Diabetes Facts

- Diabetes affects 25.8 million people
  - 18.8 million are diagnosed
  - 7 million are not diagnosed
  - 8.3% of the U.S. population has diabetes
  - Diabetes is the main cause of renal failure, non-traumatic amputations, heart disease and stroke
  - Diabetes is the 7th cause of death in the U.S.

Prevalence of Diabetes / Glycemic Abnormalities in the United States

- US Population: 275 Million in 2000 / 301.3 million in 2007 / 304.8 million in 2010

- Undiagnosed diabetes
  - 2000: 5.9 million
  - 2010: 7 million

- Diagnosed type 1 diabetes
  - ~1.0 million

- Diagnosed type 2 diabetes
  - 2000: 10 million
  - 2010: 17.8 million

Criteria for the Diagnosis of Diabetes Mellitus

- Symptoms of diabetes (polyuria, polydipsia, unexplained weight loss) and casual plasma glucose ≥ 200 mg/dL
  - or
- Fasting plasma glucose ≥ 126 mg/dL
  - or
- 2-hour plasma glucose ≥ 200 mg/dL during an oral glucose tolerance test

Centers for Disease Control. Available at: http://www.cdc.gov
Criteria for Diagnosis of Diabetes

International Expert Committee issued a consensus report in June, 2009 recommending that a HbA1C level greater than or equal to 6.5% be used to diagnose diabetes.

ADOPTED BY ADA JANUARY, 2010

5.7% - 6.4% indicates “pre-diabetes”

Pathophysiology of Type 1 Diabetes

- Loss of beta-cell function → insufficient endogenous insulin = absolute insulin deficiency
- Affects < 0.5% of the population
- Predominant type of diabetes diagnosed in individuals under 30 years of age
- Ketoacidosis often first manifestation of disease

Pathogenesis of Type 2 Diabetes

Two Defects

- Hepatic insulin resistance
- Muscle/fat insulin resistance
- Excessive glucose production
- Impaired glucose clearance

Complications of Diabetes

- Cardiovascular disease
  - 2-4 times higher heart disease mortality and risk of stroke
- Diabetic nephropathy
  - Leading cause of ESRD (40% of new cases)
- Diabetic retinopathy
  - Leading cause of new cases of blindness
- Diabetic neuropathy
  - Present in 60%-70% of patients with diabetes
- Amputations
  - Cause of more than 50% of lower-limb amputations

ESRD = end-stage renal disease.
Benefits of Reducing A1C by 1%

Type 1 Diabetes (DCCT)
- ↓ 32% risk for retinopathy
- ↓ 24 - 27% risk for nephropathy
- ↓ 30% risk for neuropathy

Type 2 Diabetes (UKPDS)
- ↓ 10% in diabetes-related death
- ↓ 6% in all-cause mortality
- ↓ 18% risk for MI
- ↓ 25% risk for microvascular complications


Goals for individual patients may vary. Aim for the Lowest A1C Possible without Hypoglycemia.

Barriers to Using Insulin

- Patient resistance
  - Perceived significance of needing insulin
  - Fear of injections
  - Complexity of regimens
  - Pain, lipohypertrophy
- Physician resistance
  - Perceived cardiovascular risks
  - Lack of time and resources to supervise treatment
- Medical limitations of insulin treatment
  - Hypoglycemia
  - Weight gain

Types of Insulin

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Onset</th>
<th>Peak</th>
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<tbody>
<tr>
<td>Lispro</td>
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</tr>
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Target Action Profiles of Insulin Analogous

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Dosing of Insulin

- Basal (glargine or levemir) – start with 10 units daily or 0.1-0.2 u/kg/day
- Pre-mixed insulin (70/30 or 75/25) 0.3 u/kg-0.6 u/kg. Give 2/3 of the dose with breakfast and 1/3 with supper
- 80 kg x 0.5 u/kg = 40 units of premix insulin per day. Bf 26 units. Supper 14 units.

Dosing of Insulin Continued

- Basal/bolus insulin – adding pre-meal insulin (aspart, lispro or glulisine). 50% basal and 50% bolus
- Either use a fixed dose or an insulin/carbohydrate ratio. To learn unit/carb ratio I suggest sending the patient to a RD.
- Sliding scale – start with 1 u/50 pts > 150.

Adjusting Bolus and Correction Doses

- Individually determined
- Based on prevailing blood glucose
- Questions to ask:
  - What is my blood glucose now?
  - What is my target glucose (eg. 100 mg/dL)?
  - How much insulin do I need to reach my target glucose?

Example

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<tr>
<th>Blood Glucose</th>
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<td>&lt;50 mg/dL</td>
<td>Decrease 2 units, or consume 10-15 g oral carbohydrate</td>
</tr>
<tr>
<td>50–69 mg/dL</td>
<td>Decrease 1 unit</td>
</tr>
<tr>
<td>70–120 mg/dL</td>
<td>Usual dose</td>
</tr>
<tr>
<td>121–160 mg/dL</td>
<td>Increase 1 unit</td>
</tr>
<tr>
<td>161–200 mg/dL</td>
<td>Increase 2 units</td>
</tr>
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Adjusting Prandial Doses of Rapid Analog Carbohydrate-to-Insulin Ratio

Based on three questions before meals
1. How much carbohydrate am I going to eat?
2. What is my insulin dose for this amount of carbohydrate?
3. Should I lower the dose because I plan to be very active or have recently been active?

Insulin Injection Devices

Insulin pens
- Faster and easier than syringes
  - Improve patient attitude and adherence
  - Have accurate dosing mechanisms, but inadequate mixing may be a problem
**Insulin Pumps**

**Continuous Subcutaneous Insulin Infusion (CSII)**
- External, programmable pump connected to an indwelling subcutaneous catheter to deliver rapid-acting insulin

**Intraperitoneal insulin infusion**
- Implanted, programmable pump with intraperitoneal catheter. Not available in the United States

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**Steve**

Steve is a 68 y.o.m. with T2DM. He is on 70/30 (NPH/Regular) BID and his glucoses are high. As you increase doses he develops hypoglycemia late morning and in the evening. AIC is 8.2%

---

**What is best for Steve?**

A. Decrease the 70/30 insulin and add glipizide
B. All 20 units of glargine at HS
C. Add sitagliptin 100mg daily
D. Change the 70/30 to an analog mix BID

---

**Jill**

Jill is a 53 y.o.f. with T2DM for 8 years. She is taking metformin 1000mg BID, glipizide 10mg BID and glargine 42 units HS. AIC is 8.9%. Her PCP ↑ glargine to help lower her glucoses and now she has low glucoses. You ↓ glargine to 38 units and FBS are 140 and HS glucoses average 220.

---

**What do you do next for Jill?**

A. Increase glipizide to 20mg BID
B. Add 70/30 insulin with supper
C. Change glargine to BID dosing
D. Stop glipizide and add pre-meal insulin at breakfast and supper
Tim

Tim is a 44 y.o.m. with nephropathy and retinopathy from his T2DM. AIC 8.9% x 1yr. He takes 70/30 40u BID. He saw a R.D./CDE recently. He is asking for a change in insulin. Wt. 94 kg.

How can you help Tim lower his AIC?

How to change to Basal/Bolus Insulin

- Tim is on 80 u/day 70/30 70% of 80= 56 u/day 30% of 80u=24u aspart/day
- 56u NPH x 80%= 44.8u glargine or detemir/day
- 24u aspart/3 meals per day – 8u/meal
- Add a sliding scale of 1u/50 pts > 150

Jean

Jean is a 64 y.o.f. with T1DM. She has been on an insulin pump for several years and her AIC is 6.8%. She calls you in a panic, her pump “died” today and she will be getting a new one tomorrow. The only insulin she has is lispro.

How can you help Jean?

Ask Jean for her basal rates of insulin
- Total the amount of insulin she receives over 24 hours from her BASAL rates (24.8u/day)
- She will need a basal insulin to cover her for the next 24 hours

How much would you give her?

Rick

Rick is a 39 y.o.m. with T2DM for 11 years. He is on metformin 1000mg BID, glipizide 10mg BID, and sitagliptin 100mg/day. AIC ↑ to 9.2%. After he see the dietician his AIC ↓ 8.7%.

What can you do to help Rick lower his AIC?

A. Add a basal insulin and continue the oral agents
B. Add 70/30 insulin at bedtime
C. Add pioglitazone 30mg/day
D. Increase the length of his exercise program
Charlie

Charlie is a 77 y.o.m. admitted to the rehab unit after a debilitating stroke. No gag reflex. He is on continuous tube feedings. Glucoses have been high (previously on oral agents for T2DM) and he has been receiving regular insulin for “sliding scale” coverage.

Long term management of tube feeds should include:

A. Basal insulin to cover glycemic load of tube feeds
B. Continue sliding scale coverage but substitute an analog insulin for regular insulin
C. Restart oral agents, crushed, through the tube
D. Switch tube feed to low glycemic load formula

Charlie starts to recover from his stroke and is able to swallow some liquids. His tube feeding is changed to a 17 hr. feeding from 4p.m. to 9a.m. and a 2 hr. feeding from 11a.m. to 1p.m.

What would you do with his insulin orders?

A. Continue with the basal insulin and regular
B. At 4p.m. give NPH insulin and an analog insulin at 11a.m.
C. Give 70/30 insulin at 11a.m. and 4p.m.
D. Restart oral agents

Enteral Feeding and Glycemic Control

Blood glucose levels should be optimized before enteral feeding commences.
Frequent monitoring of blood glucose is required after initiation of enteral feeding
   - Every 2 to 6 hours until blood glucose stabilizes
Adjust timing of enteral meals with onset, peak, and duration of the insulin being used
Basal insulins are best suited to continuous enteral feeding

Questions from the Audience?