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FOR TECHNICIANS**

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Insulin update

By Michael Boivin, B.Sc.Pharm

Statement of objectives

Upon completion of this lesson, the pharmacy technician should be able to:

1. Understand the role of insulin in the body.
2. Recognize the differences between the insulin products available.
3. Be familiar with some of the therapeutic insulin trends.
4. Identify the most common insulin delivery devices as well as the proper selection of insulin syringes.

Introduction

Insulin was discovered by Frederick Banting and Charles Best at the University of Toronto in 1922. Before this discovery, a diabetes diagnosis was considered a death sentence. And although insulin is not a cure for diabetes, with proper lifestyle and medical intervention, it allows people with diabetes to live a long and productive life.

Today's insulin has changed tremendously from the original pancreas extracts that Banting and Best used on their laboratory dog Marjorie. Table 1 (below) provides a brief history of insulin milestones since its discovery in 1922.

Insulin in the body

Insulin occurs naturally in the body, and is secreted by the pancreas. It plays a vital role in the way sugar (glucose) is broken down and utilized by the body. The pancreas secretes insulin continuously throughout the day (called basal insulin level) with additional amounts (called bolus insulin secretion) being secreted in response to the high blood-glucose levels that occur after meals or snacks. With the help of this circulating insulin, glucose is transported into the cells of the body. Insulin also signals the liver to take up some of the surplus circulating glucose and store it as glycogen. Glycogen is con-

verted back to glucose when the blood-glucose level starts to drop, such as between meals.⁴ With the constant assistance of insulin, the body keeps the blood-glucose concentration within a narrow range.

Type 1 and type 2 diabetes

In type 1 diabetes, the body's immune system attacks and destroys the beta cells in the pancreas that are responsible for insulin production. This leads to an absolute insulin deficiency.⁵ People who are diagnosed with type 1 diabetes require insulin therapy.

Type 2 diabetes is the most common form, affecting about 90% of diabetes cases. People

Table 1: History of Insulin^{1,2,3}

1922	Banting and Best use bovine (calf) insulin extract on first human patient.
1950-1953	Novo Nordisk launches animal source NPH & Lente insulin.
1982	Eli Lilly launches Humulin®, the first human insulin produced through recombinant DNA technology.
1996	Eli Lilly launches Humalog® (insulin lispro), a modified rapid-acting human insulin, to help mimic the body's natural insulin response to meals.
1999	Novo Nordisk launches NovoRapid® (insulin aspart), a modified rapid-acting human insulin, to help mimic the body's natural insulin response to meals.
2004	Aventis launches Lantus® (insulin glargine), a modified long-acting human insulin in Canada.
2006	Novo Nordisk launches Levemir® (insulin detemir), a modified long-acting human insulin in Canada. Sanofi-Aventis receives approval to market Apidra® (insulin glulisine), a modified rapid-acting human insulin.

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with type 2 diabetes develop insulin resistance and/or they do not secrete sufficient insulin. In insulin resistance, the body cannot use insulin efficiently despite sufficient or even excessive insulin secretion. Instead of glucose getting into the cells, it stays in the blood stream. This group of patients is commonly managed with lifestyle modifications and a variety of oral medications such as glyburide, metformin, acarbose, pioglitazone, repaglinide, etc. If sufficient blood-glucose control is not achieved with oral agents in type 2 diabetes, then insulin therapy may also be required.

The goal of insulin therapy is to mimic the body's "normal" insulin levels as closely as possible. This usually requires an injection of intermediate-acting insulin or extended long-acting analogues once or twice daily, which aims to duplicate the body's basal insulin levels. In addition, a fast- or rapid-acting insulin must be injected just prior to mealtime to provide sufficient insulin for the associated surge in blood glucose.

Types of insulin

The biggest differences between insulin products are in the onset of action (i.e., how quickly it works), time of peak action (i.e., when the maximum effect occurs) and the duration of action (i.e., how long it lasts). The peak action of insulin can be a concern as hypoglycemia

(low blood glucose) can result, while the onset and duration of action determine when and how frequently the insulin will be used. As explained above, when using insulin optimally the patient with diabetes attempts to mimic the natural release of insulin within the body.

Fast-acting insulin

Fast-acting insulin is marketed in Canada as Humulin® R or Novolin® ge Toronto. This type of insulin is clear, has a relatively quick onset of action and is injected before mealtime. Both of the above-mentioned products have an onset of action of about 30 to 60 minutes following injection. Their peak effect occurs 2 to 4 hours after injection, while their duration of action is approximately 6 to 8 hours.⁵ They are both available in 10 mL vials as well as 3 mL cartridges for pen delivery devices. They are normally used to cover the mealtime surges in glucose.

Rapid-acting insulin

Humalog®, NovoRapid® and recently approved Apidra® are insulin analogues that are modified versions of human insulin. These insulin types have a rapid onset of action (10 to 15 minutes) and a peak effect within 1 to 3 hours. Their duration of action is only 3 to 5 hours. These products are clear solutions, and Humalog® and NovoRapid® are available in 10 mL vials and 3 mL cartridges.

They offer a significant advantage over fast-acting insulin, as they are normally administered immediately prior to mealtime (0 to 15 minutes before) while fast-acting insulin is normally administered 30 to 60 minutes prior to a meal.⁵

Intermediate-acting insulin

Both Novolin® ge NPH and Humulin® N are considered intermediate-acting insulins. Their onset of action is 1 to 3 hours, the peak is between 5 to 8 hours and the duration of action is longer, up to 18 hours.⁵ Intermediate-acting insulins are used once or twice daily to mimic the normal basal insulin level.

Novolin® ge NPH and Humulin® N are suspensions (i.e., cloudy in appearance) and must be resuspended before use. They are available in 10mL vials and 3mL cartridges. Humulin® N is also available in prefilled 3 mL insulin pens.

Extended long-acting analogues

Long-acting analogues are the newest type of insulin. Like rapid-acting insulin, they are modifications of human insulin. These products have a long duration of action and mimic the basal level of insulin secreted by the pancreas. Lantus® is a clear insulin that is administered once daily. The onset of action is about 1 hour. It has no significant peak and the duration of action is 24 hours. In

Canada, this product is available as a 10 mL vial.⁶ The benefits of this type of insulin include its long duration of action, which allows a once-daily injection and the lack of any significant peak, which is thought to minimize the risk of hypoglycemia.

Levemir® is a clear insulin that is administered either once or twice daily. It has a peak effect approximately 6 to 8 hours after a dose and lasts approximately 12 to 24 hours. Levemir® is available in 3 mL pen cartridges.

Premixed insulin

Premixed insulin mixtures combine two types of insulin. Generally they contain a fixed ratio of fast-acting insulin to NPH (intermediate-acting insulin). For example, 30/70 insulin has 30% fast-acting insulin and 70% NPH insulin. This type of insulin is cloudy, has two onsets of action, two peaks and the duration of action would be as long as the NPH insulin. Premixed insulin is convenient for patients who have difficulty measuring their doses due to poor dexterity or eyesight problems.⁷ They are more suitable for patients who eat a consistent amount of food at regular times. However, they are being used less often as they are not as flexible and not as easy to adjust for changes in diet, exercise, meal timing and illness. Table 2 (see next page) lists the different combinations of premixed insulins available in Canada.

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Pharmacy
PRACTICE

Insulin therapy trends

A major recent trend in the management of type 1 diabetes is the use of intensive insulin therapy. This involves several daily doses of insulin, usually once- or twice-daily long-acting insulin, as well as the injection of a rapid-acting insulin just prior to mealtime. This regimen is very flexible, easy to adjust and has been associated with a reduction in complications in patients with type 1 diabetes such as kidney disease and eye disease.⁵ Conventional therapy with fixed daily doses of insulin is being used less often.

The introduction and acceptance of using insulin analogues is another growing trend in insulin therapy. Insulin analogues are modifications of human insulin, and allow for unique properties that help the patient better manage their diabetes. Humalog®, NovoRapid® and the recently approved Apidra® are analogues with a rapid onset of action. They are convenient because they allow people with diabetes to inject insulin at the same time as they eat their meals. Lantus® and Levemir® are analogues that have very long durations of action with lower insulin peaks.

Eli Lilly has decided to discontinue the production of all Lente (Humulin® L) and Ultralente (Humulin® U) products. Eli Lilly says that less than 2% of people who have diabetes use these products and newer insulin therapies have increased the number of treatment options for patients.⁶

Recently the FDA in the U.S. has approved an inhaled insulin powder, Exubera®. The powder is inhaled orally and has a rapid onset of action (within 10 minutes). It has a duration of action similar to rapid-acting insulin. This form should not be used in smokers and people with underlying lung disease.

Table 2: Premixed insulin types available in Canada

Insulin type	Availability
Novolin® ge 10/90	3 mL Penfill® cartridges
Novolin® ge 20/80	
Novolin® ge 40/60	
Novolin® ge 50/50	
Novolin® ge 30/70	10 mL vials
Humulin® 30/70	
Humalog® Mix 25	3 mL pen cartridges
(This product contains Humalog® and a long-acting modification of Humalog®)	3 mL prefilled insulin pens

Table 3: Common insulin pen devices in Canada

Novo Nordisk	Max units delivered	Approx. cost*	Special features
Innovo®	70 units in 1 unit increments	\$73	Electronic delivery device. Displays dose and time of last injection. Six-second timer tells when insulin is delivered.
Novolin Pen® 3	70 units in 1 unit increments	Free	Available in 3 different colours. Magnifier can be obtained from Novo Nordisk.
Novolin Pen® Jr	35 units in 1/2 unit increments	\$52	Specific for pediatric patients with diabetes. Allows precise dosing with 1/2 unit increments.
Novolin Pen® 4	70 units in 1 unit increments	\$79	Dosing scale is much larger. Less injection force required compared with Novolin Pen 3. Available in blue and grey.
Eli Lilly			
Humapen® Ergo™	60 units in 1 unit increments	Free	Available in teal and burgundy.
Humapen® Luxura™	60 units in 1 unit increments	\$75	Similar to Humapen® Ergo™. Available in burgundy and champagne.

Storage of insulin

When unopened insulin is stored in the refrigerator at a temperature range of 2° to 8° Celsius, it is stable until its expiration date.⁷ Once the rubber stopper has been punctured, the cartridge or vial can be stored at room temperature (15° to 30° Celsius) for up to 28 days.⁷ In-use insulin should be stored at room temperature, as cold insulin injections can be painful. Manufacturers recommend that insulin that is exposed to excessive heat or cold should not be used.

Insulin pen devices

The Canadian Diabetes Association 2003 clinical practice guidelines encourage the use of insulin pens as they facilitate multiple injections

of insulin.⁵ Pens make the injection of insulin more efficient and can lead to more accurate dosing. Table 3 lists some of the common insulin pen devices.

Syringe selection

When insulin pens are not used, proper syringe selection is necessary. Selecting a syringe size depends on the number of units of insulin required. People should select the size of syringe that is closest to the number of units of insulin they are injecting. For example, a person injecting 20 units should use a 3/10 mL or 30 unit syringe versus a 1 mL or 100 unit syringe. Currently there are three different sizes of syringes on the market. A 3/10 mL syringe can dose up

to 30 units of insulin, a 1/2 mL syringe can dose up to 50 units and the 1 mL syringe can dose up to 100 units.

Needle selection

Two main characteristics describe an insulin syringe or pen needle. The first is the needle gauge. The higher the gauge of needle, the finer the needle is (i.e., a smaller diameter). Many patients prefer finer needles as they tend to make the injection of insulin less painful.⁸ Syringe and pen needles are also available in different lengths. Syringe needles are available in 12.7 mm, 8 mm, 6 mm and 5 mm lengths.

Insulin must be injected into subcutaneous tissue. This is the layer just underneath the skin and before the

muscle tissue. Most patients should be able to safely and comfortably use an 8 mm-length needle.⁹ Very lean patients and children may prefer a needle that's 5 or 6 mm in length to avoid intramuscular injection. Obese patients and patients injecting a large number of units may prefer the longer 12.7 mm needle. When patients inject their insulin with a needle that's 5 or 6 mm in length, they require very little if any pinching when administering their insulin. Longer needles require pinching and typically need to be injected at a 90-degree angle.

Insulin pumps are another popular method of delivering insulin; however, a complete discussion of these types of devices is beyond the scope of this lesson.

The technician's role

Pharmacy technicians are often the first contact a person with diabetes encounters. Understanding the different types of insulin, pens, syringes and needles will provide the background the technician will need in order to identify situations that require the pharmacist's intervention. For example, a very lean patient buying a 12.7 mm needle may benefit from a consultation with the pharmacist. In addition the technician can play a vital role in ensuring all types of insulin and the associated supplies are in sufficient quantities in inventory as 'out of stock' can be a serious issue for a patient with diabetes.

The technician plays a vital role in recognizing situations where improvement in care can be achieved and

ensuring that the patient has an opportunity to interact with the pharmacist.

References

1. Novo Nordisk History. http://www.novonordisk.com/images/about_us/history/history_uk.pdf (accessed February 3, 2006).
2. Lilly Company Profile. http://www.lilly.com/about/citizenship/profile/profile_index.html (accessed February 3, 2006).
3. Canadian Diabetes Association. History of Diabetes. http://www.diabetes.ca/Section_About/time-line.asp (accessed February 3, 2006).
4. Collazo-Clavell, Maria, Editor. Mayo Clinic on Managing Diabetes. New York: Kensington Publishing Corp, 2001.
5. Canadian Diabetes Association Clinical Practice Guidelines Expert Committee. Canadian Diabetes Association 2003 Clinical Practice
6. Allen J, Tsiopoulos P. Comparison of insulins. *Pharm Lett* 2006; 22: No. 220217.
7. Hanna, A, Editor-in-Chief. 2005 Consumer's Guide to Diabetes Products. http://www.diabetes.ca/files/consumers_guide_2005.pdf (accessed February 19, 2006).
8. McKesson Pharmaklik. <http://www.pharmaklik.ca> (accessed March 14, 2006).
9. Virani, T et al. Best practice guideline for the subcutaneous administration of insulin in adults with type 2 diabetes. Registered Nurses Association of Ontario. http://www.rnao.org/bestpractices/PDF/BPG_Insulin_Type2_Diabetes.pdf Accessed March 14, 2006.

QUESTIONS

Please select the BEST ANSWER for each multiple choice question.

1. Which of the following statements is FALSE?

- a. Insulin is only excreted by the pancreas after food is ingested
- b. Insulin stimulates the liver to store glucose as glycogen
- c. Glycogen is converted back to glucose when the circulating glucose level drops
- d. Insulin helps the transport of glucose into the cells of the body

2. Which one of the following statements is TRUE?

- a. Insulin was discovered in Canada by Leonard Thompson
- b. Humulin[®] N and Novolin[®] NPH are made from beef and pork insulin
- c. Insulin analogues are modifications of human insulin that give them unique properties
- d. People with diabetes usually use only one type of insulin.

3. Which one of the following statements is FALSE?

- a. People with type 1 diabetes will require insulin therapy
- b. People with type 1 diabetes have insulin resistance
- c. People with type 2 diabetes are commonly managed with

- a. oral medication
- d. With insulin resistance the body cannot properly use the insulin it manufactures

4. Which of the following is NOT a rapid- or fast-acting insulin?

- a. NovoRapid[®]
- b. Levemir[®]
- c. Humulin[®] R
- d. Humalog[®]

5. With regards to premixed insulin, which of the following is TRUE?

- a. Premixed insulin is clear
- b. A 30/70 mixture contains 30% intermediate-acting insulin and 70% fast-acting insulin
- c. Premixed insulin is only available in insulin pen formats
- d. Premixed insulin is convenient for patients who have difficulty measuring their doses due to dexterity or eyesight problems

6. Which of the following statements is FALSE?

- a. Fast-acting insulin has an onset of action in 30 to 60 minutes
- b. Humalog[®] and NovoRapid[®] are insulin analogues
- c. Humulin[®] L and Humulin[®] U are being discontinued

- d. Levemir[®] is a fast-acting insulin analogue

7. Which of the following statements is TRUE?

- a. Novolin Pen[®] Jr measures half-unit increments up to 70 units
- b. The Novolin Pen[®] 3 and Humapen[®] Ergo[™] are available free of charge from their manufacturers
- c. The Canadian Diabetes Association only recommends insulin pens for people that have trouble injecting with syringes.
- d. The Humapen[®] Luxura[™] is an electronic insulin injection device

8. Which one of the following statements is FALSE?

- a. Unopened insulin should be stored in the refrigerator
- b. Any in-use insulin pens should be stored in the refrigerator
- c. Exposing insulin to excessive heat or cold can damage the product
- d. Insulin is stable for 28 days at room temperature

9. Which one of the following

statements is TRUE?

- a. Intensive insulin therapy requires multiple doses of premixed insulin
- b. Premixed insulin is being used more often as it does not require mixing of insulin and allows for easy adjustments
- c. Premixed insulin therapy is not as flexible as using intensive insulin therapy
- d. Analogues are going to be used less often as they are not exact human insulin

10. With regards to insulin syringes and needles, which of the following is FALSE?

- a. The higher the gauge of the needle the finer it is
- b. A person injecting 40 units of insulin should use a 1 mL syringe
- c. People injecting a large amount of insulin may prefer a longer needle
- d. Insulin is injected into the subcutaneous tissue just underneath the skin.

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