Diabetes Management in the Hospitalized Patient

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7/11/2014

Objectives
- Explain how the various medicines for diabetes work.
- Recognize important contraindications to and drug interactions with diabetes medications.
- Describe how other illnesses, diagnoses, and medications can affect diabetes.
- State what patients need to know about their diabetes medications.
- Discuss insulin action profiles and how insulin is dosed.
- Examine current standards of care for diabetes management in the hospital.
- Identify key strategies for successful transition of patients onto their home medication regimen upon discharge from the hospital.

Outline
- Diabetes medicines
  - Insulin
  - Standards of care for diabetes management in the hospital
  - Transitioning patients from the hospital to home

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- Diabetes medicines
  - Insulin
  - Standards of care for diabetes management in the hospital
  - Transitioning patients from the hospital to home

Diabetes Medications
- Insulin
- Sulfonylureas
- Meglitinides
- Metformin
- TZDs
- Cycloset
- DPP-IV Inhibitors
- GLP-1 Analogues
- SGLT2 Inhibitors
- Symlin
- Alpha-glucosidase Inhibitors
- Welchol

Diabetes Medications
- Insulin
- Sensitizers
  - Metformin
  - TZDs
- Secretagogues
  - Sulfonylureas
  - Meglitinides
- GLP-1 Based Therapies
  - DPP-IV Inhibitors
  - GLP-1 Analogues
- Other
  - Amylin analogue
  - Cycloset (bromocriptine)
  - Alpha-glucosidase Inhibitors
  - SGLT2 Inhibitors
  - Welchol (colesevelam)
### Diabetes Meds: Sensitizers

- **Biguanide**
  - Metformin (Glucophage, Glumetza, Fortamet)

- **TZDs**
  - Pioglitazone (Actos)
  - Rosiglitazone (Avandia)

### Metformin

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Decreases hepatic glucose production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depends Upon</td>
<td>Presence of insulin</td>
</tr>
<tr>
<td>Power</td>
<td>Decreases A1C 1 – 2%</td>
</tr>
<tr>
<td>Starting Dose</td>
<td>500 mg daily</td>
</tr>
<tr>
<td>Maximum Dose</td>
<td>2500 mg daily, divided</td>
</tr>
<tr>
<td>Dosing frequency</td>
<td>1 – 3 times daily</td>
</tr>
</tbody>
</table>

**Best Candidates**

- Nearly all type 2 diabetics

**Contraindications**

- Elevated creatinine
  - > 1.4 in women, > 1.5 in men
- CHF
- Liver disease
- Alcoholism

**Side Effects**

- Diarrhea, nausea

**Main Risk**

- Lactic acidosis

**Drug Interactions**

- IV contrast, cimetidine

### Metformin: Patient Instructions

- Take on a full stomach (after a meal)
- GI symptoms are common initially, and often improve with time and are minimized by titration
- Extended release capsules may appear whole in BMs. The capsules shouldn’t be cut or crushed
- Hold if you have a contrasted radiology study
- Hold during a GI illness

### Thiazolidinediones (TZDs)

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Increase insulin sensitivity in muscle and fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depends Upon</td>
<td>Presence of insulin and insulin resistance</td>
</tr>
<tr>
<td>Power</td>
<td>Decreases A1C 0.5 – 1.5%</td>
</tr>
<tr>
<td>Starting Dose</td>
<td>Pioglitazone 15 mg, Rosiglitazone 2 mg</td>
</tr>
<tr>
<td>Maximum Dose</td>
<td>Pioglitazone 45 mg, Rosiglitazone 8 mg</td>
</tr>
<tr>
<td>Dosing frequency</td>
<td>1 – 2 times daily</td>
</tr>
</tbody>
</table>

**Best Candidates**

- Insulin resistance, Obese patients

**Contraindications**

- CHF classes III and IV
- ALT > 2.5 X ULN

**Side Effects**

- Edema, weight gain, anemia, fractures

**Main Risks**

- CHF, possible bladder cancer (pioglitazone), rare hepatotoxicity
**TZDs: Patient Instructions**

- Mild edema is common. Stop and call prescriber if severe edema
- Stop and call prescriber if shortness of breath, chest tightness, orthopnea
- Can take any time of day, with or without food

**Diabetes Meds: Secretagogues**

- Sulfonylureas, dosed once or twice daily
  - Glimepiride (Amaryl)
  - Glipizide (Glucotrol)
  - Glyburide (Diabeta, Micronase, part of Glucovance)
- Meglitinides, dosed with meals
  - Repaglinide (Prandin)
  - Nateglinide (Starlix)

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**Secretagogues**

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Stimulate insulin release</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depends Upon</td>
<td>Presence of functioning beta cells</td>
</tr>
<tr>
<td>Power</td>
<td>Decreases A1C 1 – 2%</td>
</tr>
</tbody>
</table>
| Duration of Effect         | Sulfonylureas: 12 – 24+ hours (varies by agent)  
                            | Meglitinides: 1 – 3 hours |
| Drug Interactions          | Repaglinide: Gemfibrozil, Cyclosporine, Clarithromycin, Azoles  
                            | Nateglinide: Azoles, Cyclosporine |

| Best Candidates             | Disease duration < 10 years |
| Contraindications          | Renal failure (exception: repaglinide safe)  
                            | Caution in elderly |
| Side Effects               | Hypoglycemia, weight gain |
| Main Risk                  | Hypoglycemia |

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**Secretagogues: Patient Instructions**

- Educate regarding hypoglycemia: recognition and treatment
- Sulfonylureas: usually taken before breakfast and supper
- Meglitinides: taken before each meal
- Extended release glipizide tablets may appear whole in BMs

**GLP-1 Modes of Action in Humans**

- Stimulates glucose-dependent insulin secretion
- Suppresses glucagon secretion
- Regulates gastric emptying
- Reduces food intake

GLP-1 is secreted from the L-cells in the intestine

This in turn...
**GLP-1 Based Therapies**

- **DPP-IV Inhibitors, all once daily pills**
  - Inhibit degradation of GLP-1
    - Januvia (sitagliptin)
    - Onglyza (saxagliptin)
    - Tradjenta (linagliptin)
    - Nesina (alogliptin)
- **GLP-1 Analogues, all injectable**
  - Byetta (exenatide), twice daily, pen
  - Victoza (liraglutide), once daily, pen
  - Bydureon (exenatide), once weekly, vial though pen coming soon

**DPP-IV Inhibitors**

- **Depends Upon** Functioning beta cells
- **Power** Decrease A1C 0.5 – 0.9%
- **Best Candidates** Mild elevations A1C, patients who want to avoid hypoglycemia and weight gain
- **Contraindications** History of pancreatitis, gastroparesis
- **Side Effects** Headache, nasopharyngitis, pancreatitis??, Possible CHF w/ Onglyza (saxagliptin)
- **Drug Interactions** Tradjenta & Onglyza: avoid use with CYP3A4 inducers

**GLP-1 Analogue: Patient Instructions**

- Discuss the GI side effects, and that they usually improve with time and are reduced by avoiding overeating
- Byetta: dose 0 – 60 minutes prior to breakfast and supper
- Victoza dosed in the morning with or without food
- Bydureon dosed once weekly, any time of day, with or without food
- Educate on hypoglycemia
- Educate on symptoms of possible pancreatitis

**Amylin**

Amylin is secreted with insulin
Amylin

Amylin is secreted with insulin

- Suppresses glucagon release
- Increases satiety
- Slows gastric emptying

Amylin Analogue: Symlin (pramlintide)

<table>
<thead>
<tr>
<th>Delivery Method</th>
<th>Injection prior to each meal, pen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best Candidates</td>
<td>Motivated type 1 and 2 diabetics who are on insulin</td>
</tr>
<tr>
<td>Power</td>
<td>Decreases A1C 0.6 – 0.8%</td>
</tr>
<tr>
<td>Side Effects</td>
<td>Nausea, vomiting, hypoglycemia, weight loss</td>
</tr>
<tr>
<td>Contraindications</td>
<td>Hypoglycemia unawareness, gastroparesis</td>
</tr>
</tbody>
</table>

Symlin (pramlintide): Patient Instructions

- Dose prior to meals
- Reduce mealtime insulin 25% upon starting
- Educate regarding hypoglycemia
- Discuss GI side effects and how dose titration helps minimize them and that side effects often abate with time

Cycloset (bromocriptine, quick release)

| Mechanism | Increases dopamine, unclear how this lowers blood sugar |
| Power     | Decreases A1C 0.5% |
| Best Candidates | Uncertain, though proven CV safety |
| Dosing | Taken upon awakening |
| Side Effects | Nausea, orthostasis, headache |
| Drug Interactions | Anti-psychotic drugs, triptans, ergots |

Cycloset (bromocriptine): Patient Instructions

- Take with food within 2 hours of awakening
- Start with 1 tablet, and it will be increased weekly to a maximum to 6 tablets daily
- Warn about orthostasis (and possible syncope) and nausea

Alpha-Glucosidase Inhibitors

- Precose (acarbose)
- Glyset (miglitol)
Alpha-glucosidase Inhibitors

**Mechanism**
Delays carbohydrate absorption

**Power**
Decreases A1C 0.5 – 0.8%

**Dosing**
Prior to each meal

**Side Effects**
Flatulence, diarrhea

**Main Risk**
Elevated LFTs (with acarbose, rare)

**Contraindications**
Creatinine > 2

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Alpha-glucosidase Inhibitors: Patient Instructions

- Take at start of meals
- Warn about GI side effects, which can be decreased with titration of drug

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SGLT2 Inhibitors

- Invokana (canagliflozin)
- Farxiga (dapagliflozin)

**Mechanism**
Increase renal glucose excretion

**Power**
Decrease A1C 0.5 – 0.7%

**Best Candidates**
Unclear (new drug class)

**Side Effects**
Yeast infections, UTIs, increased urine, weight loss, small decrease systolic BP

**Contraindications**
CKD (avoid if GFR < 45 Invokana or < 60 Farxiga), Bladder cancer

**Main Risk**
Renal impairment, hyperkalemia (Invokana), orthostasis

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SGLT-2 Inhibitors: Patient Instructions

- Take once daily, with or without food
- Warn of increased urination and to watch for UTI and yeast infection symptoms

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Welchol (colesevelam)

**Mechanism**
Bile acid sequestrant, unknown how it lowers blood glucose

**Best Candidate**
Pt with elevated cholesterol who can’t tolerate statins

**Power**
Decreases A1C 0.4 – 0.6%

**Side Effects**
GI intolerance, increased triglycerides

**Contraindications**
Triglycerides > 500

**Drug Interactions**
Many based on absorption: OCPs, thyroid hormone, warfarin, phenytoin, cyclosporine
Welchol: Patient Instructions

- Need to assess their drug list to see when it is safe to take
- Take either once or twice daily, with food
- Discuss GI symptoms: may need to start at a lower dose and titrate up

Diabetes Meds and CKD

- Avoid Use
  - Metformin
  - Sulfonylureas and nateglinide (Starlix)
  - Exenatide (Byetta and Bydureon)
  - SGLT2 Inhibitors
  - Alpha-glucosidase Inhibitors

- Safe (dose adjustment may be necessary)
  - Insulin
  - TZDs
  - DPP-IV Inhibitors
  - Liraglutide (Victoza)
  - Repaglinide (Prandin)
  - Colesvelam (Welchol)
  - Bromocriptine (Cycloset)

Diabetes Meds and Pregnancy and Lactation

- Safe for pregnancy
  - Insulin
  - Glyburide
  - Metformin (likely safe in 2nd and 3rd trimester and may also be safe in 1st trimester)

- Safe for lactation (limited info on many DM drugs)
  - Insulin
  - Glyburide
  - Metformin

Outline

- Diabetes medicines
- Insulin
  - Standards of care for diabetes management in the hospital
  - Transitioning patients from the hospital to home

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Onset</th>
<th>Peak</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid Insulins:</td>
<td>5 – 15 Minutes</td>
<td>1 – 2 Hours</td>
<td>2 – 4 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>Glargine (Lantus)</td>
<td>2 Hours</td>
<td>None / Minimal</td>
<td>20 – 24 hours</td>
</tr>
<tr>
<td>Detemir (Levemir)</td>
<td>2 Hours</td>
<td>None / Minimal</td>
<td>16 – 24 hours</td>
</tr>
<tr>
<td>Regular (Novolin or Humulin)</td>
<td>500</td>
<td>30 Minutes</td>
<td>2 – 4 Hours</td>
</tr>
<tr>
<td>Humulin</td>
<td></td>
<td>4 – 10 Hours</td>
<td>12 – 24 Hours</td>
</tr>
<tr>
<td>Regular U-500</td>
<td>30 Minutes</td>
<td>2 – 4 Hours</td>
<td>Up to 24 Hours</td>
</tr>
</tbody>
</table>
Pharmacokinetics of Insulin Products

Premixed Insulins
- With NPH and Regular
  - Novolin 70/30
  - Humulin 70/30
  - Humulin 50/50
  - Relion 70/30
- With NPH and Rapid
  - Novolog 70/30
  - Humalog 75/25
  - Humalog 50/50

Components of an Insulin Regimen
- Basal Insulin (Lantus, Levemir, NPH)
  - Controls glucose between meals and overnight
  - Fairly constant throughout the day
  - About 50% of insulin needs
- Bolus Insulin (Regular or Rapid)
  - Nutritional / Meal Insulin
    - Insulin required to cover meals, IV dextrose, tube feeds, TPN, etc.
  - Correction Insulin
    - Supplemental doses given to correct elevated glucose levels
    - Usually given before meals along with nutritional insulin

Basal Bolus or MDI (Multiple Daily Injection) Insulin Therapy

Mealtime Bolus Insulin
- 7 am bolus
- 110
- 115
- Noon
- BG goal range

Mealtime Bolus Insulin: Correction
- When pre-meal glucose is above goal, a correction is added
- 220
- 120
Mealtime Bolus Insulin: Negative Correction

When pre-meal glucose is below goal, a minus correction is needed

BG goal range
65
7 am bolus minus 1 unit
noon
90

Correction Insulin or Sliding Scale
- Often overused and adjustments to doses never made
- Use it pre-meal to account for both hyperglycemia and hypoglycemia
- Sliding scale at bedtime
  - Can cause nocturnal hypoglycemia
  - Often not done unless bedtime sugar very high (300s or more) or during illness
- Do not supplement w/ long acting insulin: use regular or rapid-acting only

Individualizing the Sliding Scale
- Takes into account individual patient’s sensitivity to insulin
- Patients may know this from experience
  - To estimate: divide 1700 / TDD
    - TDD: total daily dose of insulin (basal plus bolus)
    - Example: TDD is 50 units
      - 1700 / 50 = 34 mg/dL glucose
      - A 1 unit bolus will decrease glucose by 34 mg/dL
        - For simplicity, round to 30
        - For every 30 points above 150, the patient will give 1 extra unit of insulin.

Nutritional Insulin: Carbohydrate Ratios
- Attempts to match mealtime insulin dose to amount of food eaten
  - Imperfect
  - Patients either need a set amount of carb per meal with a set mealtime dose or they need to calculate dose based on carb content of meal
  - Mealtime carbs are divided by carb ratio to arrive at dose
    - Example: Patient takes 1 unit per 8 grams of carb
      - Meal contains 70 grams of carb
      - 70 / 8 = 8.75. Round up to 9 units.
  - Caution: some patients use units of insulin per carb choice
    - 1 carb choice = 15 grams carbohydrate
    - Example: 2 units of insulin per carb choice

Mealtime Example: Combining Nutritional with Correction Insulin
- Patient with a 1:10 insulin ratio is going to eat 60 grams of carbohydrate
- 1:30 mg/dL correction factor
- Pre-meal glucose is 192
- To cover food: 60 grams / 10 = 6 units
- To cover glucose: 192 – 120 (goal glucose) = 72
  - 72 / 30 (correction factor) = 2.4 units
- Total 6 + 2.4 = 8.4 units
  - Round to either 8 or 9 units
Mealtime Example: With Sliding Scale

- Patient with a 1:10 insulin ratio is going to eat 60 grams of carbohydrate
- On standard dose sliding scale
- Pre-meal glucose is 192
- To cover food: 60 grams / 10 = 6 units
- Standard sliding scale: 2 units needed for glucose of 192
- Total mealtime dose: 6 + 2 = 8 units

Avoiding Sliding Scale Problems

- Insulin sensitive patients (type 1 diabetics, thin, elderly, renal failure) need “light” sliding scales
- Fragile patients (elderly, mental status changes, “brittle” diabetics) need sliding scales that start at higher glucoses (e.g. start at 200 rather than 150)
- If sliding scale is not decreasing glucoses to goal, consider if a steeper sliding scale is needed or if scheduled insulin doses are inadequate

Outline

- Diabetes medicines
- Insulin
- Standards of care for diabetes management in the hospital
- Transitioning patients from the hospital to home

AACE/ADA Recommended Target Glucose Levels in ICU Patients

- Starting threshold of no higher than 180 mg/dL
- Once IV insulin is started, the glucose level should be maintained between 140 and 180 mg/dL
- Lower glucose targets (110-140 mg/dL) may be appropriate in selected patients
- Targets <110 mg/dL or >180 mg/dL are not recommended

AACE/ADA Target Glucose Levels in Non–ICU Patients

- Premeal glucose target <140 mg/dL
- Random BG <180 mg/dL
- To avoid hypoglycemia, reassess insulin regimen if BG levels fall below 100 mg/dL
- Occasional patients may be maintained with a glucose range below or above these cut-points

Glucose Targets: Non-Critical Care

- More stringent targets may be appropriate in stable patients with previous tight glycemic control
- Less stringent targets are appropriate for terminally ill or those with severe co-morbidities
## Glycemic Management Strategies in Noncritically Ill Patients
- Insulin therapy preferred regardless of type of diabetes
  - Discontinue noninsulin agents at hospital admission of most patients with type 2 diabetes with acute illness
  - Use scheduled SC insulin with basal, nutritional, and correction components
    - Modify insulin dose in patients treated with insulin before admission to reduce risk for hypoglycemia and hyperglycemia
  - Avoid prolonged therapy with sliding scale insulin alone
  - Continuous IV insulin in selected patients

## Concerns with Non-insulin Diabetes Therapies in the Hospital
- Time-action profiles of oral agents can result in delayed achievement of target glucose ranges in hospitalized patients
- Sulfonylureas are a major cause of prolonged hypoglycemia
- Metformin is contraindicated in patients with decreased renal function, use of iodinated contrast dye, and any state associated with poor tissue perfusion (CHF, sepsis)
- Thiazolidinediones are associated with edema and CHF
- α-Glucosidase inhibitors are weak glucose-lowering agents
- Pramlintide and GLP-1 receptor agonists can cause nausea and exert a greater effect on postprandial glucose

## Insulin Therapy in Patients With Type 2 Diabetes
- Discontinue noninsulin agents on admission
- Insulin naïve: starting total daily dose (TDD):
  - 0.3 U/kg to 0.5 U/kg
  - Lower doses in the elderly and patients with renal insufficiency
- Previous insulin therapy: reduce outpatient insulin dose by 20%-25%
- Half of TDD as basal insulin given at the same time of day and half as rapid-acting insulin in 3 equally divided doses (AC)

## Point of Care Glucose Testing and Insulin Administration
- Proper timing of glucose testing and insulin administration can reduce the risk of hypoglycemia and hyperglycemia
- Administer regular insulin 30 min before meals
- Administer rapid-acting insulin up to 15 min before meals
  - Can be given immediately after meal
  - Recommended schedules for POC testing
    - Before meals and at bedtime in patients who are eating
    - Every 4-6 h in patients who are NPO or receiving continuous enteral feeding

## Medical Nutrition Therapy (MNT)
- MNT is an essential component of the glycemic management program for all hospitalized patients with diabetes and hyperglycemia
- Providing meals with a consistent amount of carbohydrate can be useful in coordinating doses of rapid-acting insulin to carbohydrate ingestion

## Factors Affecting Blood Glucose Levels in the Hospital Setting
- Increased counter-regulatory hormones
- Changing IV glucose rates
- TPN and enteral feedings
- Lack of physical activity
- Unusual timing of insulin injections
- Use of glucocorticoids
- Unpredictable or inconsistent food intake
- Fear of hypoglycemia
- Cultural acceptance of hyperglycemia
Glucose Control Deteriorates During Hospitalization

**Hyperglycemic Influences**
- Stress hyperglycemia
- Concomitant therapy (e.g., steroids)
- Decreased physical activity
- Medication omissions
- Medication errors
- Fear of hypoglycemia
- IV dextrose
- TPN
- Enteral feeds

**Hypoglycemic Influences**
- Decreased caloric intake
- Gastrointestinal illness
- Enforced compliance with diet and meds
- Medication errors
- Altered cognition

Importance of Nursing Care for Improving Glycemic Control

- 24-hour coverage by nursing
- Nurses are accepted as and expected to be patient advocates
- Nursing often coordinates, and is aware of, the multiple services required by patient
  - Travel off unit, (e.g., physical therapy, X-ray)
  - Amount of food eaten (carbohydrates)
  - Patient’s day-to-day concerns
  - Order changes (by various providers)

NPO Patients

- Ideally, patients should have procedures early in the morning to avoid a prolonged NPO period
- NPO patients need regular blood glucose monitoring (every 4-6 hours) and may need IV dextrose
- NPO patients on oral diabetic medications with long duration are at risk for hypoglycemia
- Advocate for early test procedures so patients do not miss too many meals

NPO Patients

- Management differs for type 1 and type 2
  - Type 1 patients always need basal insulin
  - Typical insulin adjustment for NPO status
    - Type 2s: reduce basal insulin dose by 50%, hold mealtime insulin, continue the correction dose
    - Type 1s: reduce basal insulin dose by 25%, hold mealtime insulin, continue the correction dose
- Monitor BG every 4 – 6 hours and give corrective insulin as needed
- Resume the previous regimen once the patient is eating again

Tube Feedings

- Patients on tube feedings will usually receive a continuous flow of carbohydrates via their feeding
- Blood glucose monitoring (usually every 4 or 6 hours) and scheduled dose of insulin plus corrections are needed
- Interruption of feeding can cause hypoglycemia
  - IV dextrose may be needed while the feeding is off
  - Notify physician for IV dextrose and adjustment of insulin orders when there is interruption or change in feeding rate

Total Parenteral Nutrition (TPN)

- Patients on total parenteral nutrition (TPN) may have insulin in the TPN or may be on SC insulin
- Blood glucose monitoring every 4-6 hours is needed
- Interruption of TPN can cause hypoglycemia
  - Initiation of IV dextrose may be needed
  - Notify physician for IV dextrose and adjustment of insulin orders when there is interruption or change in TPN
Impact of Medications on Blood Glucose Levels

- Medications used for the treatment of comorbid conditions can cause hyperglycemia
- Corticosteroids increase glucose production by the liver and increase insulin resistance
  - Reduction or discontinuation of the steroid can cause hypoglycemia
  - Notify physician for adjustment of insulin orders when there is a change in steroid dose

Concomitant Medications

Hyperglycemic Influences
- Corticosteroids
- Vasopressors
- Beta blockers
- Thiazide diuretics
- Atypical anti-psychotics (olanzapine, clozapine)
- Calcineurin inhibitors (cyclosporine, sirolimus, tacrolimus)
- Protease inhibitors

Hypoglycemic Influences
- Insulin and other diabetes meds
- Fluoroquinolones (rare)
- Ethanol
- Beta blockers
- Salicylates

Striking the Right Balance

Hyperglycemia

Hypoglycemia

Signs and Symptoms of Hypoglycemia

- Tachycardia
- Hunger
- Restlessness
- Weakness/fatigue
- Diaphoresis
- Pallor
- Shakiness

- Irritability
- Anxiousness
- Light-headedness
- Change in mental status (e.g., confusion)
- Impaired vision or dilated pupils
- Headache

Hypoglycemia: Areas of Risk

- Changes in carbohydrate or food intake (e.g., vomiting or new NPO status)
- Changes in clinical status or medications
- Interruption of IVF, TPN, or tube feeds
- Failure to adjust therapy based on BG patterns
- Prolonged use of sliding scale as monotherapy
- Poor coordination of POC testing with insulin administration and meal delivery
- Poor communication during patient transfers
- Transportation off ward causing meal delays
- Errors in order writing and transcription

Patient-Specific Factors Increasing Risk of Inpatient Hypoglycemia

- Advanced age
- Decreased oral intake
- Chronic renal failure
- Liver disease
- Concurrent illness (CVA, shock, sepsis)
- Altered mentation or dementia
- Ventilator use
- Concurrent meds

Nurse-Initiated Strategies for Treating Hypoglycemia

- **Blood Glucose <70 mg/dL**
  - Alert and able to eat and drink
  - Alert and awake patient who is NPO or unable to swallow
  - Patient with an altered level of consciousness

- **Administer 15–20 g of rapid-acting carbohydrate**
- **Administer 20 mL dextrose 50% solution IV and start IV dextrose 5% in water at 100 mL/h**
- **IV access: administer 25 mL dextrose 50% (1/2 amp) and start IV dextrose 5% in water at 100 mL/h**
- **No IV access: give glucagon 1 mg IM Limit, two times**

- Recheck BG and repeat treatment every 15 min until glucose level is at least 80

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15 Grams of Carbohydrate Raises Blood Glucose by 30-50 mg/dL

- 1 tube oral glucose gel
- 3 – 4 glucose tablets
- ½ cup juice
- 1 tablespoon honey, sugar, or jelly
- 8 ounces milk
- ½ can of pop

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- Standards of care for diabetes management in the hospital
- Transitioning patients from the hospital to home

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Relationship Between Inpatient and Outpatient Diabetes Management

Care received in the outpatient setting can affect need for hospitalization

Outpatient
- Compliance with glycemic goals depends on the patient

Inpatient
- Compliance with glycemic goals depends on physicians, nursing, and hospital staff

Lessons learned in the hospital can impact patient self-care behavior at home

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Functional Health Literacy and Understanding of Medications at Discharge

172 patients discharged from community-based teaching hospital with prescriptions for 1 or more new medications

- Recalled being told of ANY possible adverse effects: 11%
- Could name 21 possible adverse effects: 22%
- Knew dose: 76%
- Knew medication purpose: 64%
- Knew medication name: 64%
- Knew dosing schedule: 68%
- Aware that new medications had been prescribed: 86%

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Addressing Health Literacy

- Use graphics/pictures
- Use variety of media
- Use teach back method to assess understanding
- Focus education materials on patient action and motivation
- Check for patient understanding
- Implement follow-up phone calls to reinforce instructions

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**Health Numeracy**

- Difficulty adding and subtracting
- Effects in diabetes
  - Carbohydrate counting
  - Adding correction insulin to nutritional insulin
  - Recommended example:
    - If your blood sugar is 80 to 150, take 10 units ___ insulin
    - If your blood sugar is 151 to 200, take 12 units ___ insulin
    - If your blood sugar is 201 to 250, take 15 units ___ insulin

**Preadmission Factors to Be Considered in Discharge Planning**

- Physical/self-care limitations: blindness, stroke, amputation, dexterity
- Socioeconomic factors: insurance coverage, family support, cost of medicine and insulin
- Access to follow-up care: PCP, other HCPs
- Degree of glycemic control prior to admission and severity of hyperglycemia
- Learning issues: language, cognition, competence related to diabetes self-management

**Survival Skills to Be Taught Before Discharge**

- How and when to take medication/insulin
  - Side effects of medication
- How/when to test blood glucose (SMBG)
  - Target glucose levels
- Meal planning basics
- How to recognize and treat hypoglycemia
- Sick-day management plan
- Date/time of follow-up visits
  - Including diabetes education
- When and whom to call on the healthcare team
  - Available community resources

**Recommended Educational Strategies for Inpatients Prior to and at Discharge**

- Begin education on day 1 or as soon as the patient is able to participate
- Initiate inpatient diabetes educator consult as early as possible
- Nursing to reinforce the education as many times as possible utilizing every opportunity (medications, BG result, diet, etc.)
- Involve family members whenever appropriate
- Provide education materials to reinforce teachings and provide community and Web resource lists
- Continue education on an outpatient basis if needed by referring through appropriate channels

**Discharging Patients With Previously Diagnosed Diabetes**

- Resume preadmission diabetes regimen at time of discharge for patients with acceptable preadmission glycemic control and no contraindications to prior therapy
  - HgA1C at time of admission helps determine level of preadmission diabetes control
- Modify preadmission therapy for patients identified as being in poor control or with new contraindications
- Provide patient and family members/caregivers with written and oral instructions regarding glycemic management regimen at time of hospital discharge

**Discharging Patients New to Insulin**

- Refer to an outpatient diabetes education program shortly after discharge to discuss ongoing diabetes control
- Provide discharge information
  - When to check BG
  - Timing of insulin administration
  - When to call PCP (e.g., symptoms of hypoglycemia)
- Communicate with patient’s PCP
  - Changes made to patient’s treatment regimen during hospitalization
- Complete medication list
- Assess need for home health care
Predischarge Checklist for Diabetics

- Diet information
- Monitor/strip and prescription
- Prescription for/supplies of medications, insulin, needles
- Treatment goals
- Contact phone numbers
- Medi-alert bracelet
- Survival skills training

Objectives: Review

- We reviewed how the various diabetes medicines work
- We reviewed contra-indications to and drug interactions with diabetes medications
- We reviewed how other illnesses, diagnoses, and medications can affect diabetes
- We reviewed what patients need to know about their diabetes medications
- We discussed insulin action profiles and how insulin is dosed
- We reviewed current standards of care for diabetes management in the hospital
- We identified strategies for successful transition of patients onto their home medication regimen upon discharge from the hospital

Questions?