Basics of Diabetes and Medications

Shirley Fleishman, RN, CDE
University of Virginia
Diabetes Education and Management Program

Educational Handouts

- Basics of Diabetes and Medications (handout of slides)
- Hyperglycemia
- Hypoglycemia
- Foot Care

Additional Resources:
- Blood Glucose Logbook
- Diabetes Online Resources
Class Topics

- Basics of Diabetes and Medication
  - What diabetes is; how it is diagnosed
  - Target blood glucose ranges
  - Why blood glucose matters; complications
  - Diabetes medications: oral and insulin

- Nutrition Basics

- Glucose Control, Activity, and Stress

- Eat Smart, Change Your Lifestyle

How are Diabetes and Pre-diabetes Diagnosed?

- Diabetes
  - A1c > 6.5% *
  - Fasting blood glucose ≥ 126 mg/dl *
  - Two hour blood glucose ≥ 200 mg/dl during an oral glucose tolerance test*
  - Random blood glucose ≥ 200 mg/dl plus clinical symptoms

- Pre-diabetes
  - Fasting blood glucose 100 to 125 mg/dl

* Should be repeated in absence of clinical symptoms
Common Types of Diabetes

- Type 1 diabetes
  - 5% to 10% of diagnosed cases of diabetes
- Type 2 diabetes
  - 90% to 95% of diagnosed cases of diabetes
Type 2 Diabetes
Insulin Resistance

Type 1 Diabetes
or
Late Stage Type 2
Little or No Insulin

Cell
**Target Blood Glucose Goals**

- Before meals: 80-130 mg/dl
- After meals: Less than 180 mg/dl

(aim for no more than 50 mg/dl increase from meals)

**Comparison Chart of A1C and Glucose**

<table>
<thead>
<tr>
<th>A1C %</th>
<th>Estimated Average Glucose</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>97</td>
</tr>
<tr>
<td>6</td>
<td>126</td>
</tr>
<tr>
<td>7</td>
<td>154</td>
</tr>
<tr>
<td>8</td>
<td>183</td>
</tr>
<tr>
<td>9</td>
<td>212</td>
</tr>
<tr>
<td>10</td>
<td>240</td>
</tr>
<tr>
<td>11</td>
<td>269</td>
</tr>
<tr>
<td>12</td>
<td>298</td>
</tr>
</tbody>
</table>
Why Does Blood Glucose Matter?

- To reduce the short-term symptoms of high blood glucose values.
- To reduce long-term complications.

Large Vessel Complications

- Heart disease (Cardiovascular disease)
- Stroke/TIA (Cerebrovascular disease)
- Poor circulation to legs and feet (Peripheral vascular disease)
Tests to Discuss with Your Health Care Provider

<table>
<thead>
<tr>
<th>Test</th>
<th>ADA Recommended Value</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure</td>
<td>No more than $140/80$</td>
<td>At every visit</td>
</tr>
<tr>
<td>A1c</td>
<td>Less than 7%</td>
<td>2-4 times per year</td>
</tr>
<tr>
<td>Microalbuminuria (urine kidney test)</td>
<td>Less than 30 mg</td>
<td>Once per year</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>Less than 200</td>
<td>Once per year</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>Less than 150</td>
<td>Once per year</td>
</tr>
<tr>
<td>HDL</td>
<td>Men: 40 or higher</td>
<td>Once per year</td>
</tr>
<tr>
<td></td>
<td>Women: 50 or higher</td>
<td></td>
</tr>
<tr>
<td>LDL</td>
<td>Less than 100 (low risk)</td>
<td>Once per year</td>
</tr>
<tr>
<td></td>
<td>Less than 70 (with CVD)</td>
<td></td>
</tr>
</tbody>
</table>

Small Vessel Complications

- Eye disease
- Kidney disease
  - Microalbumin test
- Nerve disease
  - Autonomic neuropathy
  - Stomach
  - Intestines
  - Bladder and sexual function
  - Blood pressure
  - Peripheral neuropathy
  - Foot care is important!
Diabetes Medications

Two forms of medication available for persons with diabetes:

- **Oral pills (medication)**
  - Used in type 2 diabetes
  - Five drug classes of oral diabetes medications

- **Injectable medications**
  - *Insulin* – required for type 1 diabetes; may be necessary for type 2 diabetes as disease progresses
  - *Mimetics* – two drug classes; one class can be used by people with either type 1 diabetes or type 2 diabetes on insulin to improve glucose levels; the other class is just for type 2 diabetes

Oral Medication: *Sulfonylureas*

- **Glyburide** *(DiaBeta, Micronase, Glynase)*
- **Glipizide** *(Glucotrol/Glucotrol XL)*
- **Glimepiride** *(Amaryl)*
  - *How they work*: they stimulate the pancreas to produce more insulin
  - *Risk*: potential for low blood glucose – take before a meal, and do not skip meals!
Oral Medication: *Biguanides*

- Metformin (Glucophage)
- Riomet (Glucophage)
- Metformin Extended Release (Glucophage XR)
- Fortamet (Glucophage XR)
- Glumetza (Glucophage XR)

  - *How they work:* they cause the liver to produce less glucose
  - *Risk:* may cause GI distress (nausea, diarrhea); usually lasts for 7-10 days; start on low dose and advance slowly
  - *Benefit:* may help with weight loss and reduced appetite; not likely to cause low blood glucose; cost-effective

Oral Medication: *Insulin Sensitizers*

- Pioglitazone (Actos)

  - *How they work:* they help the body become more sensitive to insulin; may take 4-6 weeks to see positive effects on blood glucose
  - *Risk:* may have some swelling (fluid retention) in legs and feet
Oral Medication:
**DPP-4 Inhibitors**

- **Sitagliptin (Januvia)**
  - Janumet (sitagliptin + metformin)
- **Saxagliptin (Onglyza)**
- **Linagliptin (Tradjenta)**
- **Alogliptin (Nesina)**

  - *How they work:* increases secretion of insulin when blood glucose is elevated, so it helps to lower after-meal rises in blood glucose
  - *Benefit:* they do not cause weight gain and may have a positive effect on cholesterol levels
  - *Risk:* should not use with kidney or liver disease

Oral Medication:
**SGLT2 (sodium-dependent glucose transporter) Inhibitors**

- **Canagliflozin (Invokana)**
- **Dapagliflozin (Farxiga)**
- **Empagliflozin (Jardiance)**

  - *How they work:* transports glucose into kidney tubules; this results in improved glucose levels by excretion of glucose in urine; it creates a diuresis-like effect
  - *Benefit:* decrease A1C levels; may help with weight loss; lowers systolic blood pressure levels
  - *Risk:* increase in urinary infections; increase in blood potassium levels
Combining Oral Medication

- The different classes of oral medications work in different ways to lower blood glucose levels; sometimes, they work better in combination to improve blood glucose control.
- The most common combination of oral medications is a biguanide and a sulfonylurea.
- Switching from one single pill to another is not as effective as adding another type of diabetes medicine (oral medication or insulin).

Injectable Medication: Mimetic (Incretin) or GLP-1 Receptor Agonists

- **Exenatide (Byetta)** - injection 2x daily; for persons with type 2 diabetes
- **Liraglutide (Victoza)** - injection 1x daily; for persons with type 2 diabetes
- **Exenatide extended release (Bydureon)** - injection once weekly; for persons with type 2 diabetes
- **Dulaglutide (Trulicity)** - injection once weekly; for persons with type 2 diabetes
- **Lixisenatide (Adlyxin)** - injection once daily, within 1 hour before first meal of the day; for persons with type 2 diabetes
- **Pramlintide (Symlin)** - injections before each meal; for persons with type 2 diabetes.
  - *How they work:* slows emptying from stomach; stimulates insulin release
  - *Benefit:* decreases appetite; helps in weight loss
  - *Risk:* transient nausea
Frequently Asked Questions About Insulin

- Will I have to be on insulin forever once I start it?
- Does taking insulin mean my diabetes has gotten “worse”?
- Will insulin injections hurt?
- Is this a sign that I’m a failure at diabetes self-management?
- Do I have to carry a cooler with my insulin supplies?
Insulin

Purpose:

- To allow glucose from the blood stream to move into the cells of the body
- To provide fuel and energy
- Administered by injection only
  - **Type 1** - requires insulin injections; ideally, given 4 times daily before meals and bedtime or via insulin pump
  - **Type 2** – may need insulin as disease progresses and the body’s insulin becomes deficient; diet, exercise, and oral medication become ineffective for blood glucose control; initially, given once daily at bedtime.
Effective Insulin Therapy

- **Basal Dose** (NPH, Lantus, Toujeo, Levemir, Tresiba, U500)
  - Background insulin for blood glucose control when not eating

- **Bolus or Meal Dose** (Regular, Humalog, Novolog, Apidra)
  - To cover glucose rise from food (mainly carbohydrates)
  - Give before or after meals

- **Correction Dose** (Regular, Humalog, Novolog, Apidra)
  - To correct hyperglycemia pre-meal, if needed
  - Give before meals

Types of Insulin & Action

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Onset</th>
<th>Peak</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid-acting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• aspart (Novolog)</td>
<td>5 minutes</td>
<td>1-2 hours</td>
<td>4-6 hours</td>
</tr>
<tr>
<td>• lispro (Humalog)</td>
<td>5 minutes</td>
<td>1-2 hours</td>
<td>4-6 hours</td>
</tr>
<tr>
<td>• glulisine (Apidra)</td>
<td>5 minutes</td>
<td>1-2 hours</td>
<td>4-6 hours</td>
</tr>
<tr>
<td>Short-acting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Regular)</td>
<td>30 minutes</td>
<td>2 to 4 hours</td>
<td>6 to 10 hours</td>
</tr>
<tr>
<td>Intermediate-acting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(NPH)</td>
<td>1 to 3 hours</td>
<td>4 to 8 hours</td>
<td>10 to 20 hours</td>
</tr>
<tr>
<td>Long-acting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• glargine (Lantus)</td>
<td>1 to 3 hours</td>
<td>flat</td>
<td>24 hours</td>
</tr>
<tr>
<td>• detemir (Levemir)</td>
<td>1 to 3 hours</td>
<td>flat</td>
<td>24 hours</td>
</tr>
<tr>
<td>• Glargine (Toujeo)</td>
<td>1 to 3 hours</td>
<td>flat</td>
<td>24 hours</td>
</tr>
<tr>
<td>• degludec (Tresiba)</td>
<td>1 to 3 hours</td>
<td>flat</td>
<td>24 hours</td>
</tr>
</tbody>
</table>
Insulin Injection Sites

- Abdomen (avoid area 2 inches around navel)
  - Preferred site
  - Fastest rate of absorption
  - More subcutaneous tissue
- Arms
- Thighs
- Buttocks

Insulin Storage

- 36° to 86° F (do not store near extreme heat or cold)
- Room temperature if discarded after 28 days of being opened
- Glargine must be discarded after 28 days of use (refrigerated or not)
- Levemir – good for 42 days after opened at room temperature
- Pre-filled syringes (30 days)
Needle Lengths of Insulin Syringes

- Micro: 4mm x 32 G
- Mini: 6mm x 31 G
- Short: 8mm x 31 G
- Original: 12.7mm x 29 G

Barrel Capacity of Insulin Syringes

- 30 units
- 50 units
- 100 units
Examples of Insulin Pens

**Eli Lilly**

- **Basaglar KWIKPEN**
  - Disposable INSULIN Basaglar
  - **DOSE DELIVERY** 1-unit increments, up to 60 units at a time
  - **TOTAL CAPACITY** 300 units
  - **DETAILS**
    - Pen is light gray, with a green ring on the end of the dose knob and green bars on the label.

- **Humalog KWIKPEN**
  - Disposable INSULIN Humalog U-100
  - **DOSE DELIVERY** 1-unit increments, up to 60 units at a time
  - **TOTAL CAPACITY** 300 units
  - **DETAILS**
    - Pen is blue, with different colored labels for various types of insulin.

**Novo Nordisk**

- **Levemir KWIKPEN**
  - Disposable INSULIN Levemir
  - **DOSE DELIVERY** 1-unit increments, up to 80 units at a time
  - **TOTAL CAPACITY** 300 units
  - **DETAILS**
    - Pens come in navy with aqua/light green label. Spring-loaded mechanism requires less force for dose delivery. There is an audible click at the end of the dose, but the full dose has not been delivered until the dose counter returns to zero.

- **NovoLog PenFill Cartridges**
  - **DOSE DELIVERY** 0.5-unit increments, up to 30 units at a time
  - **TOTAL CAPACITY** 300 units
  - **DETAILS**
    - Pen is red with optional decorative skins. Memory function shows units of last dose and hours since last injection.
Examples of Insulin Pens

NOVO NORDISK
NOVOLOG
FLEXPEN
Disposable
INSULIN
Novolog
NovoLog Mix 70/30
DOSE DELIVERY
1-unit increments, up to 80 units at a time
TOTAL CAPACITY
300 units
DETAILS
Pen is blue. With different colored labels, cartridge holders, and dosing buttons for various types of insulin. Disroducts to zero after injection to indicate delivery.

NOVO NORDISK
TRESEDA
FLEX TOUCH
Disposable
INSULIN
Tresiba U-100
DOSE DELIVERY
For U-100: 1-unit increments, up to 80 units at a time. For U-200: 2-unit increments, up to 160 units at a time.
TOTAL CAPACITY
300 units
DETAILS
Pen comes in different colors for various types of insulin. An internal spring loaded mechanism requires less force to deliver a dose. There is an audible click at the end of a dose, but the full dose has not been delivered until the dose counter returns to zero.

OWEN
MUM FORD
AUTOOPEN
CLASSIC
Reusable
INSULIN
Humalog
DOSE DELIVERY
One version delivers 1-unit increments, up to 21 units at a time. Another version delivers 2-unit increments, up to 42 units at a time.
TOTAL CAPACITY
300 units
DETAILS
Pen is blue. Dosing button is located on the side of the pen for easier injecting and handling. Spring loaded mechanism requires less force for dose delivery. Dosage selector has audible clicks to ensure proper dosage.

SANOFI
API DRA
SOLOSTAR
Disposable
INSULIN
Apidra
DOSE DELIVERY
1-unit increments, up to 80 units at a time
TOTAL CAPACITY
300 units
DETAILS
Pen is blue.

SANOFI
LANTUS
SOLOSTAR
Disposable
INSULIN
Lantus
DOSE DELIVERY
1-unit increments, up to 80 units at a time
TOTAL CAPACITY
300 units
DETAILS
Pen is gray.

SANOFI
TOUJEO
SOLOSTAR
Disposable
INSULIN
Toujeo
DOSE DELIVERY
1-unit increments, up to 450 units
TOTAL CAPACITY
450 units
DETAILS
Pen is off-white with a green label.
Advantages of Insulin Pens

- Easy, accurate dosing
- Compact
- Fewer supplies required
- Less errors
- Smaller amount of insulin in cartridge (300 versus 1000 units)

Cost of Insulin

<table>
<thead>
<tr>
<th>Insulin Type</th>
<th>Insulin Brand</th>
<th>Price per Vial</th>
<th>Price per Pen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid-acting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>aspart (Novolog)</td>
<td></td>
<td>~$297.17</td>
<td>~$551.32</td>
</tr>
<tr>
<td>lispro (Humalog)</td>
<td></td>
<td>~$278.32</td>
<td>~$524.15</td>
</tr>
<tr>
<td>glulisine (Apadra)</td>
<td></td>
<td>~$96.00</td>
<td>~$184.00</td>
</tr>
</tbody>
</table>

|                      |               | ~$551.32 (5 pens 3 ml each) | ~$1184 (5 pens 3 ml each) |

| Short-acting (Regular) | ~$53 (10 ml vial) | ~$89-$121 |
| Intermediate-acting (NPH) | ~$52 (10 ml vial) | ~$91-$121 |

| Long-acting | glargine (Lantus) | ~$425 (5 pen 3 ml each) | ~$926 (5 pens 3 ml of 100 units/ml) |
|            | detemir (Levemir) | ~$425 (5 pens 3 ml each) |
|            | Largine (Toujeo) | ~$425 (5 pens 3 ml each) |
|            | degludec (Tresiba) | ~$425 (5 pens 3 ml each) |

*Prices based on CVS Pharmacy and without health insurance! Contact your health insurance or pharmacy for your estimate*
Insulin Pumps

- Devices that deliver rapid or short-acting insulin 24 hours a day through catheter placed under the skin
- Doses are separated into basal, bolus, and corrections
- Brands of insulin pumps include Medtronic, Tandem T-Slim, Animas Vibe, Insulet Omnipod
- Prescribed to those with type 1 diabetes and type 2 diabetes on insulin

Treatment of Hypoglycemia

- Low blood sugar (hypoglycemia) – 70 mg/dl or less
- Treatment (15-15 Rule)
  - Take in 15 grams of carbohydrate:
    - 4 glucose tablets
    - ½ cup fruit juice
    - 1 cup of skim milk
    - 2 Tbsp. raisins
  - Wait 15 minutes and recheck blood glucose
  - If still below 100 mg/dl, repeat 15 grams carbohydrate
  - Follow treatment with a light snack of protein and carbohydrate
    - peanut butter and crackers OR ½ sandwich OR nuts and fruit
How Do You Manage Your Diabetes?

✦ Medication
✦ Nutrition
✦ Exercise
✦ Stress Management