Insulin Pens & Improving Patient Adherence

Bonnie Pepon, RN, BSN, CDE
Certified Diabetes Educator
Conemaugh Diabetes Institute

Kip Benko, MD FACEP
Asst Clinical Professor
University of Pittsburgh School of Medicine
Diabetes

- 21 million people in the U.S. have diabetes
- $132 billion each year
  - Type 1 diabetes: no insulin production
  - Type 2 diabetes: some insulin production
Goals of Insulin Therapy

- To keep the blood glucose levels as close to normal as possible
  - Fasting 70-100 mg/dl
  - After meals 100-140 mg/dl
- To prevent acute and long term complications
- To keep the HbA1c at 6.5% - 7%
- To feel better if you are in your goal range
Type 1 Diabetes

1. The stomach changes food into glucose.
2. Glucose enters the bloodstream.
3. The pancreas makes little or no insulin.
4. Little or no Insulin enters the bloodstream.
5. Glucose builds up in the bloodstream.
Food high in sugar stimulates insulin release.

Lack of food inhibits insulin release.
Type 1 Diabetes

- Insulin secreted into bloodstream
- Blood capillary

- Insulin-producing cells
- Insulin-producing cells destroyed
Insulin Production of Type 2

Normal insulin production

Insufficient insulin production (diabetes mellitus)
Your goal is to maintain normal blood glucose levels.

Glucose in blood

Excessive blood glucose
The Era of Insulin Delivery

- Began in August of 1921
- Canadian Surgeon Frederick Banting & assistant Charles Best
Insulin Delivery Systems
Available Now
Cut-section view of skin

Insulin pen injector

Insulin jet injector

External insulin pump
Syringes are most widely available
- Can be adjusted to 1 or ½ units
- Can use most types of insulin
- Require good vision to measure a dose
Insulin Devices

Pens

- Portable injection choice
- Easy to set the correct dose by a dial
- Can be adjusted with ½ units or 1 unit
- Can use most types of insulin
- Very convenient and accurate for the vision impaired and those on the go
Insulin Devices

Pumps

- Results in better diabetes control
- More flexible eating schedule
- Dose adjusted by 1/10 to 1/20 units
- Requires higher level of involvement & more advanced diabetes education and skills

Dosage instructions are entered into the pump's small computer and the appropriate amount of insulin is then injected into the body in a calculated, controlled manner.
SO, YOU WANNA KNOW MY SECRET?
IT’S NO SECRET!
IT’S THE PUMP!

IT LOOKS LIKE A PAGER, BUT INSIDE’S A RESERVOIR THAT SUPPLIES THE INSULIN!

SEE? AN ADHESIVE PATCH HOLDS IT IN PLACE, LIKE SO!
Syringe/Needle/Vial

- Most common method of delivery
- Syringes (range of sizes)
  - needle gauge
  - needle length
  - syringe capacity
- 3/10cc, 1/2cc, 1cc
Insulin comes in U–100 in the U.S.
- orange cover and black scale
- 100 units of insulin per milliliter of fluid in the vial

U–500 available
- high insulin resistance using more than 200 units a day

Outside the U.S.: U-40
- red cover and red scale
Insulin Syringes

- Multiple manufacturers
  - BD, Monoject, SureComfort, Ulticare Precision Sure Dose, UltiGuard, Medicore, Aimsco

- Injection aides
  - Inject-Ease by BD and Palco, Instaject (can be combined with a lancet device), NeedleAid, NovoPen 3 Penmate
Insulin Needles

- Syringes available
  - 1/2 in or 12.7 mm
  - 5/16 or 8mm

- Pen needles available
  - ½ in
  - 5/16 in
  - 3/16 in

- Gauges available
  - 31, 30, 29, 28
Insulin Injection Sites

- Outer arm
- Abdomen
- Hip area
- Thigh
Insulin Types

- Almost all the insulin sold in the U.S. is “human insulin”
  - DNA recombinant technology
  - 4 types of insulin available
- Previously: insulin from beef and pork sources
### Rapid Acting Insulin

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Onset of action</th>
<th>Peaks</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humalog or lispro</td>
<td>5 to 15 minutes</td>
<td>30 to 60 minutes</td>
<td>3 to 5 hours</td>
</tr>
<tr>
<td>Novolog or aspart</td>
<td>3 to 6 hours</td>
<td>2 to 3 hours</td>
<td>3 to 6 hours</td>
</tr>
<tr>
<td>Apidra or glulisine</td>
<td>30 minutes</td>
<td>2 to 3 hours</td>
<td>3 to 6 hours</td>
</tr>
</tbody>
</table>

### Short Acting Insulin

<table>
<thead>
<tr>
<th>Humulin R or Novolin R</th>
<th>30 minutes</th>
<th>2 to 3 hours</th>
<th>3 to 6 hours</th>
</tr>
</thead>
</table>

- Clear in appearance
- Available in vials and pens
# Intermediate Acting Insulin

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Onset of action</th>
<th>Peaks</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humalin N (NPH) or Novolin N (NPH)</td>
<td>2 to 4 hours</td>
<td>4 to 12 hours</td>
<td>12 to 18 hours</td>
</tr>
</tbody>
</table>

- Cloudy in appearance
- Available in vials and pens

# Long Acting Insulin

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Onset of action</th>
<th>Peaks</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levimir (detemir)</td>
<td>1 to 2 hours</td>
<td>6 to 8 hours</td>
<td>6 to 23 hours</td>
</tr>
<tr>
<td>Lantus (glargine)</td>
<td>1 hour</td>
<td>no peak</td>
<td>24 hours</td>
</tr>
</tbody>
</table>

- Clear in appearance
- Available in vials and pens
- Cannot be mixed in the same syringe with any other type of insulin
# Pre-mixed Insulin

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Onset of action</th>
<th>Peaks</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humalog mix 75/25 or 50/50</td>
<td>30 minutes</td>
<td>2 to 4 hours</td>
<td>22 to 24 hours</td>
</tr>
<tr>
<td>Humulin mix 70/30 or 50/50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Novolog mix 70/30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Novolin mix 70/30</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Helpful for those with poor eyesight, dexterity problems or those who have trouble mixing from 2 different vials.
Insulin Pens

- Pre-filled disposable pen or refillable pens with cartridges

- Uses an insulin needle
  - available in different sizes and gauges
  - units can be counted as dialed by a click
  - plunger is pushed in and held for several seconds before removing the needle
Insulin Pens

- Storage in refrigerator until the pen is started
  - storage life ranges from 7 to 42 days

- Pre-filled pens
  - 28 days: Humalog/Novolog/Novolin R
  - 14 days: Novolin N
  - 10 days: Novalin 70/30
## Insulin Pens: Insulin Cartridges

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humalog</td>
<td>28 days</td>
</tr>
<tr>
<td>Novolin R</td>
<td>30 days</td>
</tr>
<tr>
<td>Novolin 70/30 and Novolin N</td>
<td>7 days</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novolin R/Novolog/Lantus</td>
<td>28 days</td>
</tr>
<tr>
<td>Novolin N</td>
<td>14 days</td>
</tr>
<tr>
<td>Novolin 70/30</td>
<td>10 days</td>
</tr>
<tr>
<td>Levemir</td>
<td>42 days</td>
</tr>
</tbody>
</table>
Insulin Pens

Affordable and easy to use, it can help you manage your insulin treatment with new confidence.

This convenient device gives you a safe, simple and accurate alternative to the vial and syringe.

- **Large Push Button** makes it easy for you to deliver your insulin accurately and securely.
- **Large Numbers on Easy-to-Read Dial** make it easy to accurately dial the exact number of units of insulin you need, in 1-unit increments.

- **Clear Window** shows you about how much insulin you have left, with clearly marked increments.

- **NovoFine® Needles** are used with InnoLet dosers. These short, ultra-fine needles were called "practically pain-free" by 90% of insulin users.¹,²

- **Safe, Clean Transport** and storage with the cap, which fits snugly over the bottom of the doser.

- **Convenient Needle Storage** for safe transportation of your NovoFine needles.
Insulin Pumps

Figure 1. Insulin pumps. a. Early design by Arnold Kadish, MD. b. Early portable pump. c. Modern pump.
Insulin Pumps

- Delivers a rapid acting insulin through a flexible tube inserted under the skin
- Users get a continuous flow of basal insulin
- Also delivers a bolus dose to cover meals or elevated blood glucose levels
- Worn 24 hours a day/7 days a week
Insulin Pumps

Advantages

- Waterproof
- Include a carb wizard or carb counter
- Mimic the way a healthy pancreas works
- Allows greater flexibility in insulin delivery
- Provides better glucose control

Disadvantages

- Increased risk of moderate to severe low blood sugars
- Risk of inflammation and infection at the insertion site
- Increased risk of high blood sugars and ketoacidosis
- Must do an increased amount of blood glucose readings
- Cost is around $6,000
Inhaled Insulin

- Delivers rapid acting dry powder insulin
- Absorbed through the lungs into the bloodstream
  - 1mg and 3mg blister packets
  - Cannot be used for smokers, children, pregnant women or anyone with lung problems

Will be taken off the market in January 2008
Jet Injector

- Force tiny stream of insulin through the skin
- Doesn’t puncture the skin
- Pressure can cause bruising
- Sometimes more painful
- Cleaning can take a long time
- Expensive and may not be covered by health insurance
Minimize needle sticks by creating a portal to inject insulin into

A small tube is inserted into the fatty tissue of the injection site

It is taped in place for 2-3 days

Insulin injected into the tube via pen or syringe instead of the skin

Drawbacks: risk of infection and complaints of discomfort
Insulin Delivery Systems
In the Future

- Oral insulin
- Transdermal insulin
- Buccal insulin
- Artificial pancreas
- Implantable insulin pump
Oral Insulin

- Insulin is a protein that would be broken down during digestion before it can work
- Needs a protective coating to protect it from digestion
  - None have been successful as of yet
Transdermal Insulin

- Insulin is a larger molecule than nicotine
- SpectRx, Inc., has in development a “pumpless patch”
- Possible systems may be combined with ultrasound and electric current
Buccal Insulin

- Spray absorbed by the lining at the back of the mouth and cheeks
- Some think it will be better absorbed than inhaled since it doesn’t go into the lungs
Implantable Insulin Pumps

- Causes less hypoglycemia than external pumps
- Requires a surgical procedure to frequently unclog
Artificial Pancreas

- Different approaches include:
  - gene therapy, bioengineering or medical equipment approach
- New area of FDA regulations
Artificial Pancreas

- Surgically implanted closed loop system
- Automatically adjusts insulin doses as needed
- Users release bolus insulin via remote control
Cost Saving Alternative

- Type 2 Diabetes patients
  - 1,162 patients using syringe/vial
  - 168 who began with a pre-filled insulin pen

- Total annual health care costs per patient excluding prescriptions
  - pen group: $14,900 per patient
  - syringe group: $32,000 per patient
Cost Saving Alternative

- 1,100 patients already using a syringe
  - half were switched to a pen during the course of study

- Results showed annual healthcare costs were only slightly higher
  - $11,476 per patient vs. $10,755 per patient
Case Study

John has started to draw up his insulin pen to the dose he needs and his cell phone rings. John stops to answer his phone.

When he is done he has forgotten how many units he has drawn up. What should John do?