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), insulin aspart (NovoLog by Novo Nordisk), and insulin glulisine (Apidra) begin to work about 15 minutes or less after they are injected, peak in about an hour, and continue to work for 2 to 4 hours. (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, insulin aspart, or insulin glulisine.

Also, because these insulins leave the bloodstream quickly, there is less chance of hypoglycemia (low blood glucose) several hours after the meal. Insulin lispro, insulin aspart, and insulin glulisine are only available by prescription. All 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).

**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. NPH is an intermediate-acting insulin, and it is often used in combination with regular insulin. (See tables, page RG15.)

**Long-acting** insulins insulin glargine (trade name Lantus) and insulin detemir (trade name Levemir) have 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. 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.

Insulin detemir is a new, long-acting insulin that lasts up to 24 hours. It is a clear, ready-to-inject solution that can lower blood glucose with a decreased risk of hypoglycemia.

Many people use both rapid- or short-acting insulins and insulin glargine or insulin detemir in an effort to mimic the body’s natural insulin secretion. Because insulin glargine has no peak, injections of rapid-acting or short-acting regular 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. Humalog 50/50 and Humulin 50/50 are additional mixtures that are available. Likewise, a mixture of 70 percent insulin aspart protamine and 30 percent insulin aspart (NovoLog Mix 70/30) is available.

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 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 the 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...
# Insulins Commonly Used in the United States (As of Sept. 1, 2006)

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
<th>Form</th>
<th>Manufacturer</th>
<th>Cloudy or Clear</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RAPID-ACTING</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>insulin glulisine</td>
<td>Apidra*</td>
<td>analog</td>
<td>Sanofi-Aventis</td>
<td>clear</td>
</tr>
<tr>
<td>insulin lispro</td>
<td>Humalog*</td>
<td>analog</td>
<td>Eli Lilly and Company</td>
<td>clear</td>
</tr>
<tr>
<td>insulin aspart</td>
<td>NovoLog*</td>
<td>analog</td>
<td>Novo Nordisk, Inc.</td>
<td>clear</td>
</tr>
<tr>
<td><strong>REGULAR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>regular</td>
<td>Humulin R</td>
<td>human</td>
<td>Eli Lilly and Company</td>
<td>clear</td>
</tr>
<tr>
<td>regular</td>
<td>Novolin R*, ReliOn (Wal-Mart)</td>
<td>human</td>
<td>Novo Nordisk, Inc.</td>
<td>clear</td>
</tr>
<tr>
<td><strong>INTERMEDIATE-ACTING</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPH</td>
<td>Humulin N*</td>
<td>human</td>
<td>Eli Lilly and Company</td>
<td>cloudy</td>
</tr>
<tr>
<td>NPH</td>
<td>Novolin N*, ReliOn (Wal-Mart)</td>
<td>human</td>
<td>Novo Nordisk, Inc.</td>
<td>cloudy</td>
</tr>
<tr>
<td><strong>LONG-ACTING</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>insulin detemir</td>
<td>Le vemir*</td>
<td>analog</td>
<td>Novo Nordisk, Inc.</td>
<td>clear</td>
</tr>
<tr>
<td>insulin glargine</td>
<td>Lantus*</td>
<td>analog</td>
<td>Sanofi-Aventis</td>
<td>clear</td>
</tr>
<tr>
<td><strong>MIXTURES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50% lispro protamine, 50% insulin lispro</td>
<td>Humalog Mix 50/50*</td>
<td>analog</td>
<td>Eli Lilly and Company</td>
<td>cloudy</td>
</tr>
<tr>
<td>70% NPH/30% regular</td>
<td>Humalog 70/30*</td>
<td>human</td>
<td>Eli Lilly and Company</td>
<td>cloudy</td>
</tr>
<tr>
<td>70% NPH/30% regular</td>
<td>Novolin 70/30†, ReliOn (Wal-Mart)</td>
<td>human</td>
<td>Novo Nordisk, Inc.</td>
<td>cloudy</td>
</tr>
<tr>
<td>75% lispro protamine/ (NPL) 25% lispro</td>
<td>Humalog Mix 75/25†</td>
<td>analog</td>
<td>Eli Lilly and Company</td>
<td>cloudy</td>
</tr>
<tr>
<td>70% aspart protamine/ 30% aspart</td>
<td>NovoLog Mix 70/30†</td>
<td>analog</td>
<td>Novo Nordisk, Inc.</td>
<td>cloudy</td>
</tr>
</tbody>
</table>

*Available in prefilled, disposable pens or cartridges for reusable pens. Apidra is available in pens, pumps, or infusion sets. (Insulin pens are listed on pages RG28 and RG29.) †Note difference between Novolin 70/30 (70% NPH/30% regular) and NovoLog Mix 70/30 (70% aspart-protamine/30% aspart).

## Human & Analog Insulin: Time of Action

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Onset</th>
<th>Peak (hours)</th>
<th>Duration (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lispro, aspart, glulisine</td>
<td>&lt;15 minutes</td>
<td>1–2</td>
<td>3–4</td>
</tr>
<tr>
<td>regular</td>
<td>0.5–1 hour</td>
<td>2–3</td>
<td>3–6</td>
</tr>
<tr>
<td>detemir</td>
<td>0.8–2 hours</td>
<td>relatively flat</td>
<td>up to 24</td>
</tr>
<tr>
<td>NPH</td>
<td>2–4 hours</td>
<td>4–10</td>
<td>10–16</td>
</tr>
<tr>
<td>glargine</td>
<td>2–4 hours</td>
<td>peakless</td>
<td>20–24</td>
</tr>
</tbody>
</table>
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.

U-500 insulin can be purchased in the United States, but it is rarely used. It is available by prescription only.

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, insulin lispro, and insulin glulisine. Please note that mixtures containing insulin aspart, insulin lispro, or insulin glulisine should be injected immediately after mixing and that these insulins should be mixed with NPH only under the advice and instruction of your doctor.

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
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Signature Date
Send all payments w/orders to: American Diabetes Association® General Membership, PO Box 363, Mt. Morris, IL 61054-0363 XADF71
LESS COMMONLY USED INSULINS

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
<th>Form</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>regular</td>
<td>Humulin R, U-500</td>
<td>human</td>
<td>Eli Lilly and Company</td>
</tr>
<tr>
<td>50% NPH/50% regular</td>
<td>Humulin 50/50</td>
<td>human</td>
<td>Eli Lilly and Company</td>
</tr>
</tbody>
</table>

*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.

OTHER INJECTABLE DRUGS

<table>
<thead>
<tr>
<th>Drug Name (generic)</th>
<th>Manufacturer</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Byetta (exenatide)</td>
<td>Amylin Pharmaceuticals and Eli Lilly and Company</td>
<td>For use only by those with type 2 diabetes who take metformin, a sulfonylurea, or both. Enhances insulin secretion in the presence of high blood glucose. Available in 5- and 10-microgram pens. <strong>When to take:</strong> twice daily within 60 minutes before the morning and evening meals. <strong>Side effects:</strong> nausea, vomiting, and hypoglycemia. May need to reduce sulfonylurea dose.</td>
</tr>
<tr>
<td>Symlin (pramlintide acetate)</td>
<td>Amylin Pharmaceuticals</td>
<td>Prescription-only injectable drug for people with diabetes (type 1 or type 2) who take mealtime insulin. It helps keep after-meal glucose levels from going too high. <strong>When to take:</strong> Take before a meal that has at least 250 calories or (&gt; 30 \text{ g} ) of carbohydrates. Cannot be mixed with insulin so it must be taken as a separate shot. When starting Symlin, it is recommended to reduce mealtime insulin by half. <strong>Side effects:</strong> hypoglycemia and nausea. To limit nausea, start with a low dose.</td>
</tr>
</tbody>
</table>

*Text continued from page RG16*

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, insulin glargine, insulin glulisine, or insulin detemir, make sure the insulin is clear. Check for particles or discoloration of 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. △