

# Type 1 Diabetes

## What is Type 1 diabetes?

### What is the difference between Type 1 and Type 2 diabetes?

#### *Type 1*

Type 1 diabetes occurs when the body stops producing insulin. Insulin is the hormone which allows glucose (sugar) to enter cells to providing them with energy. A buildup of glucose in bloodstream causes a variety of short-term and long-term problems which will be explained in this paper.

Within the pancreas are cells called beta cells, which are responsible for producing insulin. In individuals with Type 1 diabetes, the pancreas no longer produces insulin because white blood cells of the immune system attack and destroy these beta cells. The cause for this is not yet fully understood, but is assumed to be due to a combination of genetic and environmental causes.

Only 5-10% of Americans diagnosed with diabetes have Type 1 diabetes.<sup>1</sup>

#### *Type 2*

In Type 2 diabetes, the body resists the effects of insulin. The body produces normal or even excessive amounts of insulin for a time, and then fails to produce enough insulin. Both Type 1 and Type 2 diabetes deal with increased blood glucose levels.

### What are the conditions associated with Type 1 diabetes?

#### *Hypoglycemia*

Hypoglycemia is low blood glucose. Hypoglycemia will occur in all individuals who have diabetes, no matter how well they are controlling their blood glucose level.

Symptoms of hypoglycemia vary from person to person, but common reactions are tiredness, shakiness, dizziness, hunger, headaches, sudden moodiness or behavior changes (such as a higher propensity to cry), or confusion. It is important to treat hypoglycemia quickly, because if glucose level continues to drop the individual will faint. If this occurs, the victim will need immediate attention such as an injection with an emergency glucagon pen, or hospital treatment.

The quickest way to bring blood sugar back to normal is ingestion of sugar. Fruit juice or hard candies are commonly used for this. Diabetics should be sure to have some form of sugar with them at all times in case their blood sugar drops. Sugar ingestion can only be used if the patient is conscious.

## Hyperglycemia

Hyperglycemia is high blood glucose. Hyperglycemia will happen to all individuals who have diabetes, no matter how well they are controlling their blood glucose level. For type 1 diabetes, hyperglycemia occurs when the body does not have enough insulin, by eating more than planned, or by exercising less than planned.

Without insulin to keep moving glucose from the bloodstream to the cells of the body, glucose levels increase and the cells of the body do not receive enough energy. If the blood glucose level gets too high, a condition called *ketoacidosis* (diabetic coma) could occur. Ketoacidosis is life-threatening; if it occurs, immediate treatment is necessary. Also, constantly high levels of blood glucose speed up the occurrence or increase the likelihood of complications from type 1 diabetes.

Hyperglycemia can usually be avoided by carefully dosing for the amount of food eaten. However, sometimes this will still occur. Stress and illness could also affect blood glucose levels and cause hyperglycemia.

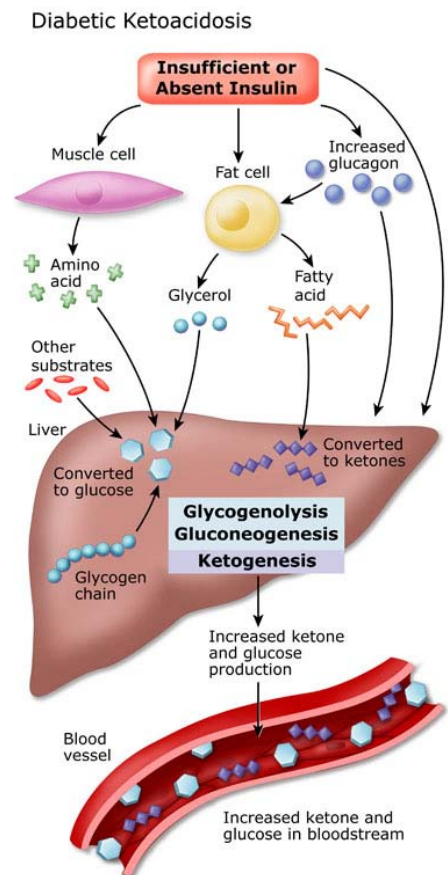
## Diabetic Ketoacidosis

Diabetic ketoacidosis is an incredibly dangerous condition which can occur when blood glucose is higher than 240 mg/dl (milligrams per deciliter). Ketoacidosis requires immediate treatment at a hospital.

As glucose levels increase, fat cells release fat to be used as energy. The liver breaks down these fats and releases ketones and ketoacids as an alternative form of energy. This is the normal reaction of the body to situations where is not enough energy for metabolism to be maintained, such as during dieting, fasting, or even starvation. The process is carefully controlled and regulated by the body.

However, for type 1 diabetics, because there is not enough insulin, the fat cells continually pump out fat which the liver continually converts into more ketones and ketoacids. The increased levels of these alternative fuels alter blood pH, making it too low (acidotic). This perpetuating cycle essentially poisons the body.

It is important to remember that while exercise can help bring high blood glucose levels down, exercising when ketones are present makes the situation much worse, as it demands the body to burn more energy, and thus create more ketones and ketoacids. Those who develop ketoacidosis should contact their healthcare provider or visit the nearest emergency room immediately.



## How do you monitor and control your blood glucose level?

All Type 1 diabetics need to have a kit, such as the one pictured here. Included in this kit should be a *glucose monitor* (commonly referred to as a *glucose meter* or simply *meter*) and *test strips* to calculate blood sugar levels, as well as a *lancet* to puncture the skin to retrieve a blood sample. Type 1 diabetics will also need an *insulin pen* or *pump* to dose insulin for meals and snacks, and to help control hyperglycemia.



### Insulin

There are a wide variety of types of insulin. In fact, there are 20 different types of insulin sold in the United States.<sup>2</sup> Insulin comes in four main categories: *rapid-acting*, *regular/short acting*, *intermediate acting*, and *long-acting*. The differences between these categories are the *onset*, *peaktime*, and *duration* of the insulin.

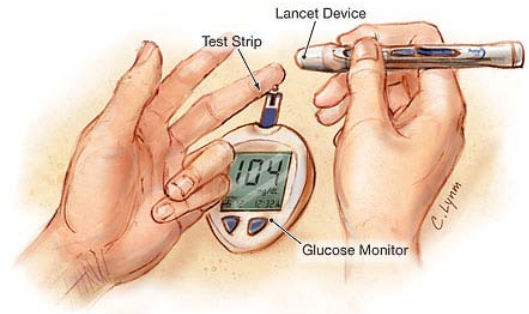
*Onset* is the length of time it takes the insulin to reach the bloodstream and begin to lower blood glucose levels. *Peaktime* is the time after injection when the insulin reaches its maximum strength (*Long-lasting* insulin tends to be a more stable rate of lowering blood glucose than other types of insulin). *Duration* is the length of time the insulin continues to have effect.

Insulin Type	Time until Onset	Time until Peaktime	Duration
Rapid-Acting	5 minutes	1 hour	2-4 hours
Regular/Short-Acting	30 minutes	2-3 hours	3-6 hours
Intermediate-Acting	2-4 hours	4-12 hours	12-18 hours
Long-acting	6-10 hours	N/A	20-24 hours

Until the 1980's, animal insulin, particularly from pigs and cows, was used. Today types of insulin are produced by genetically engineered bacteria in laboratories. These insulins have additives to prevent bacteria growth, stabilize acids or bases, and increase duration. In rare situations individuals may have allergic reactions to these additives. The manufacture of beef insulin in the United States ceased in 1998, and the manufacture of pork insulin was ceased in 2006. Animal insulin is no longer sold in the United States, but up to a six month supply may be imported for personal use under FDA guidance. The importation of these insulins is heavily regulated to guard against bovine spongiform encephalopathy (BSE) or "mad cow disease".<sup>3</sup> Most individuals with diabetes use one or several forms of manufactured insulin.

## Lancets

Lancets are the devices used to puncture the skin in order to gain a blood sample. The main difference between lancets is their *gauge*, or the size of the point of the needle. The larger the gauge is, the smaller the needle point. For example, common gauge readings are “28G” or “30G”. Smaller needles hurt less, but may not provide enough blood.



## Glucose Monitors and Test Strips

There are at least 25 different commercially available meters.<sup>4</sup> These vary in size and capabilities in terms of memory, amount of blood needed, cost, and other factors. Most meters require blood from fingertips, but newer models can use other locations. A test strip is inserted into the meter, and after breaking the skin with a lancet, the edge of the test strip is set on the drop of blood. It only takes the meter a few seconds to give a reading on the blood glucose level.

## Pumps

Pumps help give Type 1 diabetics better control over blood sugar levels because their proper use more closely mimics the natural function of the pancreas. A pump injects insulin into the body through a catheter which is inserted just under the skin of the abdomen and then taped into place. The pump itself is worn on a belt or placed in a pocket, and manually injects insulin as directed. Pumps enable doses to be spread out over time instead of being injected in a single dose, and also can constantly deliver very low doses of insulin. Pumps also allow for increasing or decreasing insulin at certain times of day, to compensate for inconsistencies such as the dawn effect. The American Diabetes Association gives a very comprehensive listing of advantages of disadvantages of pumps. Most diabetics find that pumps give them much more control and freedom, and that the advantages of a pump outweigh the costs.



Advantages of Pumps	Disadvantages of Pumps
---------------------	------------------------

eliminates individual insulin injections	Can cause weight gain
eliminates unpredictable effects of intermediate- or long-acting insulin	Can cause diabetic ketoacidosis if your catheter comes out and you don't get insulin for hours
often improve A1C Test results	Can be expensive
allow you to exercise without having to eat large amounts of carbohydrates	Can be bothersome since you are attached to the pump most of the time
makes adjusting for hyperglycemia easier	Can require a hospital stay or maybe a full day in the outpatient center to be trained
allow you to be flexible about when and what you eat	
reduces severe low blood glucose episodes	
deliver insulin more accurately than injections	
usually results in fewer large swings in your blood glucose levels	

### *A1C Test*

A1C tests, also known as glycated hemoglobin or HbA1c. Hemoglobin from red blood cells can link (glycate) with extra glucose in the blood stream. As red blood cells die they are constantly being replaced with new cells that have not been glycated; a red blood cell's life span is about 120 days. Measuring the percentage of red blood cells which are glycated gives a fairly good indication of how well blood sugar has been managed over the past 120 days. The average percentage is around 5%, but if blood glucose levels have been managed poorly, it could be as high as 25%.<sup>5</sup>

## **What complications can arise from Type 1 Diabetes?**

### *Heart*

Type 1 diabetics also have an increased risk of heart attack, stroke, and complications from poor circulation. In fact, two out of three people with diabetes die from heart disease or strokes.<sup>6</sup> Many of the risk factors are the same as for those without diabetes, but diabetics are at increased risk. Diabetics should be careful to keep their blood glucose levels under control to decrease their risk of heart disease and stroke. People with diabetes also need to be aware of peripheral arterial disease (PAD), where block vessels to the legs become blocked or narrow, which affects one out of every three individuals with diabetes.<sup>7</sup>

### *Eye*

Most eye complications developed as a result of Type 1 diabetes are minor or controllable if diagnosed quickly. People with diabetes are 40% more likely to develop glaucoma and 60% more likely to develop cataracts.<sup>8</sup> Type 1 diabetics also need to have their eyes checked for both nonproliferative and proliferative retinopathy. These are the overarching terms for retina disorders caused by diabetes. Blood vessels in the retina become blocked, and new ones which form may leak blood which blocks vision, a condition called vitreous hemorrhage.

## Nerve

About half of all people with diabetes have some form of nerve damage.<sup>9</sup> When this damage is caused by diabetes it is called diabetic neuropathy. Diabetic neuropathy is more likely in those who have had the diabetes for several years. There are several different types of diabetic neuropathy. The two most common types are *sensorimotor neuropathy* and *autonomic neuropathy*

*Sensorimotor neuropathy* causes pain, tingling, numbness, or similar sensations in the feet and hands. For this reason, it is also known as peripheral neuropathy. Another form of diabetic neuropathy is *autonomic neuropathy*. This much more serious condition can affect nerves in the digestive system, urinary tract, sex organs, heart and blood vessels, sweat glands, and eyes. Most symptoms can be treated on an individual basis, such as through dietary changes or medications.

Keeping blood glucose levels in their target range can decrease the risk of diabetic neuropathy.

## Skin

Up to one-third of individuals at some point in their lives develop a skin disorder caused or affected by their Type 1 diabetes.<sup>10</sup> Conditions for which diabetics are at higher risk include bacterial infections, fungal infections, and itching. Also, diabetic dermopathy, necrobiosis lipoidica diabetorum, diabetic blisters, and eruptive xanthomatosis are specific to those with diabetes.

Diabetic dermopathy is the appearance of light brown patches, usually on the front of the legs. These are caused by changes in small blood vessels caused by diabetes. These patches are harmless and painless, and do not need to be treated.

Necrobiosis lipoidica diabetorum is a rare condition similar to diabetic dermopathy. However, the spots are dull red and may be itchy and painful. Necrobiosis is only a problem if the sores break open.

## Bibliography

"All About Diabetes." American Diabetes Association. American Diabetes Association. 2 Mar. 2008 <[www.diabetes.org](http://www.diabetes.org)>.

"Frequently Asked Questions About Importing Beef or Pork Insulin for Personal Use." Center for Drug Evaluation and Research. 27 June 2007. U.S. Food and Drug Administration. 14 Apr. 2008 <<http://www.fda.gov/cder/drug/beefandporkinsulin/default.htm#Q-2>>.

"Glucose Meters and Diabetes Management." FDA Diabetes Information. 14 June 2005. U.S. Food and Drug Administration. 14 Apr. 2008 <<http://www.fda.gov/diabetes/glucose.html#3>>.

"Ketones." Diabetes Teaching Center. 21 Sept. 2007. University of California, San Francisco. 2 Mar. 2008 <[http://dtc.ucsf.edu/understanding\\_dm/ketones.php](http://dtc.ucsf.edu/understanding_dm/ketones.php)>.

"The Pancreas, Insulin, and Diabetes." Diabetes Manuel. 11 Jan. 2008. The Children's Hospital At Westmead. 2 Mar. 2008 <[http://www.rch.org.au/diabetesmanual/manual.cfm?doc\\_id=2729](http://www.rch.org.au/diabetesmanual/manual.cfm?doc_id=2729)>.

"Type 2 Diabetes." MayoClinic.Com. 24 Oct. 2007. Mayo Clinic. 2 Mar. 2008 <<http://www.mayoclinic.com/health/type-2-diabetes/DS00585>>.

## Citations

1. American Diabetes Association, *All About Diabetes*, [www.diabetes.org](http://www.diabetes.org)
2. American Diabetes Association, *About Insulin and other drugs*, [www.diabetes.org](http://www.diabetes.org)
3. Center for Drug Evaluation and Research,  
<http://www.fda.gov/cder/drug/beefandporkinsulin/default.htm#Q-2>
4. FDA Diabetes Information, <http://www.fda.gov/diabetes/glucose.html#3>
5. American Diabetes Association, *A1C Test*, [www.diabetes.org](http://www.diabetes.org)
6. American Diabetes Association, *All About Stroke*, [www.diabetes.org](http://www.diabetes.org)
7. American Diabetes Association, *All About Peripheral Arterial Disease*, [www.diabetes.org](http://www.diabetes.org)
8. American Diabetes Association, *Eye Complications*, [www.diabetes.org](http://www.diabetes.org)
9. American Diabetes Association, *Diabetic Neuropathy (Nerve Damage) and Diabetes*,  
[www.diabetes.org](http://www.diabetes.org)
10. American Diabetes Association, *Skin Complications*, [www.diabetes.org](http://www.diabetes.org)