Insulin

There are many different insulins for many different situations and lifestyles. This section should help you and your doctor decide which insulin or insulins are best for you.

Characteristics

The three characteristics of insulin are:

Onset. The length of time before insulin reaches the bloodstream and begins lowering blood glucose.

Peak time. The time during which insulin is at its maximum strength in terms of lowering blood glucose levels.

Duration. How long the insulin continues to lower blood glucose.

Kinds

Here is a brief look at the kinds of insulins available. Remember, each person has his or her unique response to insulin, so the times mentioned here are approximate.

Rapid-acting insulins, such as insulin lispro (Humalog by Eli Lilly) or insulin aspart (NovoLog by Novo Nordisk), begin to work about 15 minutes after they are injected, peak in about an hour, and continue to work for 2 to 4 hours. (The U.S. Food and Drug Administration [FDA] has approved another rapid-acting insulin called insulin glulisine [Apidra], which is manufactured by Sanofi-Aventis, but it is not yet available to consumers.) People should inject rapid-acting insulins 15 minutes before a meal. (Be sure to check the package inserts on rapid-acting insulins for product-specific directions, because they vary slightly.) In fact, you should never delay eating after using insulin lispro or insulin aspart.

Also, because these insulins leave the bloodstream quickly, there is less chance of hypoglycemia (low blood glucose) several hours after the meal. Both insulin lispro and insulin aspart are only available by prescription. Insulin lispro and insulin aspart are very similar in their activity, but you should not use them interchangeably unless advised to do so by your doctor.

After-meal use of rapid-acting insulins may also be of some benefit to young children, because their caloric intake is often difficult to predict before meals. After-meal use can also benefit those who have delayed stomach emptying (gastroparesis).

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DAVID MENDELSOHN/MASTERFILE

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Many people use both rapid- or short-acting insulins and insulin glargine in an effort to mimic the body's natural insulin secretion.

Regular or short-acting insulin (human) usually reaches the bloodstream within 30 minutes after injection. It peaks anywhere from 2 to 3 hours after injection, and is effective for approximately 3 to 6 hours. Typically, the higher the dose of regular insulin, the greater the effect.

Intermediate-acting insulin (human) generally reaches the bloodstream about 2 to 4 hours after it is injected. It peaks 4 to 12 hours later, and is effective for about 12 to 18 hours. The varieties of intermediate-acting insulin include both NPH and lente. These are often used in combination with short-acting insulin. (See tables, page RG19.)

Long-acting insulin (ultralente) reaches the bloodstream 6 to 10 hours after injection and is usually effective for 18 to 24 hours. It does have peak action, so ultralente does not mimic basal insulin action.

Human ultralente, which is considered to be a long-acting insulin, may be absorbed at different rates in different people. Therefore, for some people, human ultralente functions as an intermediate-acting insulin, while for others, it is long-acting.

A long-acting insulin known as insulin glargine (trade name Lantus) was approved for use in April 2000. Insulin glargine has continuous, "peakless" action that mimics natural basal (background) insulin secretion. Although it provides a long-lasting effect, insulin glargine's onset is between 2 and 4 hours—quicker than other long-acting insulins. Insulin glargine has been clinically proven to reduce low blood glucose, especially during the night.

Insulin glargine is clear in appearance. However, insulin glargine must not be mixed with any other type of insulin and should not be administered intravenously.

In June 2005, the FDA approved insulin detemir (Levemir), manufactured by Novo Nordisk, another long-acting insulin. However, it was not yet available to consumers at press time.

Many people use both rapid- or short-acting insulins and insulin glargine in an effort to mimic the body's natural insulin secretion. Because insulin glargine has no peak, injections of rapid-acting insulin must be given before all meals to provide bolus coverage for food intake. Both types of insulin are clear in appearance. If you are on this type of dual insulin therapy, it is very important that you choose the correct insulin from the correct vial. (One distinguishing factor is that insulin glargine vials are taller and narrower than those of other insulins.)

Insulin glargine can be injected any time during the day, as long as it is taken around the same time each day.

Premixed insulins may be convenient for those who mix NPH and regular into one syringe. Often, the insulin is premixed in a prefilled insulin pen, a portable and accurate means of administering insulin, replacing the traditional vial and syringe.

The most typical mixture is 70 percent NPH and 30 percent regular. A mixture of 75 percent insulin lispro protamine and 25 percent insulin lispro, known on the market as the Humalog Mix 75/25, combines intermediate-acting insulin and rapid-acting mealtime insulin. Likewise, a mixture of 70 percent insulin aspart protamine and 30 percent insulin aspart (NovoLog Mix 70/30) is available.

NovoLog, Humalog, NovoLog Mix 70/30, and Humalog Mix 75/25 can be given just after the meal if the person with diabetes is an erratic eater.

Premixed insulin can be helpful for people who have trouble drawing up insulin out of two different bottles and reading the correct dosages. It's also useful for those who have poor eyesight or dexterity and is convenient for people whose diabetes has been stabilized on this combination. Insulin pens are also useful for those with dexterity problems or poor eyesight.

Sources

Today, recombinant DNA human insulins are the most widely used insulins in this country. Through genetic engineering, bacteria or yeast are transformed into little "factories" that produce synthetic human insulin. Years ago, the most commonly used insulins were pork, beef, and beef-pork combinations.

The source of an insulin is important because it affects how quickly an insulin will be absorbed, peak, and last.

Strength

All insulins come dissolved or suspended in liquids, but the solutions have different strengths.

The most commonly used strength in the United States today is U-100. That means it has 100 units of insulin per milliliter of fluid (100 units per cc). Not used in the United States, but still used in Europe and Latin America, is U-40, which has 40 units of insulin per milliliter of liquid.

If you are traveling, it's essential that you purchase the correct strength of insulin. And because different syringes are used for different insulin strengths (for example, U-40 syringes deliver U-40 insulin and U-100 syringes deliver U-100 insulin), it's essential that your syringe match your insulin.

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If you **are traveling**, it's essential that you **purchase the correct strength** of insulin.

U-500 insulin can be purchased in the United States, but it is rarely used. It is available by prescription only, and must be ordered by the pharmacy from the manufacturer.

It usually takes 2 to 3 days to obtain this type of insulin, so if you use it, plan ahead.

If you take U-500 insulin, you will have to use a tuberculin syringe, which is designed for very small doses. When discussing your insulin dosage with a new health care provider—for example, if you are in the hospital—be sure to specify that you use U-500 insulin.

Mixing Insulins

Often people will be instructed to take a given amount of rapid-acting and a given amount of another type of insulin. NPH insulins mix easily with regular, insulin aspart, and insulin lispro. Please note that mixtures containing insulin aspart or insulin lispro should be injected immediately after mixing and that these insulins should be mixed with NPH only under the advice of your doctor.

Some doctors advise against mixing regular insulin with lente or ultralente insulins because such mixtures may lead to unpredictable results. However, some people have achieved good control with these mixtures. If your doctor suggests

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INSULINS COMMONLY USED IN THE UNITED STATES *(As of Sept. 1, 2005)*

Generic Name	Brand Names	Form	Manufacturer	Cloudy or Clear
RAPID-ACTING				
insulin lispro	Humalog*	analog	Eli Lilly and Company	clear
insulin aspart	NovoLog*	analog	Novo Nordisk, Inc.	clear
REGULAR				
regular	Humulin R	human	Eli Lilly and Company	clear
regular	Novolin R*, ReliOn (Wal-Mart)	human	Novo Nordisk, Inc.	clear
INTERMEDIATE-ACTING				
NPH	Humulin N*	human	Eli Lilly and Company	cloudy
NPH	Novolin N*, ReliOn (Wal-Mart)	human	Novo Nordisk, Inc.	cloudy
LONG-ACTING				
insulin glargine	Lantus	analog	Sanofi-Aventis	clear
MIXTURES				
70% NPH/30% regular	Humulin 70/30*	human	Eli Lilly and Company	cloudy
70% NPH/30% regular	Novolin 70/30*†, ReliOn (Wal-Mart)	human	Novo Nordisk, Inc.	cloudy
75% lispro protamine/ (NPL) 25% lispro	Humalog Mix 75/25*	analog	Eli Lilly and Company	cloudy
70% aspart protamine/ 30% aspart	NovoLog Mix 70/30*†	analog	Novo Nordisk, Inc.	cloudy

*Available in prefilled, disposable pens or cartridges for reusable pens (see pages RG32 and RG34). †Note difference between Novolin 70/30 (70% NPH/30% regular) and NovoLog Mix 70/30 (70% aspart-protamine/30% rapid-acting aspart).

HUMAN & ANALOG INSULIN: TIME OF ACTION

Insulin	Onset	Peak (hours)	Duration (hours)
lispro, aspart	<15 minutes	1–2	3–4
regular	0.5–1 hour	2–3	3–6
NPH	2–4 hours	4–10	10–16
glargine	2–4 hours	peakless	20–24

LESS COMMONLY USED INSULINS

Generic Name	Brand Name	Form/source	Manufacturer
regular	Humulin R, U-500	human	Eli Lilly and Company
50% NPH/50% regular	Humulin 50/50	human	Eli Lilly and Company

Humulin R, U-500 is used in the rare patient who is extremely insulin resistant. Otherwise in the United States, insulin is standardized to U-100 (100 units per cc). U-40 insulin is used in some countries and requires syringes designed for that strength of insulin.

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that you mix regular and lente or ultralente, be sure to take the injection immediately after mixing. Problems are more likely to occur if the mixture is allowed to sit. The interval between mixing and administration should be standardized for more predictable results.

Additives

All insulins have added ingredients. These prevent bacteria from growing and help maintain a neutral balance between acids and bases.

In addition, intermediate- and long-acting insulins also contain ingredients that prolong their actions.

In some rare cases, the additives can bring on an allergic reaction.

Consumer Advice

Convenience. In selecting a pharmacy for purchasing your insulin and diabetes supplies, consider one that is close to you and open during the hours you want to shop.

Service. Those who order insulin by mail should consider the effect of shipping during hot summer months in the South or freezing winter months in the North. Ask the distributor how the bottles will be kept cool and inspect the bottles carefully when they arrive.

If you choose to use a local pharmacy, look for one that makes deliveries. This can be helpful when you are ill or busy.

Professional pharmacist. Use a store where a pharmacist is available, and get to know him or her. Make sure the pharmacist will take an interest in your medical needs, be available to answer questions, and tell you what problems to watch for.

Check labels. Don't just ask for "NPH insulin"; look at the full brand name, strength, and kind. In fact, you might bring a used bottle with you to make sure you get the same exact insulin you got before. Then, before you pay, check the insulin label to make sure you have the correct insulin and the correct directions.

Expiration date. Make sure you will be using all the insulin you are buying before its expiration date.

Quantity purchases. Inquire whether buying more than one bottle of insulin at a time would be cheaper than buying it by the bottle. Of course, keep the expiration date in mind.

Keep alert. On the rare occasion that insulin lots must be recalled, check to see if the control number on any of your bottles matches that of the recalled lot.

Price. It does pay to shop around for your insulin. Prices can vary by several dollars a bottle depending on where it's sold. (Note: Don't switch brands or types of insulin without your doctor's advice.) However, it is important to get all of your prescriptions at one pharmacy to ensure that there is one central source for all your medications.

Storage And Safety

Although manufacturers recommend storing your insulin in the refrigerator, injecting cold insulin can sometimes make the injection more painful. To counter that, many providers recommend storing the bottle of insulin you are using at room temperature. Most believe that insulin kept at room temperature will last about a month.

Remember, though, if you buy more than one bottle at a time—a possible money-saver—store the extra bottles in the refrigerator. Then, take out the bottle ahead of time so it is ready for your next injection.

Don't store insulin at extreme temperatures. Never store insulin in the freezer, direct sunlight, or the glove compartment of a car.

Before you use any insulin, especially if you have had it awhile, check the expiration date. Don't use any insulin beyond its expiration date. And examine the bottle closely to make sure the insulin looks normal before you draw the insulin into the syringe. If you use regular, insulin aspart, insulin lispro, or insulin glargine, make sure the insulin is clear. Check for particles or discoloration of the insulin. If you use NPH, ultralente, or lente, check for "frosting" or crystals in the insulin or on the inside of the bottle, or for small particles or clumps in the insulin.

If you find any of these in your insulin, do not use it, and return the unopened bottle to the pharmacy for exchange or refund.