinical condition changes: TPN, steroids, octreotide etc.

No h/o diabetes BG ≥140 mg/dL
- Start POC glucose monitoring for 24-48 h Check A1C
- A1C ≥6.5%

History of diabetes
- BG monitoring

BG, blood glucose; POC, point of care.

Case 2

A 60-year-old man with type 2 diabetes and A1c of 8.2% is admitted for hematochezia. An EGD is scheduled for the morning, and he is NPO after midnight. At home, he takes glargine 80 units at bedtime and no other insulin. In addition to starting an aspart sliding scale every 6 hours, what is the most appropriate dose of glargine for the night prior to procedure since he is NPO?

- A) Order glargine 76 units HS
- B) Order glargine 44 units HS
- C) Order glargine 25 units HS
- D) Hold home glargine

“NPO” with diabetes

- **Basal:** Reduce basal insulin by 30-50%
  - Closer to 30% if good control on an evenly matched basal-bolus regimen
  - Closer to 50% if “basal-heavy”

- **Mealtime:** Mealtime insulin coverage should be temporarily discontinued while NPO

- **Correction:** Continue correction insulin dosing but order for every 6 hours (rather than pre-meal and at bedtime) in order to ensure routine insulin administration
• He has a basal heavy regimen, so: 0.5 x 80 units = 40 units
• But A1c is high, so probably needs a little more than 40 units

  - A) Order glargine 76 units HS
  - B) **Order glargine 45 units HS**
  - C) Order glargine 25 units HS
  - D) Hold home glargine

---

**Case 2 – the adventure continues**

EGD and colonoscopy completed. Patient started on a consistent carb diet.

At home he takes glargine 80 units qHS. He was given 45 units glargine HS while NPO, with fasting BG in 130s.

In addition to continuing the glargine and aspart sliding scale, what is the most appropriate dose of meal aspart for him?

  - A) Aspart 16 units with full meal / 8 units with half meal
  - B) Aspart 20 units with each meal / 10 with half meal
  - C) Aspart 4 units with each meal
  - D) Hold aspart
Basal-bolus insulin ratio

- Most patients need TDD of insulin divided into
  - 50 percent basal and 50 percent bolus

- Exceptions
  - Low carbohydrate diets
  - Cystic fibrosis patients
  - Glucocorticoids
  - Enteral or parenteral nutrition
Case 2 (continued)

• Basal:bolus ratio goal is about 50:50
  – On 45 units glargine, so will also need 45 units to cover meals
  – 45/3 = 15 units (round to even # of units), half for small meals

  – A) Aspart 16 units with full meal / 8 units with half meal
  – B) Aspart 20 units with each meal/ 10 with half meal
  – C) Aspart 4 units with each meal
  – D) Hold aspart

Case 3

Estimate the total daily dose (TDD) of insulin for a 45 year-old woman with type 1 diabetes, weight - 67 kg, and Cr 1.1 who comes in with a foot ulcer. She thinks her TDD is between 30-50 units. She has a non-working insulin pump, so there’s no way to confirm her recent dosing.

  – A) 30 units per day
  – B) 40 units per day
  – C) 55 units per day
  – D) 75 units per day
Estimating total daily dose (TDD) of insulin: weight-based dosing

\[
\text{TDD in units of insulin} = \text{N} \times \text{patient’s weight in kg}
\]

<table>
<thead>
<tr>
<th>If your patient has these features…</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulin Sensitive</td>
<td>0.3</td>
</tr>
<tr>
<td>Lean or malnourished patients, elderly, CKD IV or V, or insulin naïve</td>
<td></td>
</tr>
</tbody>
</table>

How to Initiate MDI

- Starting TD dose = 0.4 x wt in kg
- Weight is 67kg: 0.4 units/kg x 67 kg = 28 units (TDD)
- Basal dose (glargine) = 50% of starting dose at HS: 0.5 x 28 units = 14 units at HS
- Total bolus dose (aspart or lispro) = 50% of TDD ÷ 3; = 14 ÷ 3 = 5 units with each meal
- Correction bolus = Low dose scale
Case 3
Estimate the total daily dose (TDD) of insulin for a 45-year-old woman with type 1 diabetes, weight of 67 kg, baseline Cr 1.1 who comes in with a foot ulcer. She thinks her TDD is between 30-50 units. She has a non-working insulin pump, so there’s no way to confirm her recent dosing.

– A) 30 units per day
– B) 40 units per day
– C) 55 units per day
– D) 75 units per day

Case 4
41-year-old woman with well-controlled type 1 diabetes is admitted for a scheduled cholecystectomy. A1c-7%. Her home insulin regimen consists of:

   Basal: Bedtime glargine 21 units QHS,
   Bolus: Mealtime aspart 7 units with a correction scale for hyperglycemia.

She has fewer than one hypoglycemic episode per month. She will be NPO after midnight for her surgery. You decide to hold her dinnertime insulin and add an aspart correction scale. In addition, you should do which of the following:

– A) Hold glargine the night prior to surgery
– B) Order 15 units of glargine the night prior to surgery
– C) Order 10 units of glargine the night prior to surgery
– D) Hold glargine and start an insulin drip
“NPO” status and type 1 diabetes

• **Basal**: NEVER hold basal insulin in patients with type 1 diabetes. Even if that means starting IV dextrose.

• **Basal** insulin may be reduced by 30% when NPO, if glucose well controlled (70% of 21 units is ~15 units)

• **Mealtime**: Mealtime insulin should be discontinued while NPO

• **Correction**: Continue correction insulin doses, but order for every 6 hours rather than pre-meal and pre-bedtime in order to ensure consistent dosing while NPO

Case 4

41-year-old woman with well-controlled type 1 diabetes is admitted for a scheduled cholecystectomy. A1c-7%. Her home insulin regimen consists of:

- Basal: Bedtime glargine 21 units QHS,
- Bolus: Mealtime aspart 7 units with a correction scale for hyperglycemia.

She has fewer than one hypoglycemic episode per month. She will be NPO after midnight for her surgery. You decide to hold her dinnertime insulin and add an aspart correction scale. In addition, you should do which of the following:

- A) Hold glargine the night prior to surgery
- **B) Order 15 units of glargine the night prior to surgery**
- C) Order 10 units of glargine the night prior to surgery
- D) Hold glargine and start an insulin drip
Case 5

Estimate the total daily dose (TDD) of insulin for a 60-year-old man with type 2 diabetes, weight of 100 kg, admitted for cellulitis and hyperglycemia. He takes 3 oral agents at home and his A1c is 7.9%. He has a fever and his WBC is 14,000. Glucose on admission is 300mg/dl.

- A) 20 units per day
- B) 45 units per day
- C) 70 units per day
- D) 90 units per day

Calculating TDD insulin dose in type 2 DM

Total = 100kg x 0.7 (N)=70 units

Basal = 35 units (1/2 of total)
35 units glargine ‘daily’ (or) 17 units NPH BID

Prandial = 35 units (1/2 of total)
Aspart - 36units/3 meals
12 units for meals (6 for half meals)

Correction scale
Calculating correction scales

### Low Dose Algorithm
(For pts requiring TDD < 40 units of insulin/day)

<table>
<thead>
<tr>
<th>Premeal BG</th>
<th>Additional Insulin</th>
</tr>
</thead>
<tbody>
<tr>
<td>150-199</td>
<td>1 unit</td>
</tr>
<tr>
<td>200-249</td>
<td>2 units</td>
</tr>
<tr>
<td>250-299</td>
<td>3 units</td>
</tr>
<tr>
<td>300-349</td>
<td>4 units</td>
</tr>
<tr>
<td>&gt;349</td>
<td>5 units</td>
</tr>
</tbody>
</table>

### Medium Dose Algorithm
(For pts requiring TDD 40 to 80 units of insulin/day)

<table>
<thead>
<tr>
<th>Premeal BG</th>
<th>Additional Insulin</th>
</tr>
</thead>
<tbody>
<tr>
<td>150-199</td>
<td>1 unit</td>
</tr>
<tr>
<td>200-249</td>
<td>3 units</td>
</tr>
<tr>
<td>250-299</td>
<td>5 units</td>
</tr>
<tr>
<td>300-349</td>
<td>7 units</td>
</tr>
<tr>
<td>&gt;349</td>
<td>8 units</td>
</tr>
</tbody>
</table>

### High Dose Algorithm
(For pts requiring TDD >80 units of insulin/day)

<table>
<thead>
<tr>
<th>Premeal BG</th>
<th>Additional Insulin</th>
</tr>
</thead>
<tbody>
<tr>
<td>150-199</td>
<td>2 units</td>
</tr>
<tr>
<td>200-249</td>
<td>4 units</td>
</tr>
<tr>
<td>250-299</td>
<td>7 units</td>
</tr>
<tr>
<td>300-349</td>
<td>10 units</td>
</tr>
<tr>
<td>&gt;349</td>
<td>12 units</td>
</tr>
</tbody>
</table>

### Individualized Algorithm

<table>
<thead>
<tr>
<th>Premeal BG</th>
<th>Additional Insulin</th>
</tr>
</thead>
<tbody>
<tr>
<td>150-199</td>
<td>1 unit</td>
</tr>
<tr>
<td>200-249</td>
<td>3 units</td>
</tr>
<tr>
<td>250-299</td>
<td>5 units</td>
</tr>
<tr>
<td>300-349</td>
<td>7 units</td>
</tr>
<tr>
<td>&gt;349</td>
<td>8 units</td>
</tr>
</tbody>
</table>

---

**A sliding scale is NOT a correction scale**

- Sliding scales (w/o mealtime insulin) force patients to ‘earn’ their insulin by being hyperglycemic.

  For temp < 99, give no ceftriaxone.
  For temp 99 – 100, give 250 mg ceftriaxone
  For temp 100-101, give 500 mg ceftriaxone
  For temp 101-102, give 750 mg ceftriaxone
  For temp > 102, give 1000 mg ceftriaxone, and call MD
Case 6

A 48-year-old man with type 2 diabetes and an A1c of 9.7% is recovering s/p coronary artery bypass graft. He had a poor appetite but is now eating meals. Glargine has been gradually increased from 24 to 38 units qHS. Today his fasting glucose was 76 mg/dl. However, he is persistently hyperglycemic during the day, requiring about 20 units of aspart on a moderate-dose sliding scale.

What do you do next?

–A) Keep glargine at 38 units qHS and decrease aspart to low-dose scale
–B) Decrease glargine to 32 units and decrease aspart to low-dose scale
–C) Decrease glargine to 32 units, and add scheduled doses of aspart with meals
–D) Change glargine to 20 units BID

Adjusting basal insulin

• Fasting glucose < 70 mg/dl ➔ **decrease** glargine by ≥ 20%

• Fasting glucose 70-100 ➔ **decrease** glargine by 10%

• Fasting glucose 100-140, no hypoglycemia the previous day ➔ **no change** in glargine

• Fasting glucose 141-180 ➔ **increase** glargine by 10%

• Fasting glucose >180 ➔ **increase** glargine by 20%
Matching insulin dosing to insulin needs: it’s a “basal-bolus” world

- **Basal Insulin**: suppresses glucose production between meal and overnight (~ 50% of TDD)
- **Bolus Insulin**: consists of mealtime/prandial insulin and correction insulin (combined, ~ 50% of TDD)

### Case 6

A 48-year-old man with type 2 diabetes with an A1c of 9.7% is recovering s/p coronary artery bypass graft. He had poor appetite but now is eating meals. Glargine has been gradually increased from 25 to 38 units qHS. Today his fasting morning BG was 76mg/dl but he is persistently hyperglycemic during the day and is requiring about 20 units of moderate-dose aspart correction scale.

Reduce glargine by 10% -- Ten percent of 38 units = 3.8 units.
So, reduce glargine by at least 4 units

What do you do next?

- A) Keep glargine 38 units QHS and decrease aspart to low-dose scale
- B) Decrease glargine to 32 units and decrease aspart to low-dose scale
- C) Decrease glargine back to 32 units and add scheduled doses of aspart with meals
- D) Change his glargine to 20 units BID
Bonus topic:

How to frustrate an endocrinologist

<table>
<thead>
<tr>
<th></th>
<th>Breakfast</th>
<th>Lunch</th>
<th>Dinner</th>
<th>Bedtime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>256 / 6+5</td>
<td>240 / 6+3</td>
<td>278 / 6+5</td>
<td>220 / 3 (20 glargine)</td>
</tr>
<tr>
<td>Tuesday</td>
<td>262 / 6+5</td>
<td>215 / 6+3</td>
<td>312 / 6+7</td>
<td>205 / 3 (20 glargine)</td>
</tr>
<tr>
<td>Wednesday</td>
<td>247 / 6+3</td>
<td>291 / 6+5</td>
<td>228 / 6+3</td>
<td>288 / 5 (20 glargine)</td>
</tr>
<tr>
<td>Thursday</td>
<td>210 / 6+3</td>
<td>303 / 6+7</td>
<td>234 / 6+3</td>
<td>292 / 5 (20 glargine)</td>
</tr>
</tbody>
</table>

Insanity is doing the same thing over and over and expecting a different result

-Typically attributed to Albert Einstein (without much data to support it)
Our patient is getting ~18 units of correction every day, her glucoses remain poorly controlled, yet her basal-bolus insulin stays the same.

Use yesterday’s data to inform today’s insulin regimen.

18 units of correction divided into equal amounts (basal and bolus):
9 units added to the basal insulin (Glargine increases from 20 to 29)
3 units added to each meal (AC aspart increases from 6 to 9)
Sliding scale continues
Case 7

A 68-year-old woman with type 2 diabetes is admitted for cellulitis. She is continued on her home dose of glargine 30 units qHS and started a low-dose aspart correction scale AC and HS. Her 10pm glucose is 368 mg/dL. Aspart is given according to correction scale. At 11pm her BG is rechecked and it’s still elevated at 296 mg/dL. You’re called urgently about this “very high sugar”. What do you do next – after taking a few cleansing breaths?

- A) Give aspart according to low-dose scale; re-check in one hour
- B) Give aspart according to moderate scale; re-check in one hour
- C) Give aspart according to moderate scale then start patient on an IV insulin drip
- D) Give no additional aspart; re-check in three hours
Beware of stacking insulin

Insulin Effect

Breakfast | Lunch | Dinner | Bedtime | Breakfast

Rapidly-acting insulin

Glucose level 368 mg/dL

Glargine insulin

Case 7

A 68-year-old woman with type 2 diabetes is admitted for cellulitis. She is continued on her home dose of glargine 30 units qHS and started a low-dose aspart correction scale AC and HS. Her 10pm glucose is 368 mg/dL. Aspart is given according to the scale. At 11pm her BG is rechecked and still elevated at 296 mg/dL. You're called urgently about this “very high sugar”. What do you do next – after taking a few cleansing breaths?

- A) Give aspart according to low-dose scale; re-check in one hour
- B) Give aspart according to moderate scale; re-check in one hour
- C) Give aspart according to moderate scale then start patient on an IV insulin drip
- D) Give no additional aspart; re-check in three hours
Case 8

A 43-year-old woman with systemic lupus erythematosus and diet-controlled type 2 diabetes (A1c 6.6%) was admitted for a lupus flare. She received a 3-day pulse of methylprednisolone 1g IV daily, and now is on prednisone 60 mg po daily with plans for a prolonged taper. She is currently on a lispro correction scale before meals and at bedtime. Her fasting BGs are in the 100-130 mg/dL range, but are rising to 400 mg/dL by bedtime.

What should you do next?
- A) Start metformin
- B) Start glargine QHS
- C) Start mealtime lispro
- D) Increase the lispro correctional scale

Integrating steroids into basal-bolus therapy

Corticosteroids raise ALL blood sugars but disproportionately affect post-prandial values.

To match insulin dose to insulin needs, you are going to need a disproportionately greater increase in bolus insulin at mealtimes.

Basal insulin (e.g., glargine) may also be helpful in these situations.

*Endocrine 'glass bead':* Consider giving NPH insulin at the same time as the prednisone. The onset/peak/duration of NPH match nicely with the effect of an AM dose of prednisone.
Effects of prednisone dosing on glucose levels

NPH provides best for afternoon coverage, when glucocorticoid-induced hyperglycemia is greatest. (Works best when am BG is controlled.)
Adjusting insulin in setting of steroid therapy

- Increase correction scale
- Add or increase meal insulin
- Add NPH with steroids
  - 5 units with steroids if no history of diabetes
  - 10 units with steroids if there is a history of diabetes

Case 8

A 43-year-old woman with systemic lupus erythematosus and diet-controlled type 2 diabetes (A1c 6.6%) was admitted for a lupus flare. She received a 3-day pulse of methylprednisolone 1g IV daily, and now is on prednisone 60 mg po daily with plans for a prolonged taper. She is currently on a lispro correction scale before meals and at bedtime. Her fasting BGs are in the 100-130 mg/dL range, but are rising to 400 mg/dL by bedtime.

What should you do next?
- A) Start metformin
- B) Start glargine QHS
- C) Start mealtime lispro
- D) Increase the lispro correctional scale
Let’s finish with everyone’s favorite topic:

**Discharge**

**Choosing a discharge regimen**

- Patients with pre-existing well-controlled diabetes
  - If taking po well: OK to discharge on home regimen
  - If decreased po intake: Consider temporary overall decrease in doses by 1/3 to 1/2 (short and long acting)

- Patients w/ modest insulin needs (< 20 units daily)
  - Usually OK to discharge on oral agent(s)
  - Try to avoid sulfonylureas
Choosing a discharge regimen

• Patients with newly diagnosed diabetes or with poor control on prior outpatient treatment
  – Discharge on your now well-honed inpatient regimen.

  – This may be a ‘welcome to the next level’ for patients. Pre-discharge teaching and outpatient follow-up are critical.

  – Good discharge prescribing can make a big difference.

Discharge insulin algorithm

Discharge regimens if on basal-bolus Rx as inpatient

- A1C < 7.5%
  - Discharge on previous outpatient regimen (orals and/or insulin)

- A1C >7.5%-8%
  - Re-start outpatient regimen with some adjustment of orals or insulin

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

- A1C >9%
Diabetes testing supplies

• Monitor

• Lancets (Bags of 100)

• Test strips (Containers of 50)
  – Document number of tests/day in your Rx
  Oral agents - one test/day
  Type 2 on insulin – generally two tests/day
  Type 1 or multiple daily injections – four tests/day

Insulin vials

• Vials are 10 mL (at 100 units/mL) = 1000 units/vial
  • Vials last for 28 days at room temperature, so prescribe at least one vial/month
  • Calculate ‘vials per month’: Example - 60 units/day = 1800 units/month = 2 vials per month

• Syringes:
  • 0.3 mL (30 units), 0.5 mL (50 units), or 1 mL (100 units)
  • Gauge: 28-31 gauge (Use ‘bigger’ needles for larger doses)
  • Length: 6mm (15/64”), 8mm (5/16”), or 12.7mm (1/2”)


Insulin pens

• Great option, when available
  • Not always covered by insurance
  • Some pens available in concentrated forms (e.g., 300 units/ml)
  • Need to consider possible pen ‘wastage’ with larger doses

• One pen is 3 mL (typically 300 units at 100 units/mL)
  • Five pens in one box (typically 1500 units/box)
  • Each pen is used for multiple doses (until empty)

• Needle tips
  • Usually changed with each injection. Bags of 100.
  • Commonly used size - Ultra-Fine Nano Pen Needles (4mm x 32G)

Things to remember if you’re just waking up

• Hyperglycemia is common in hospitalized patients, and is associated with complications and poor outcomes

• Goal is <140 (fasting & pre-meal). But it’s not a limbo contest.

• Relying only on sliding scale insulin ‘rewards’ hyperglycemia, and does not lead to good glucose control.
Things to remember if you’re just waking up

• If your patient needs daily insulin, long acting insulin should be part of that regimen.

• Inpatient insulin regimens should (generally) include basal, bolus, and correction dosing.

• Use yesterday’s data to adjust today’s insulin dosing.

• Be sure your patients have the right medications and supplies at discharge.