TOPICS:
Medications (Insulin)

TEACHING OBJECTIVES:

1. Describe insulin and what it does in the body.
2. Present the types of insulins to be used and their actions.
3. Discuss the schedule for insulin injections.
4. Identify who and when to call for insulin doses.

LEARNING OBJECTIVES:

Learners (parents, child, relative or self) will be able to:

1. State why the body needs insulin.
2. List the specific types of insulins to be used and their actions (onset, peak and duration).
3. State the schedule for insulin injections (including before or after meals).
4. Identify who and when to call for insulin doses.

Chapter 8

Insulin: Types and Activity

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INSULIN

Before insulin was discovered in 1921, there was little help for people who had type 1 diabetes. Since then, millions of people all over the world have been helped by insulin.

Insulin is a hormone made in the pancreas, an organ inside the abdomen (see picture in Chapter 2). Special cells called "beta cells" make the insulin. These cells are located in a part of the pancreas called the "islets" (pronounced eye-lets). When a person has type 1 diabetes, there is a loss of the cells which make insulin. Most people with diabetes now use human insulin or insulin analogs. The human insulin does not come from humans, but has the same "make-up" as human insulin. It is produced by bacteria (Lilly) or by yeast (Novo-Nordisk) using "genetic engineering." There are no known advantages of one brand of insulin over another brand. The analog insulins have slight changes that make their activity resemble normal insulin activity.

WHAT DOES INSULIN DO?

Food (carbohydrate) is converted to sugar for the body's energy needs. The insulin allows the sugar to pass from the blood into the cells. There it is burned for energy. The body cannot turn sugar into energy without insulin (see diagram in Chapter 2). Insulin also turns off the making of sugar in the liver (see Chapter 2). If insulin is not available, the sugar builds up in the blood and spills into the urine.

People who have type 1 diabetes can't make enough insulin. These people have to get the needed insulin through injections. **Insulin cannot be taken as a pill, because the stomach acid destroys it.** There are no known vitamins, herbs or other medications which can take the place of insulin injections. People who have type 2 diabetes still make insulin (although not enough to keep their sugars in a normal range, see Chapter 4). They can take pills to help them make even more insulin or to be more sensitive to their own insulin. However, these pills **are not** insulin.

TYPES OF INSULIN

Several companies make many different types of insulins.

The three broad classes of insulin are:

1. "rapid-acting" (such as Humalog [H], NovoLog [NL], Apidra [AP]) and Regular (R)
2. "intermediate-acting" (such as NPH [N])
3. "long-acting" such as Lantus® (insulin glargine) and Levemir ® (insulin detemir)

Insulin action (when it begins working, when it peaks in activity and how long it lasts) may vary from person to person. The action may also vary from one day to the next in the same person. The site of the shot and exercise may influence the insulin action. Increased temperature (bath, shower, hot tub, sauna) may increase blood supply to the skin and cause the insulin to be absorbed more rapidly. Average times of action for different insulins are shown in Table 1.

1. Rapid-Acting Insulins and Regular Insulin

Humalog/NovoLog or Apidra (H, NL or AP) insulins are rapid in onset of activity (10-15 minutes). They have a peak activity in 30-90 minutes and effectively last three to four hours. The figures show the activities of the rapid-acting insulins. All are similar in activity. We may use the term "rapid-acting insulin" to indicate that the insulin used may be any one of the three (H, NL or AP).

Regular insulin begins to act approximately 30-60 minutes after being injected. It has its peak effect two to four hours after the injection and lasts six to nine hours. There is again, considerable variability in these times from person to person.

Humalog/NovoLog/Apidra (H/NL/AP) insulins have several advantages over Regular insulin:

- They start to work in 10-20 minutes rather than in 30-60 minutes. It is best to take the premeal insulin 10-15 minutes before eating (see Table 3 in Chapter 9). If given before the meal, they peak in activity as the carbs are turned into blood sugar. On the other hand, Regular insulin peaks after the food is mostly absorbed and is more likely to cause low blood sugars!
- The blood sugar levels two hours after meals are lower when a rapid-acting insulin is taken 10-15 minutes prior to meals.
- Because the rapid-acting insulin does not last as long as Regular insulin, there is less danger of lows during the night when taken at dinner.
- Use of rapid-acting insulin after meals in toddlers who eat varying amounts can help to prevent hypoglycemia as well as food struggles (Chapter 18).

It is important to remember to avoid taking a warm shower (or bath) or getting into a hot tub for one to two hours after taking insulin. The warm water increases the blood flow to the skin and causes the insulin to be absorbed faster. This faster rate of absorption could cause a low blood sugar.

2. Intermediate-acting insulins (last 10-20 hours)

- ✔ **NPH (N)** insulin is made with a protein that allows it to be absorbed in the body more slowly. The letters NPH stand for **N**eutral **P**rotamine **H**agedorn. Protamine is the protein added to the insulin to make it

longer-acting (also referred to as "cloudy" insulin). Hagedorn is the name of the man who developed it. Human NPH has its peak activity four to eight hours after the injection in most people. If it is taken in the morning, the peak action comes before supper. Human NPH insulin lasts an average of 13 hours. The peak in NPH insulin activity and the duration of activity may vary for some people. NPH insulin may be premixed with Regular insulin without changing the activities of either insulin. (NPH is now called "N" on the bottles.)

✔ **Pre-mixed Insulins:** The pre-mixed insulins are used primarily by people who do not wish to draw the insulins from separate vials prior to injecting. They have the disadvantage that the percentage of each insulin is fixed and the individual insulins cannot be varied (for variations in blood sugar, exercise, food, illness, etc.). There are many mixtures available and only two examples will be given.

- **70/30® and Mixtard®;** different combinations of pre-mixed NPH and Regular insulin are available. The most frequently used are 70/30 and Mixtard, both of which have 70 percent NPH and 30 percent Regular insulins. The usual times of activity are shown in Table 1.
- **Humalog mix 75/25** (Lilly) is also a combination of a rapid (25 percent) and an intermediate-acting (75 percent) insulin. The rapid-acting portion is a bit "blunted" when compared with the usual Humalog peak. Some people require a third injection of 75/25 at lunch or bedtime for better control.

3. Long-acting insulin (lasts 20-24 hours)

✔ **Lantus (Insulin Glargine)** insulin became readily available in the U.S. in May, 2001. It is a clear insulin that lasts 24 hours with almost no peak (the first true basal insulin). Its profile is similar to the basal insulin (the insulin that stops sugar output from the liver) put out by a normal pancreas. It is often compared with the basal insulin of an insulin pump (Chapter 26).

✔ **Insulin detemir** (**Levemir**; made by Novo-Nordisk) is also being used as a basal insulin. Its duration is up to 24 hours, but it may need to be taken twice daily for some people. Levemir was approved by the FDA for use in adults in June, 2005, and for use in children in October, 2005. It is a clear insulin but cannot be mixed with a rapid-acting insulin. As of this writing, we have not had experience in using it.

Advantages of Lantus (and presumably of Levemir)

Its consistency in absorption and activity make it more predictable. NPH varies in its peak activity even in the same person from one day to the next. Lantus insulin has less variability and does not have a peak (unless it is accidentally injected into the muscle).

- Because it is a clear insulin, it does not need to be turned up and down to mix. There is no settling in the vial and insulin concentrations do not vary from one shot to the next.
- Reduction of low blood sugars. Initial studies at our Center have shown a decrease in very low blood sugars, particularly during the night, when compared with using NPH insulin. This is due to less of an activity peak as well as consistent absorption.

Disadvantages of Lantus (and presumably of Levemir)

- When using Lantus, three or more shots per day of insulin may be needed.
- Because it is clear and has a purple cap, care must be taken not to confuse it with the rapid-acting insulins, which are also clear.
- The directions state that it may not be mixed with other insulins. However, a study from Texas Children's Hospital found that mixing Lantus with a rapid-acting insulin did not change insulin activities. A study from our Center also showed no

change in HbA_{1c} values after families began mixing the two. However, five to 10 percent of families did not feel mixing worked for them. In summary, although not approved by the FDA ("off-label"), many families now mix Lantus and a rapid-acting insulin. This should be done only after discussing it with their diabetes healthcare provider. The method is discussed in Chapter 9.

Basal-Bolus Insulin Therapy

With the rapid-acting insulin analogs now available (H/NL/AP) and the basal insulin, Lantus (or Levemir), it is now possible to simulate normal physiologic insulin secretion (of a person without diabetes) using injections (or using insulin pumps, see Chapter 26). The body normally secretes a low-level basal insulin and peaks (boluses) of insulin with food or other causes of increased sugar levels.

The Lantus, Humalog and NovoLog insulins are all available in pre-filled pens (see Chapter 9). This makes use much easier for many families.

Three ways we are currently using Lantus insulin:

1. Lantus can be (consistently) taken once daily (either in the morning, at dinner or in the evening) and rapid-acting insulin (H/NL/AP) taken before each meal (see Figure 1-A). The pre-meal insulin is often taken with an insulin pen. The advantage of taking Lantus in the morning is that if some of the injection is accidentally given into muscle, there may be a peak in early activity (two to four hours). If this occurs, it is better to have it happen during the daytime. (As discussed in Chapter 9, intramuscular injections are least apt to occur when using the buttocks.) However, the best time to take it should be considered jointly between the family and care-providers.

   Other advantages of taking the Lantus in the morning are:

   - ✔ people usually do not mind a large insulin dose in the morning as much as in the evening
   - ✔ most high blood sugars occur during the day so it is good to have optimal insulin activity during this time
   - ✔ if the activity does diminish at 22-24 hours, it may be best to have this happen in the early morning hours (especially for very young children)

   For infants or those who have trouble with shots, Lantus can be given while they are sleeping (in the buttocks). This should be discussed between the family and the healthcare provider. It is best used this way with the permission of the child.

2. Lantus and H/NL/AP taken alone at dinner (or the Lantus in the evening). A mixture (in the same syringe) of NPH and H/NL/AP is taken prior to breakfast (see Figure 1-B). This works well for children who are not ready to take a noon shot at school. The NPH insulin may also help to cover an afternoon snack. Some people who take a noon shot still do better with a small amount of NPH insulin in the morning. This may be because H/NL/AP taken at noon is gone by 4 p.m. We usually give about one-half of the previous morning NPH dose.

   Some younger children do better getting their Lantus in the morning. Insulin activity can then fall off in the early morning hours of the next day. A separate morning shot of rapid-acting and NPH is then required. A third shot of H/NL/AP prior to dinner is also usually needed.

3. The third way Lantus is now sometimes used (not approved by the FDA or by the Sanofi-Aventis company;"off-label") is by giving it in the same syringe with the rapid-acting insulin (H/NL/AP) before dinner. (As discussed in Chapter 9, the rapid-acting insulin is put into the syringe first.) A mixture of rapid-acting insulin with NPH (or just the rapid-acting insulin) can be taken prior to breakfast, and sometimes a rapid-acting insulin is also taken prior to lunch (especially if NPH is not taken in the

a.m.). This regimen usually results in two or three injections daily. The insulin patterns would be the same as in Figure 1-B, except the Lantus and H, NL or AP would be in the same syringe at dinner.

Lantus Dose: the starting dose is often half the total units of intermediate-acting insulin (e.g., NPH) taken per day (a.m. and p.m.).

For example:

If 40 units of NPH insulin was taken in the morning and 20 units at dinner, a total of 60 units was taken per day. We would then start the person on 30 units of Lantus insulin.

This dose can then be increased or decreased depending on morning blood sugars. The Lantus dose is adjusted based on morning blood sugars, no matter when the Lantus dose is given.

The goal for the morning and pre-meal blood sugar values is:

Under 5 years of age:
80-200 mg/dl (4.5-11.1 mmol/L)

5-11 years of age:
70-180 mg/dl (3.9-10.0 mmol/L)

12-18 years
70-150 mg/dl (3.9-8.3 mmol/L)

>18 years:
70-130 mg/dl (3.9-7.3 mmol/L)

It is important to bring morning fasting sugar levels in range. If the day starts with high values, subsequent values are also often high (from liver production of sugars, see Chapter 2).

Once the Lantus dose is set, if sugar values are too high during the day, the rapid-acting and NPH insulins (usually about one-half the previous morning NPH dose) can be adjusted in the morning and/or at noon. The dose of morning NPH is increased until the pre-dinner blood sugars are within the ranges listed above (unless lows are occurring earlier in the day).

Figure 1: Use of Lantus Insulin (or presumably, Levemir)

Two of the most common methods of using Lantus insulin:

Figure 1-A. In the first example, Lantus is used as the basal insulin (given in the a.m., or at dinner or at bedtime) and a rapid-acting insulin is taken prior to meals and snacks.

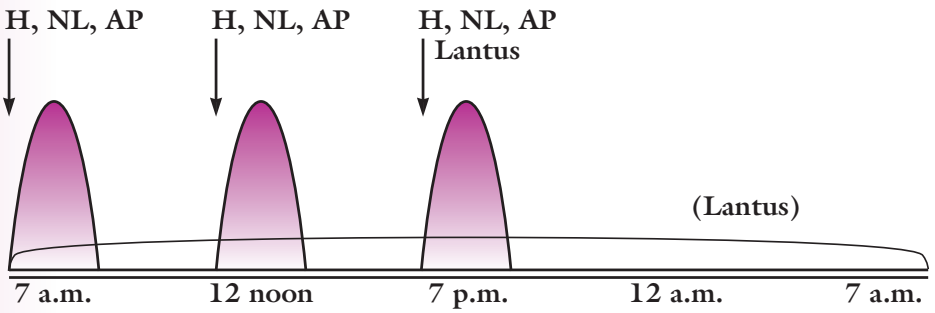
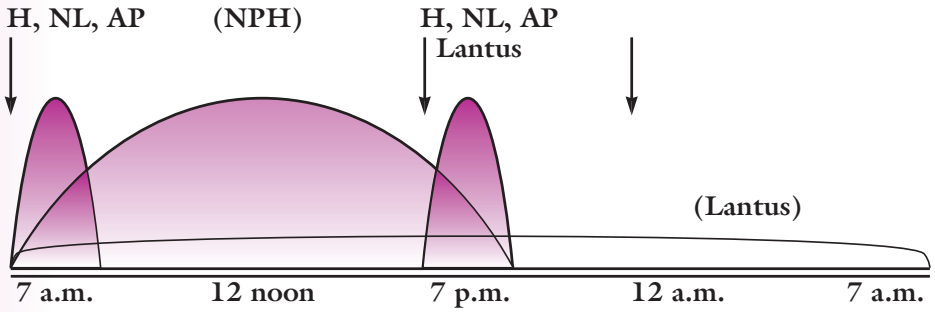


Figure 1-B. In this second example, NPH and a rapid-acting insulin are taken in one syringe in the a.m. A rapid-acting insulin is taken alone at dinner. Lantus (alone in the syringe) is taken consistently either in the a.m., at dinner, or at bedtime.



HOW OFTEN IS INSULIN GIVEN?

This section is complex and you may initially only wish to read the section related to the regimen chosen by your doctor.

One Injection Per Day

A few people have good blood sugar control by taking insulin once a day. This is particularly true during the "honeymoon" period that occurs shortly after diagnosis and for people with type 2 diabetes. Lantus insulin (and presumably, Levemir) is the first true "basal" insulin and is usually taken in the morning or at dinner. It has very little "peak" (unless given into muscle) and lasts about 24 hours (see Table 1). One injection a day of Lantus might be used during this "honeymoon" period. Some people with type 2 diabetes who need insulin may do well with one injection of Lantus each day. The combination of insulins often used is an intermediate-acting insulin (NPH) and a rapid-acting insulin (H/NL/AP). The two types of insulin are combined in one syringe for a single injection to provide insulin activity over several time periods. The morning shot of NPH insulin has its main activity in the afternoon. It does not last through the night. Thus, at least two injections per day of NPH insulin are usually necessary.

People who take one insulin injection per day may do better on two injections per day if they:

- do not have a good level of sugar control (particularly in the early morning)
- have frequent low blood sugars
- have to take a very large dose in one injection
- have many changes in their daily lives
- come out of the honeymoon phase

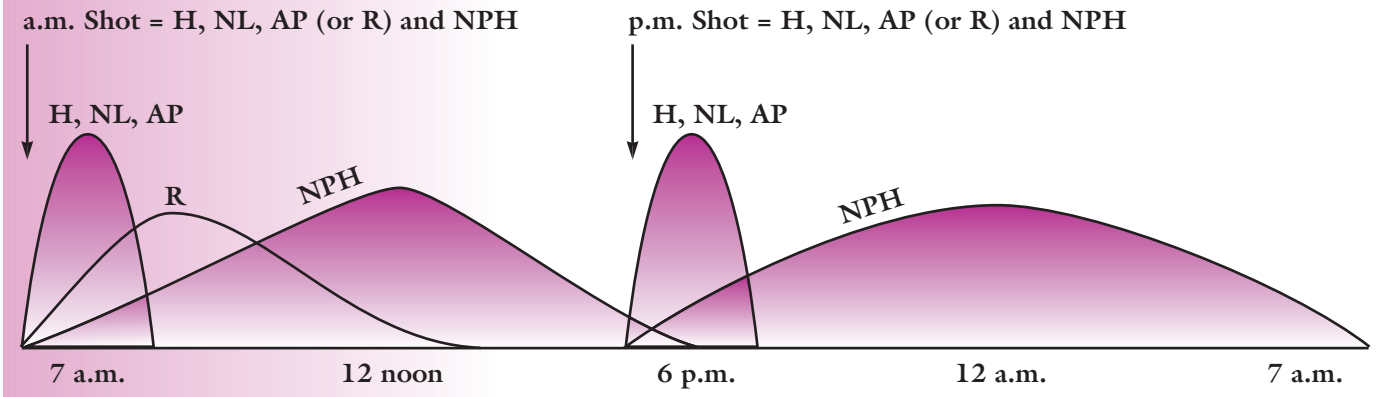
Two Injections Per Day

Most people obtain better sugar control using two or more injections of insulin per day. Most doctors now believe it is best to treat all

Table 1
Insulin Activities

Type of Insulin	Begins Working	Main Effect	All Gone
RAPID-ACTING and REGULAR			
Humalog/NovoLog/Apidra	10-15 minutes	30-90 minutes	3-4 hours
Regular	30-60 minutes	2-4 hours	6-9 hours
INTERMEDIATE-ACTING (lasts 10-20 hours)			
NPH	1-2 hours	3-8 hours	12-15 hours
LONG-ACTING/BASAL			
Lantus (Insulin Glargine)	1-2 hours	2-22 hours	24 hours
Levemir (insulin detemir)	1-2 hours	2-20 hours	20 hours
PRE-MIXED INSULINS			
70/30 NPH/Regular	30-60 minutes	3-8 hours	12-15 hours
75/25 NPH/Humalog	10-15 minutes	30 minutes-8 hours	12-15 hours

Figure 2: Example of Two Injections Per Day



Many people receive two injections per day. NPH may be used as the intermediate-acting insulin in the a.m. They can then take a rapid-acting insulin plus Lantus (see Figure 1-B) or NPH prior to dinner.

patients with type 1 diabetes with two or more injections per day. When a person receives two injections per day, there are four (or more) small peaks of insulin activity. Each of the small peaks in insulin activity can be adjusted to fit the person's schedule. Figure 1-B shows two injections of insulin per day using NPH in the a.m. and Lantus (combined with a rapid-acting insulin) at dinner. In countries in which a basal insulin is not yet available, it may be necessary to use two injections per day of NPH insulin (combined with a rapid-acting insulin [see Figure 2]). There is then a greater risk of low blood sugars during the night. The risk for nighttime lows has been shown to be slightly reduced if the second shot of NPH is taken at bedtime rather than at dinner. This means a third daily shot.

During adolescence, diabetes control may become more difficult. Teens usually need

Figure 3: Example of Three or More Injections Per Day

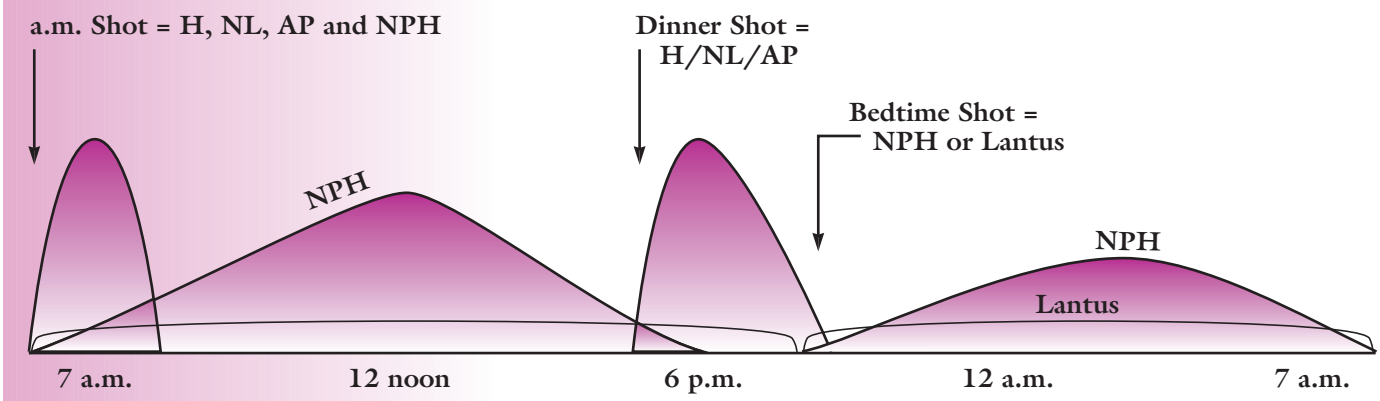


Figure 1-A shows Lantus in the a.m. (or p.m.) and H/NL/AP prior to each meal. If Lantus is unavailable, NPH insulin may be mixed with the H/NL/AP prior to breakfast and dinner (Figure 2) or taken in the a.m. and at bedtime. If the NPH is taken at bedtime, the H/NL/AP is taken prior to dinner.

more insulin due to insulin resistance. The growth and sex hormones make it more difficult for insulin to work. These hormones also seem to increase the likelihood of blood vessel changes in people with diabetes. Because of this, better sugar control is an important goal at this time (see Chapter 14). This goal can often be achieved more easily with three or more injections of insulin per day.

NPH insulin can be used as the intermediate-acting insulin when two or three injections of insulin are taken each day. NPH insulin and a rapid-acting insulin (H/NL/AP) are used in the morning. The peak in NPH activity helps allow the food eaten during the day to be used for energy. When Humalog/NovoLog/Apidra insulin is used in the dinner shot with Lantus (rather than NPH) there is less risk for low blood sugars during the night. If Lantus is not available, the dinner shot will likely be NPH plus a rapid-acting insulin. Due to the peak from NPH insulin, lows will be more likely to occur during the night.

Three or More Injections Per Day

Most people over age 12 now receive three (or more) shots of insulin each day. The various regimen are usually variations of Figures 1-A, 1-B and 2, depending on the needs of the person. People using Lantus as their basal insulin usually take at least three shots per day (see Figure 1-A).

Four or More Injections Per Day

The example above of Lantus insulin given once daily (often by pen) and a rapid-acting insulin given prior to meals and snacks (also often given by pen) is now the most common insulin regimen used by people willing to take multiple injections. Children who are not happy with multiple injections may still use this regimen by using an injection portal (e.g., Insuflon®, Chapter 9). Our families give all of the different insulins (including Lantus) through the portal.

There are many different insulin regimens and they may need to be individualized to the person with diabetes. Regimens may change with age, food intake, exercise, stress, growth or other factors. The healthcare providers will help to make needed changes.

AMOUNT OF INSULIN

Insulin is measured in "units" per cc (ml). All U.S. insulin now contains 100 units per cc (ml). It is called U-100 insulin. Standard insulin syringes hold either 3/10cc (30 units), 1/2cc (50 units) or 1cc (100 units). The 3/10cc syringes have larger distances between the unit lines and are easier to use if it is necessary to measure small doses.

Insulin dosage is based on body weight, blood sugar test results, planned exercise and food intake (especially carbohydrate). After the initial diagnosis and treatment, people are usually started on approximately 1/4 unit of insulin per pound (1/2 unit per kilogram [kg]) of body weight per day. The dose is then gradually increased as needed up to 1/2 unit per pound body weight (1 unit per kg body weight). After a few weeks to months, many children go into a "honeymoon" or "grace" period when very little insulin is required (see Chapter 2). Frequent telephone contact with the diabetes team is important when the honeymoon starts. The insulin dosage must then be reduced to prevent low blood sugars. We generally recommend continuing the injections during this period. After the honeymoon, most people gradually increase to an average insulin dosage of 1/2 unit per pound body weight (1.1 units per kg body weight). During the teenage growth spurt, the growth hormone level is high and blocks insulin activity. The insulin dosage may increase to 1.5 units per kg body weight (0.7 units/pound). The dosage then goes back down after the period of growth is over. Insulin dosages can be adjusted to fit the person's lifestyle and needs.

For example, seasonal changes are common.

- In the winter: when it is cold outside, children do not go out to play after dinner. They may need more H/NL/AP insulin before the evening meal.

Table 2
Insulins Frequently Used

Type	Name	Color of Box or Cap	Manufacturer
Humalog	Humalog	Purple Cap	Lilly
Regular	Humulin-R	White Box With Black Print	" "
NPH	Humulin-N	" "	" "
Humalog Mix	75/25	" "	" "
Regular	Novolin-R	White Box With Blue Markings	Novo-Nordisk
NPH	Novolin-N	" "	" "
Regular (Pen)	Novolin R PenFill	" "	" "
NPH (Pen)	Novolin N PenFill	" "	" "
NovoLog	NovoLog	Orange cap	" "
Insulin Glargine	Lantus (clear)	Purple cap, tall thin vial	Sanofi-Aventis
Insulin Glulisine	Apidra	Blue cap, tall thin vial	" "

- In the summer: when they go outside to play after dinner, the evening H/NL/AP insulin dose often can be decreased. Chapter 21 deals with how to adjust insulin dosages.

INTENSIVE DIABETES MANAGEMENT

Intensive Diabetes Management involves:

- Three or more shots of insulin per day (or use of an insulin pump)
- Checking blood sugar levels four or more times per day
- Paying attention to food intake
- Frequent communication with the healthcare provider

The Diabetes Control and Complications Trial (DCCT) used Intensive Diabetes Management to show that sugar control "closer to normal" helped to prevent the complications of type 1 diabetes (Chapter 14). Similar studies have shown this to also be true for type 2 diabetes. Most individuals are now selecting intensive diabetes management. The goal of intensive management is to keep the blood sugars closer to normal than can be done with one or two injections per day. For intensive therapy to be safe, frequent blood sugar tests are needed. When people tell us they are ready for intensive management, we often test their commitment by first asking them to do four blood sugar tests per day for one month. It is pointless to recommend intensive management until people decide that they are ready and willing. Intensive diabetes management is most easily accomplished using Lantus insulin (once daily) and a rapid-acting insulin prior to food intake. Insulin pumps provide an alternative and have become safer and more popular in recent years. Chapter 26 discusses insulin pump use.

DEFINITIONS

Analog: A form of insulin with a slightly different make-up that results in different times of onset and duration of activity. Humalog, NovoLog and Apidra are examples of insulin analogs modified to have a rapid onset of activity.

Beta cells: The cells in the islets of the pancreas which produce insulin.

cc (cubic centimeter; same as ml or milliliter): A unit of measurement. Five cubic centimeters (cc) equals one teaspoon; 15cc equals one tablespoon; 30cc equals one ounce; 240cc equals one cup.

DCCT: The Diabetes Control and Complications Trial. A very large research trial that showed that better sugar control reduced the likelihood of eye, kidney and nerve complications in people over age 13 with type 1 diabetes.

Hormone: A chemical made in certain glands and secreted into the blood. An example is insulin that is produced by the pancreas.

Insulin pump: A pager-sized device designed to give a preset steady (basal) injection of insulin throughout the day, as well as before-meal supplements (boluses) which are regulated by the user. Current pumps do not stop injecting insulin when blood sugars are low.

Lantus insulin (insulin glargine): A basal insulin that is flat in activity and lasts 24-hours. It has an acid pH in contrast to other insulins which all have a neutral pH.

Levemir (insulin detemir): A basal insulin that is flat in activity and lasts up to 24 hours. It has a fatty acid attached that binds to plasma albumin resulting in slow release.

Questions and Answers from NewsNotes

Q **I sometimes have low sugars in the middle of the night. Do you have any suggestions to prevent this?**

A People who use Regular at dinner time and who tend to have hypoglycemic episodes between 10 p.m. and 2 a.m. will likely have fewer lows when they change to Humalog/NovoLog/Apidra. This is because these three insulins last only about four hours. A shot taken at 6 p.m. won't be active in the middle of the night. In contrast, Regular insulin may still be lowering the blood sugar six to 10 hours later, and sometimes even 12 hours later. Our research shows that the total number of hypoglycemic events is reduced by half in people taking Humalog compared with Regular insulin. The frequency of nighttime lows, in particular, is reduced. In addition, use of Lantus insulin rather than an insulin that peaks (NPH) in the night greatly reduces the risk of nighttime lows. A consistent bedtime snack is also helpful.

Q **What are the main advantages of the insulin analogs, Humalog/NovoLog/Apidra (H/NL/AP)? Should everyone be changed to use one of them?**

A H/NL/AP are rapid-acting and start working in 10 minutes. With the human Regular insulin, we asked people to wait 30-60 minutes to eat after taking their shot. This would allow the insulin to work as the carbs turned to blood sugar, rather than first sending the blood sugar to 300-500 mg/dl (16.7-27.8 mmol/L). Unfortunately, this was inconvenient and most people (90 percent in one survey) just took their Regular insulin and ate. The high blood sugars in the hour or two after eating added to higher HbA_{1c} values at clinic visits. Now, with H/NL/AP, the waiting is not necessary. People can take their shots and immediately eat their meals. This will result in lower blood sugars in the two hours after meals as well as less guilt from not following rigid instructions.

Q **What are the main advantages of the insulin analog, Lantus?**

A By far the main advantage is in reducing the likelihood of low blood sugars during the night. This is because there is no peak in activity as occurs with NPH insulin. In addition, the use of a true basal insulin helps to prevent the large "swings" in blood sugars often seen with NPH insulin.

Q **I recently heard that some people are mixing Lantus and Humalog or NovoLog (H/NL). Is this true?**

A The company advises that Lantus always be given alone. However, a group from Texas Children's Hospital described mixing the Lantus and rapid-acting insulin in the same syringe with little difference in the subsequent blood sugar levels. Many families in our clinic are mixing the two. The rapid-acting insulin is put into the syringe first, and then the Lantus. Some cloudiness occurs as the two are mixed, but this does not seem to plug the needle. Most families who have started mixing the two have continued to do so with no significant change in HbA_{1c}. However, some families have thought the blood sugars higher after mixing, and have returned to giving the Lantus as a separate injection. If families are giving NPH and H/NL in the morning, the Lantus and H/NL can be given prior to dinner. If a family does decide to make the switch, it would be wise for them to measure bedtime blood sugars before mixing and for a week after mixing (with no food between dinner and the bedtime snack).