understanding diabetes

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You'll find it easier to manage your diabetes if you have a good understanding of what's going on in your body. This section explains how diabetes interferes with your body's normal processes and how the disease can affect your health.

In this section...

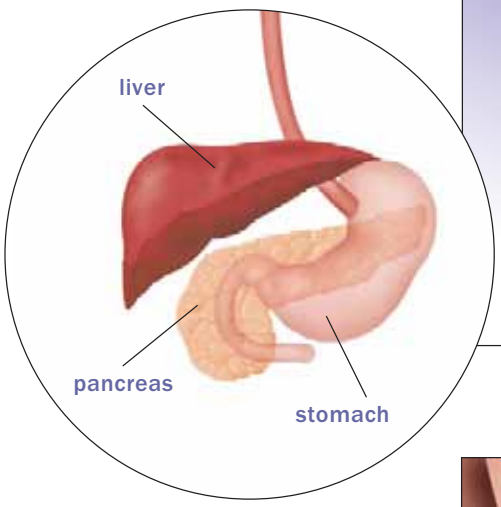
How things normally work

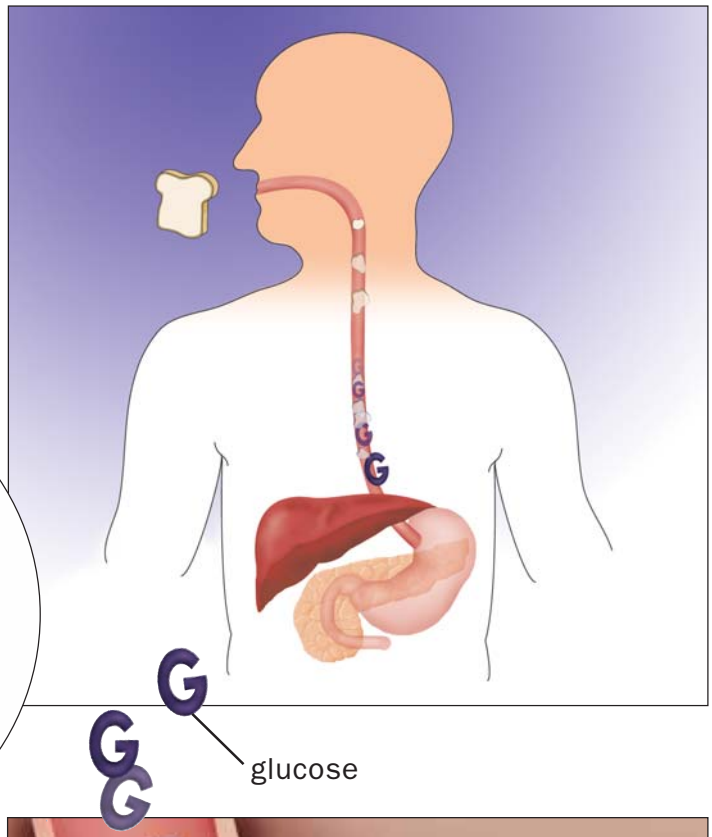
Diabetes affects your ability to turn food into energy. To really understand this impact of diabetes, it helps to know how your body does this when you DON'T have diabetes.

From food to fuel

1

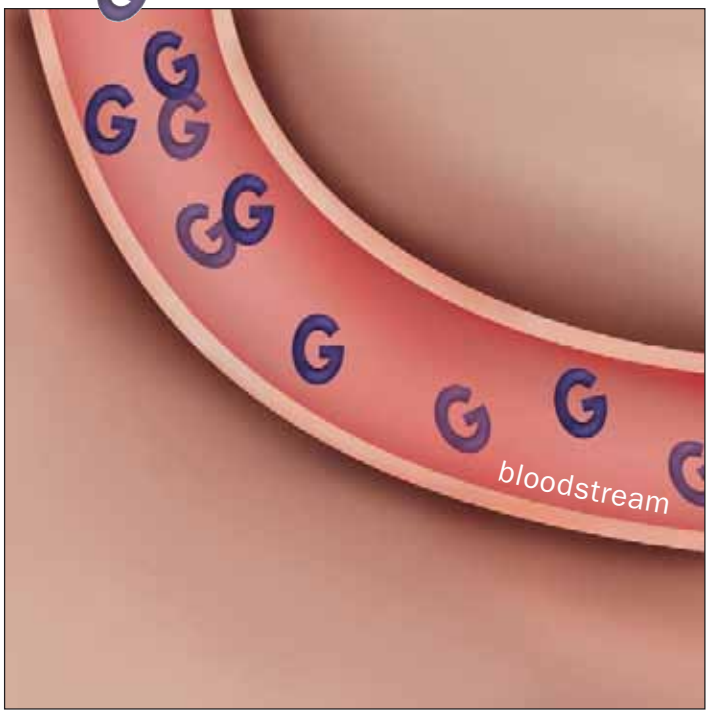
When you eat, your body breaks food down into glucose. **Glucose** is a type of sugar that is your body's main source of energy.

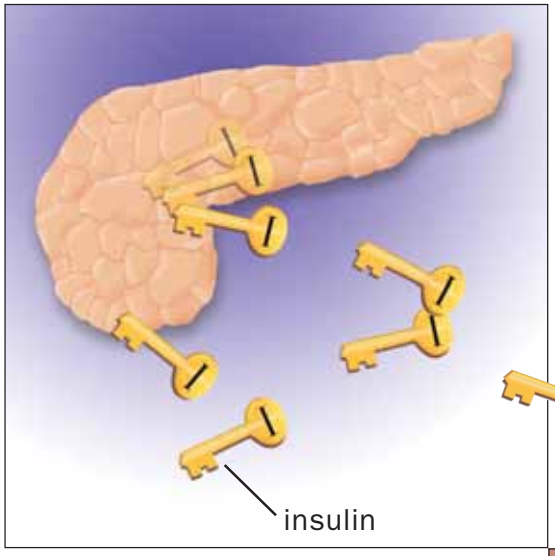




2

Glucose from food is absorbed into the bloodstream. Your **blood glucose**—the amount of glucose in your blood—begins to rise.



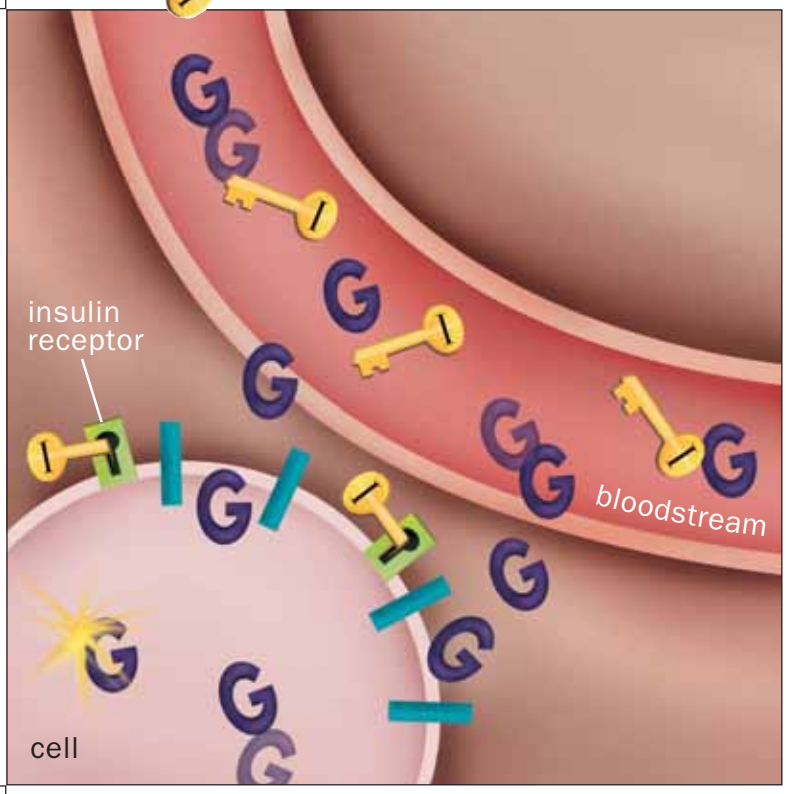


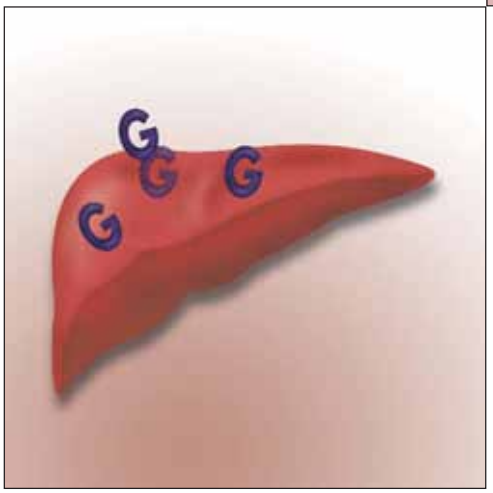
3

As blood glucose rises, the body sends a signal to the pancreas, which releases a hormone called **insulin.**

4

Insulin allows the glucose to enter the body's cells. Here's how: Acting as a key, insulin binds to a place on the cell wall called an **insulin receptor,** unlocking the cell so that glucose can pass from the bloodstream into the cell. Once inside the cell, most of the glucose is used for energy right away.





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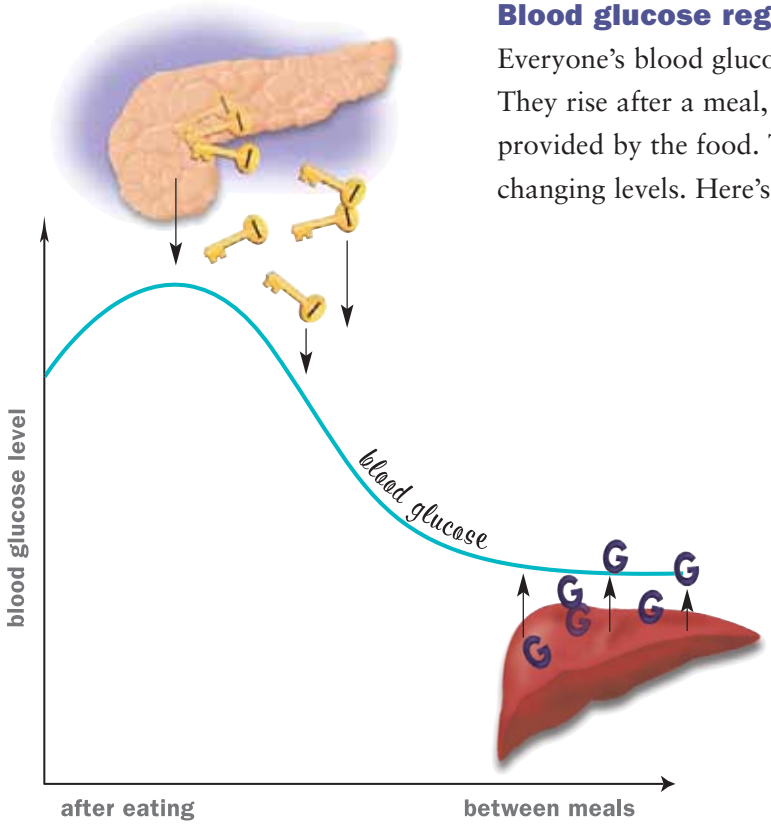
Some glucose is stored by the liver for later use.

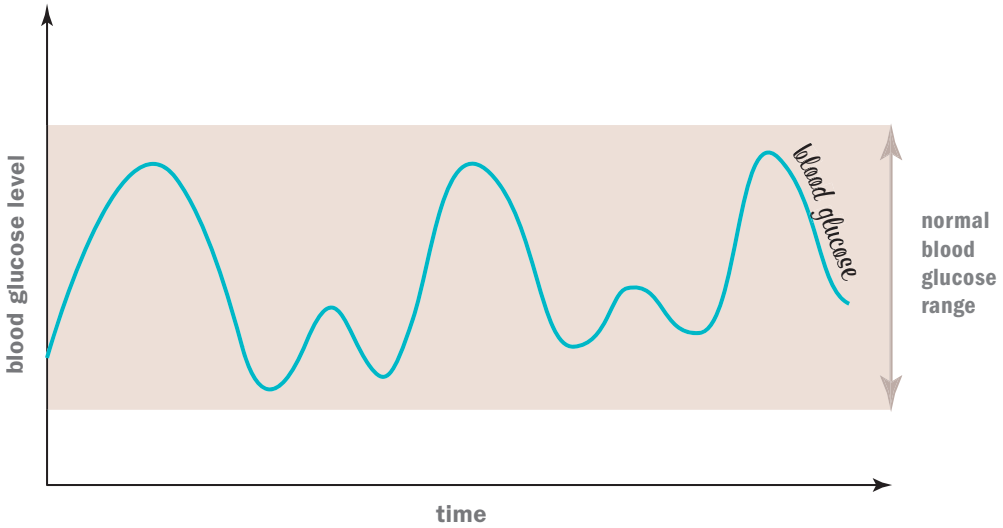


Blood glucose regulation

Everyone's blood glucose levels go up and down throughout the day. They rise after a meal, then drop again as the body uses up the glucose provided by the food. The pancreas and liver help regulate these changing levels. Here's how it normally works:

- **As your blood glucose starts to rise—as it does after you eat—**the pancreas senses this rise in blood glucose. It responds by making insulin and releasing it into the bloodstream to help move the glucose into your cells where it's used for energy.
- **When your blood glucose is low—as can happen when you don't eat—**the liver senses this drop, and responds by releasing glucose into the bloodstream.

With insulin helping glucose get into the cells, and the liver preventing blood glucose from dropping too low, blood glucose levels remain within normal limits.



What happens with diabetes?

When you have diabetes, your body still breaks down the foods you eat into glucose. The problem lies in what happens later, when your body tries to use the glucose.

Starving cells—and high blood glucose

With diabetes, your body has trouble getting glucose out of your bloodstream and into your cells to be used for energy. The reasons for this depend on the type of diabetes you have. Your pancreas may make little or no insulin. Or, your body's cells may not respond properly to the insulin in your blood. Or you may have a combination of these problems. Still, without the right amount of properly working insulin, the end result is the same:

- **Your cells are starved for energy**—even though your blood contains large amounts of glucose. Right away you feel fatigue, hunger, and other symptoms.
- **Your blood glucose is too high.** Unused glucose builds up in your bloodstream. Over time, high levels of blood glucose can damage your nerves and blood vessels—and cause a variety of health complications.

DIABETES IN A NUTSHELL

Diabetes is a **metabolism** disorder—a problem with the way your body uses digested food for growth and energy.

Diabetes mellitus: what's in the name?

The medical name for diabetes is **diabetes mellitus,** often abbreviated "DM." It comes from these words:

DIABETES =
Greek for "siphon."

A reference to the thirst and frequent urination that can accompany untreated diabetes—as if people are like siphons, water flowing in and out.

MELLITUS =
Latin for "honey" or "sweet."

A reference to the glucose (sugar) in the urine of people with uncontrolled diabetes.

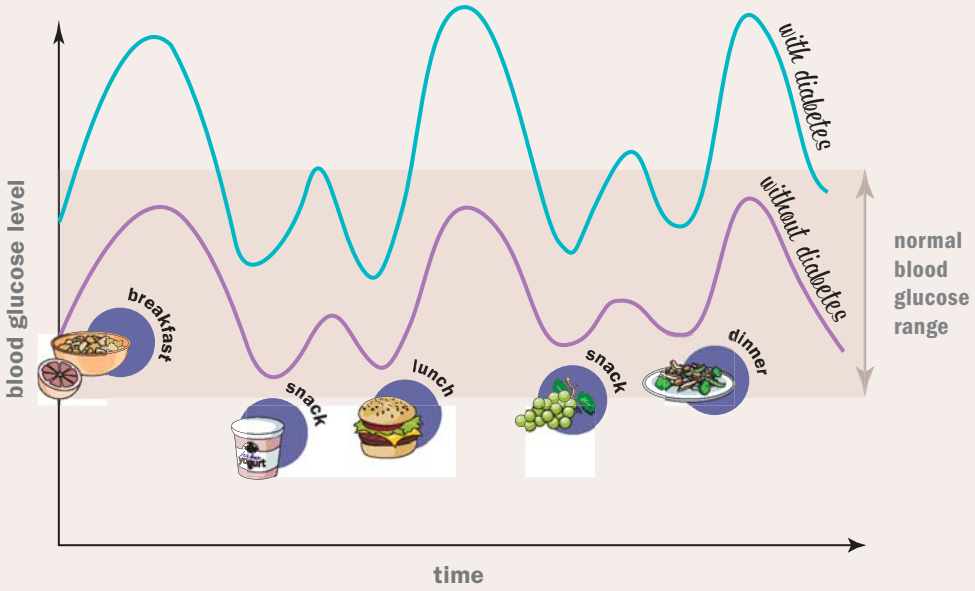
This ancient name is fitting for a disease that was first identified more than 2,000 years ago.

Diabetes and your blood glucose levels

Here's a comparison of normal blood glucose levels—and those in a person with diabetes:

In a person **with diabetes,** blood glucose levels tend to run high. They may also vary dramatically throughout the day.

In a person **without diabetes,** blood glucose levels usually stay within normal ranges despite ups and downs throughout the day.



Keep in mind that there's a lot of variation from person to person and day to day. Still, generally speaking, when you have diabetes, your treatment needs to help you smooth out the peaks and valleys in your blood glucose levels and lower your average blood glucose level. This helps make sure your blood glucose stays in your target range.

MYTH

"Diabetes comes and goes."

TRUTH

Unfortunately not. Although diabetes symptoms may come and go—and your condition may change over time—the underlying disease is always there. It can't be cured, only managed.

That's why you need to stick to your diabetes self-management plan and stay in contact with your healthcare providers. If you do need an adjustment to your plan, they can help you.

Types of diabetes and other metabolic disorders

There are two main types of diabetes, **type 1** and **type 2**. Two other conditions—**gestational diabetes** and **pre-diabetes**—also affect your blood glucose. So can the **metabolic syndrome**, a condition that often contributes to the development of diabetes.

These conditions can have different causes, and they may behave differently and require different treatments. That's why it's important to know exactly what you've been diagnosed with, and how it affects your body.

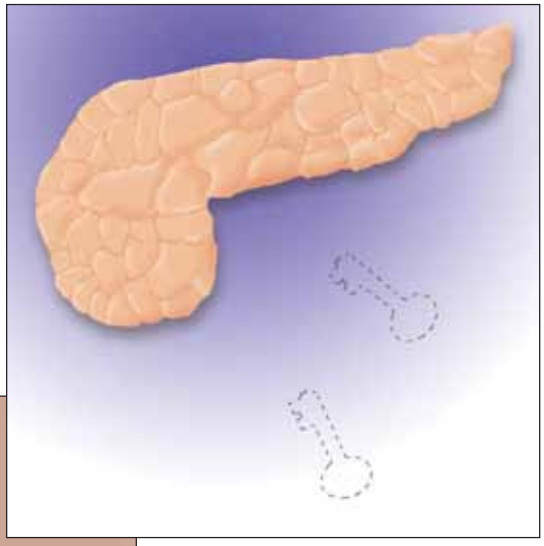
Type 1 diabetes

If you have **type 1 diabetes**, your pancreas has stopped—or nearly stopped—making insulin. This is sometimes called **insulin deficiency.**

HOW COMMON IS TYPE 1—AND CAN IT BE PREVENTED?

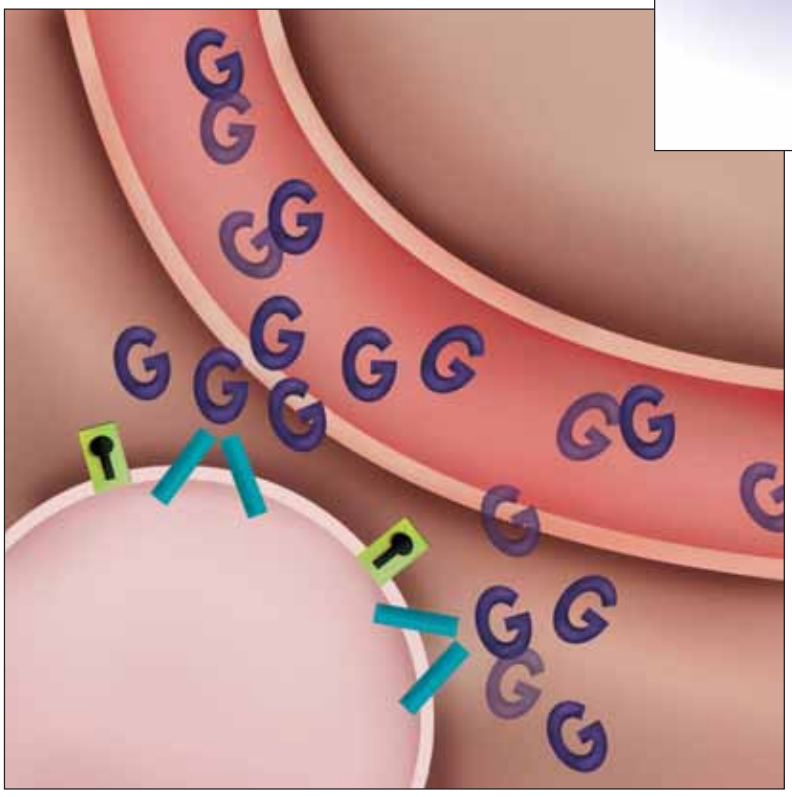
According to the National Institutes of Health, one out of every 400 to 500 children or teenagers has type 1 diabetes.

Researchers are studying how and why type 1 happens. Right now there is no known way to prevent it.



▲ Your pancreas has stopped—or nearly stopped—producing insulin.

When you have type 1 diabetes...



◀ Since you've suddenly lost your insulin "keys," you have no way to unlock your body's cells and allow glucose to enter.

"Type 1 diabetes can be cured with islet cell transplantation surgery." (This is a surgery to implant new insulin-producing cells into the body of a person with type 1 diabetes.)

Although islet cell transplantation currently offers the best hope of cure for people with type 1 diabetes, experts say that there are several serious obstacles to be overcome before it can be considered a true cure for diabetes.

Since 2000, more than 250 transplanted patients have been living without the need for insulin injections. However, these people must take powerful, potentially harmful drugs for the rest of their lives to prevent rejection of the transplanted cells. Another problem is the severe shortage of islets for human transplantation. The good news is that scientists are working hard to solve these problems.

What causes type 1—and who gets it?

Type 1 diabetes occurs when your body's immune system—which is responsible for fighting infection—attacks your own pancreas. When the pancreas cells that produce insulin are destroyed, your body can't make insulin any more.

What causes this destructive autoimmune process? Although scientists are still studying the reasons, it seems that both genetics (inheritance) and environment are factors. Scientists believe that type 1 occurs when something in the environment triggers diabetes in a person who already has a genetic tendency toward the disease.

Type 1 diabetes usually appears suddenly and progresses quickly. It tends to occur in people of normal weight, and can cause a rapid weight loss before it's detected and treated. And although anyone can get type 1, it appears most often in children and young adults, especially those with a strong family history of type 1 diabetes.

How is type 1 treated?

People with type 1 diabetes must take insulin every day—usually several times a day. Most people take insulin by injection (a shot). Others wear a small pump that delivers insulin continuously into their body. People with type 1 also need to follow a meal plan and get regular exercise to help regulate blood glucose levels.

MORE TERMS FOR TYPE 1

Previous names for type 1 diabetes include the following:

- **Juvenile-onset diabetes.** This term came from the fact that type 1 is often diagnosed in children and teens. However, we now know that you can get type 1 at any age.
- **Insulin-dependent diabetes.** This name refers to the fact that people with type 1 MUST take insulin every day. Yet many people with type 2 diabetes also use insulin to control their blood glucose levels.

Type 2 diabetes

Most people with diabetes have **type 2 diabetes.** If you have type 2, you might have one or both of the following problems:

- Your cells don't use insulin properly. This is called **insulin resistance.**
- Your pancreas doesn't produce enough insulin **(insulin deficiency).**

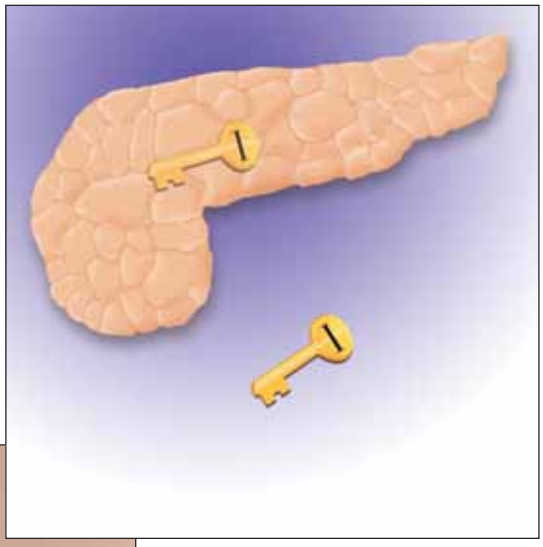
Often when type 2 diabetes is first diagnosed, the problem is insulin resistance. But as the disease progresses, the pancreas may also produce less insulin. Unlike type 1 diabetes, type 2 usually comes on gradually.

IN THE MAJORITY

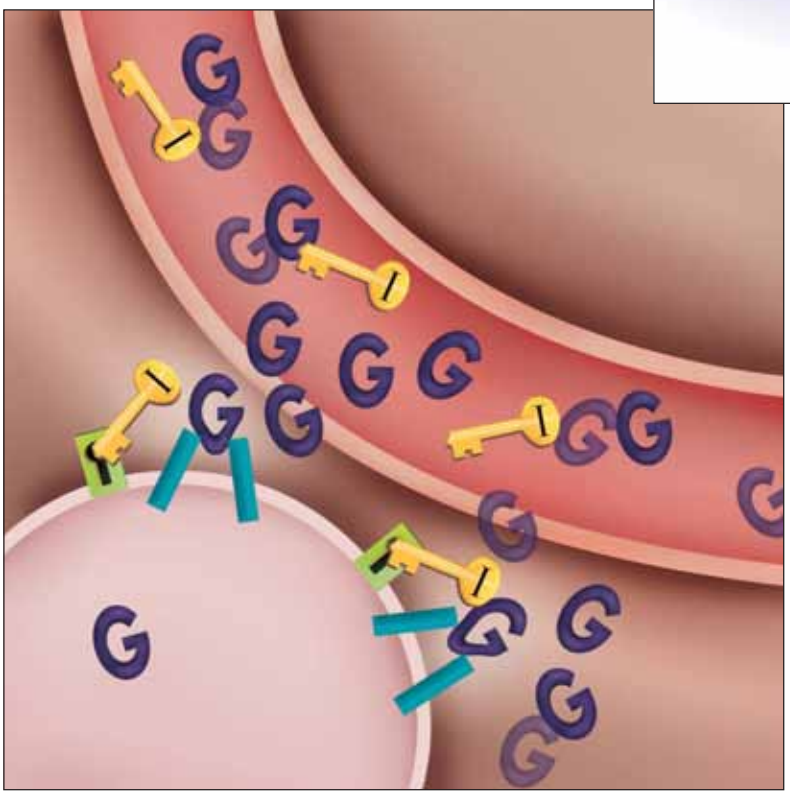
About 90% to 95% of all people with diabetes have type 2. That means that right now, more than 18 million Americans have type 2—many of whom don't even know it.

When you have type 2 diabetes...

Your cells may not use insulin properly. The insulin can't fully "unlock" the cells to allow enough glucose to enter.



At other times, the pancreas doesn't produce enough insulin. There are too few insulin "keys."



A WEIGHTY ISSUE?

Scientists don't know whether the factors listed at right act independently to increase your risk for type 2 diabetes—or if it's their connection to obesity that matters most.

The issue is complex, as several of these factors tend to go hand-in-hand. For example, you're more likely to gain extra weight if you're older and inactive. And being overweight may contribute to your high blood pressure.

What do we know for sure about risk factors for type 2? How to reduce them. A recent major study has shown that exercising regularly and reducing body weight can go a long way in delaying the onset of type 2 diabetes—and perhaps even preventing it—in people at risk for the disease.

What causes type 2—and who gets it?

No one knows exactly why type 2 diabetes develops in some people. But several factors have been shown to increase your risk of developing type 2 diabetes. For example, scientists have shown that type 2 is more likely to occur in people who:

- **Are overweight.** Being overweight doesn't cause diabetes, but it may trigger it in some people. Having too much body fat promotes insulin resistance. And if you tend to carry your extra weight around your waistline—if you have an "apple-shaped" body—you have a higher risk than people who carry their excess weight on their hips and thighs.

- **Are 45 or older.** Even though type 2 is more common in adults, the disease is seen in more and more children every year. This is probably because more children today are inactive and obese.

- **Are physically inactive.** Inactivity promotes obesity and insulin resistance.

- **Have a parent or sibling with diabetes.** Type 2 diabetes often runs in families. In fact, the genetic link for type 2 is much stronger than it is for type 1 diabetes.

- **Are African American, Native American, Hispanic American, or Pacific Islander.** Because the tendency to develop type 2 may be inherited, your ethnic background is also a factor. People in the groups listed above are at higher risk.

- **Have abnormal cholesterol levels.** For example, you may have high triglycerides, high LDL cholesterol ("bad cholesterol"), or low HDL cholesterol ("good cholesterol") levels.

- **Have had gestational diabetes, or given birth to a baby who weighed more than 9 pounds at birth.** Although gestational diabetes usually goes away when your baby is born, once you've had it, you're at risk for developing type 2 diabetes later in life.

- **Have high blood pressure.** High blood pressure and diabetes often occur together—and are a dangerous combination for your heart and blood vessels.

How is type 2 treated?

Type 2 diabetes is treated with a combination of diet, exercise, and oral medications (pills). In some cases, insulin injections may also be added to the treatment plan to help control blood glucose levels.

MYTH

"You might start out with one type of diabetes—but switch later on."

TRUTH

The type of diabetes you have doesn't change over time—although your treatment might. For example, if you have type 2, you may be able to control it with diet, exercise, and oral medications for some time. Later on, you might need to start taking insulin. But that doesn't mean that your type 2 has developed into type 1 diabetes. Type 1 and type 2 diabetes are two different diseases.

Preventing type 2 in kids

More and more American children and adolescents are being diagnosed with type 2 diabetes. In fact, the increase is so alarming, it has prompted many experts to label type 2 an "emerging childhood epidemic."

What does this have to do with you? Unfortunately, if you're a parent with type 2, your children face a higher risk for the disease. To protect your kids from developing type 2, the whole family must help them do the following:

- **Stay at a healthy weight.** Being overweight is one of the biggest risk factors for type 2—but studies show that parents often don't recognize their children's weight problems. Ask your children's doctor what a healthy weight is for each child. Then, help them reach their targets by encouraging physical activity and cutting calories.
- **Be active every day.** Physical activity will help your children maintain a healthy weight and a positive outlook. So look for ways to keep your kids moving. Have them walk or bike to school. Limit TV time. Sign them up for a sports team or fitness class. And exercise with them every day—it's a great way to stay close and get fit.
- **Eat healthy foods.** Build a better diet with a few key actions. Eat more fruits and vegetables. Choose whole grain foods. Drink water throughout the day, not sodas or sports drinks. Limit sweets, processed snacks, and fatty foods.

It may not be easy to change your family's habits. But it's worth it! By helping your kids build a healthy lifestyle, you're helping them live better, happier, and longer lives. For more tips to keep your family healthy, visit **intermountainhealthcare.org/weight**.

Gestational diabetes

Gestational diabetes develops only during pregnancy. When you're pregnant, hormones make it more difficult for insulin to move glucose into your cells. If your body can't produce enough insulin to overcome the effects of this insulin resistance, you'll develop gestational diabetes.

If you're pregnant, you should be tested for gestational diabetes between the 24th and 28th week of your pregnancy. If tests show that you have gestational diabetes, you'll need to follow a treatment plan to help avoid problems for you and your baby. This means doing the following:

- **Following a meal plan.** Stick to the eating plan your healthcare providers give you. This will help you control your blood glucose—while ensuring that you and your baby are well nourished.
- **Exercising consistently.** Regular exercise is also part of treatment for gestational diabetes. Follow your healthcare providers' recommendations to make sure you're exercising in a healthy way for you and your baby.
- **Meeting regularly with your healthcare providers.** Keep your regular prenatal appointments, and call with any questions or concerns.

Most of the time, changing your eating habits and exercising regularly will control gestational diabetes and reduce the risk to you and your baby. However, your provider may prescribe monitoring or medicines to help you manage your condition.

Gestational diabetes usually disappears after delivery. However, once you've had gestational diabetes, you're at a higher risk for developing type 2 later in life. You're also more likely to have gestational diabetes again with future pregnancies. The good news is that you may be able to prevent these problems. Talk to your doctor about setting healthy goals for yourself, such as losing weight and becoming more physically active.

TREATING FOR TWO

Gestational diabetes occurs in up to 7% of all pregnancies. Although it's a serious condition, there's a lot you can do to protect the health of your baby—and your own health. Your healthcare provider can show you what to do.

Pre-diabetes

People with pre-diabetes have blood glucose levels that are higher than normal, but not high enough for a diabetes diagnosis. Recent research shows that if you have this condition, you're not only at risk for developing type 2 diabetes—but you're also more likely to have a heart attack or stroke.

Fortunately, pre-diabetes can be treated. Weight loss and regular exercise have been shown to be most helpful in lowering blood glucose levels in people with pre-diabetes. In fact, studies show that these changes can delay—and perhaps even prevent—the onset of diabetes and other problems.

Here are a few of the most striking findings from the Diabetes Prevention Program (DPP), an important new research study conducted on people with pre-diabetes:

- Participants who were counseled on effective diet, exercise, and behavior modification reduced their risk of developing diabetes by 58%. This was true across all participating ethnic groups, and for both men and women.
- Lifestyle changes worked particularly well for participants aged 60 and older, reducing their diabetes risk by 71%.

▲ Exercise and an effective diet can help reduce the risk of developing diabetes.

RUNNING THE NUMBERS... AND RUNNING THE RISKS

People with pre-diabetes have fasting blood glucose levels of 100-125 mg/dL. This is higher than normal (less than 100 mg/dL), but not high enough for a diabetes diagnosis (126 mg/dL and above). See the next chapter for more on diagnostic tests and what the results mean.

If you have certain other health risks—but don't yet have blood glucose above 100 mg/dL—your doctor may still consider you "pre-diabetic." For example, high blood pressure, abnormal cholesterol, and waistline obesity together signal an increased risk for diabetes. They also put you at a higher risk for heart disease.

You should always take a pre-diabetes diagnosis seriously—and take steps to reverse it by losing weight and getting more exercise.

Metabolic syndrome

Metabolic syndrome (also called **syndrome X** or **insulin resistance syndrome**) isn't a type of diabetes. But people with this syndrome often go on to develop diabetes—and like people with diabetes, they are at risk for hardening of the arteries and heart and kidney disease.

The National Cholesterol Education Program defines the metabolic syndrome as the presence of any 3 of the following factors:

- Excess weight around the waist (waistline measurement of more than 40 inches for men, or more than 35 inches for women)
- Triglycerides of 150 mg/dL or greater
- HDL cholesterol ("good" cholesterol) below 40 mg/dL for men, or below 50 mg/dL for women
- Blood pressure of 130/85 mmHg or higher
- Fasting blood glucose levels 110 mg/dL or higher

The more factors you have in this syndrome, the greater the risk of diabetes and other problems. But you can help protect your health by losing weight, getting more exercise, and doing other things that your healthcare providers recommend.

STOPPING THE SYNDROME

People with metabolic syndrome are at high risk for heart disease and diabetes. The good news is that when the syndrome is diagnosed early in its development, it can be slowed, and in some cases, even reversed. How? By losing weight and getting more exercise. Studies have shown that even small weight losses—even in people who are obese—can significantly improve metabolic factors.

The syndrome in the states

The metabolic syndrome has become increasingly common in the United States. It's estimated that about 20-25% of US adults have it.

How diabetes can affect your health

Regardless of which type of diabetes you have, you'll need to manage your blood glucose levels carefully. The time and energy you spend doing this will be well worth it. Good management can help you prevent serious short- and long-term health problems.

Short-term problems

In the short term, undiagnosed or poorly managed diabetes can result in high blood glucose **(hyperglycemia)** or low blood glucose **(hypoglycemia)**. Both conditions require your immediate attention. If you don't act to bring your blood glucose within normal range, you risk serious problems—some of which are life-threatening.

TOO HIGH? TOO LOW? HOW DO YOU KNOW—AND WHAT DO YOU DO?

See pages 92-97 for information on recognizing and treating hyperglycemia and hypoglycemia. These acute complications can become serious if they're not treated in good time.

"People with diabetes always end up with terrible health problems—they go blind, end up in a wheelchair, etc."

Many people never develop diabetes complications, even after many years with the disease. And although there are no guarantees that you won't have serious problems because of your diabetes, you can greatly reduce your chances of developing long-term complications by controlling your blood glucose levels and other health risk factors. You also need to get regular health checks.

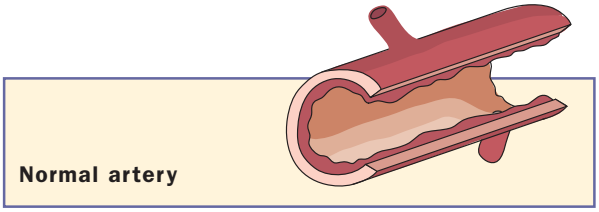
Long-term problems

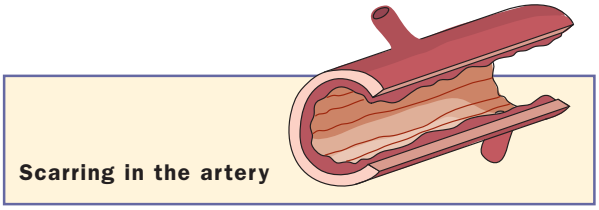
In the long term, diabetes can cause health complications throughout your body. Diabetes complications are usually caused by damage to blood vessels and nerves.

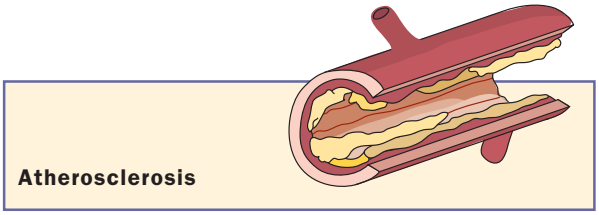
Damage to blood vessels

High blood glucose levels can damage small and large blood vessels, causing **vascular disease.** Here's how:

- **In smaller blood vessels,** high blood glucose can cause weakening and swelling. This can cause clogging and rupture in the vessels that carry blood to your eyes, toes, fingers, and kidneys.
- **In larger blood vessels (arteries),** high blood glucose—and especially high blood pressure and high cholesterol—can cause scarring. In this case, your arteries become stiff and hard, and tend to collect fatty substances from the bloodstream. This fatty buildup narrows blood vessels and can cause clots and blockages. You have **atherosclerosis**—and a higher risk for heart attacks, strokes, and other problems.







Neuropathy may cause nerve signals to stop, slow down, or be sent at the wrong time—creating problems throughout your body.

Damage to nerves

Diabetes can damage the nerves in your body, causing **diabetic neuropathy.** That's because high blood glucose can damage nerves directly—or indirectly, by damaging the blood vessels that supply oxygen to the nerves. Neuropathy can cause nerve signals to stop, slow down, or be sent at the wrong time.

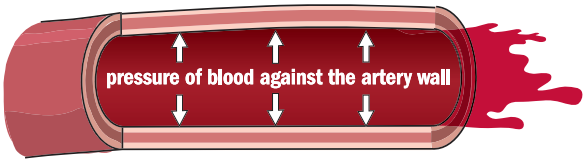
Neuropathy can bring sensations such as tingling, prickling, burning, pain, or numbness throughout your body. It can also interfere with your sex life, and affect important bodily processes like digestion.

Triple trouble: diabetes, high blood pressure, and high cholesterol

Unfortunately, people with diabetes usually have high blood pressure and high cholesterol as well. This is a serious "triple threat" to your health. Why? By itself, each condition can damage your blood vessels and your heart. If you have all three—high blood glucose, high blood pressure, and high cholesterol—this damage is likely to happen sooner and progress more quickly.

High blood pressure

Blood pressure is the force of blood pressing against the walls of your arteries—much like the pressure of water in a garden hose.



You need some blood pressure to move blood through the arteries to where it's needed in the body. But if you have too much pressure inside your arteries—for too long—you have *high* blood pressure **(hypertension)**. And like high blood glucose, high blood pressure can damage your blood vessels. It makes your heart work harder and increases your chance for serious health problems throughout your body.

For more information...
To learn more about blood pressure and how to control it, see *Intermountain's BP Basics*. This booklet is available from your healthcare providers and on the Internet at **www.intermountainhealthcare.org/bp.**

High cholesterol

It's normal and healthy to have different types of cholesterol and fat in your body. But too much cholesterol and fat—or abnormal levels of different types of cholesterol and fat—can cause fatty buildup inside your blood vessels (atherosclerosis). But as with high blood pressure, you may not notice this dangerous condition. Most people have no symptoms.

"HIGH CHOLESTEROL" AS A CATCH-ALL TERM

People use the term "high cholesterol to mean a high amount of total cholesterol—but also for abnormal levels of different kinds of cholesterol, for example:

- High LDL cholesterol ("bad cholesterol")
- Low HDL cholesterol ("good cholesterol")
- High triglycerides

A medical term for abnormal levels of cholesterol is **dyslipidemia**. Dyslipidemia is a risk factor for heart disease and other problems.

The good news

The good news? You can control your blood pressure and cholesterol levels. In fact, much of what you do to manage your blood glucose—like getting regular exercise, losing weight, and quitting smoking—can also help lower your blood pressure and control your cholesterol. So can taking medications prescribed by your doctor for these conditions.

Complications of diabetes

Over time, damage to your blood vessels and nerves can cause problems throughout your body. Some of the more common complications are described below.

Heart disease and stroke

Two out of three people with diabetes die from a heart attack or stroke.

Heart disease—caused by low blood flow in the arteries that feed your heart—may lead to heart attacks, heart muscle disease (**cardiomyopathy**), and other problems. Likewise, a blockage in the artery that leads to your brain can cause a dangerous stroke.

To lower your risk of cardiovascular problems, you not only need to control your blood glucose, you also need to lower any other risk factors you may have. For most people, this means controlling your blood pressure, cholesterol, and body weight.

Kidney disease

Diabetes is the most common cause of kidney failure in the United States, accounting for more than 40% of new cases.

Damage to your smaller blood vessels can cause **nephropathy**. This is a serious condition that makes it more difficult for your kidneys to filter waste and excess fluid from your blood. Unless it's detected and treated in its early stages, it can cause your kidneys to fail completely. Nephropathy is much more common with type 1 than type 2 diabetes.

Since most people don't have any symptoms of disease until their kidneys are severely damaged, you need to see your health-care provider for a regular screening test called a microalbumin screen.

Eye diseases

Diabetes is the leading cause of new cases of blindness among adults aged 20-74.

People with diabetes are at risk for several different eye diseases. **Retinopathy** is caused by damage to the small blood vessels of the retina, an area in the back of your eye that records images and sends them to the brain. People with diabetes are also at risk for **cataracts** (a clouding of the lens of the eye) and **glaucoma** (increased pressure in the eyes, which can damage sensitive eye nerves).

To help preserve your vision, you should have an initial eye exam to give you a baseline for any changes that may occur later on. After that, regular screening tests can help you catch and treat eye problems early.

Foot and leg problems

Among people with diabetes, about 82,000 lower-limb amputations are performed every year.

Foot and leg problems can be caused by damage to nerves or blood vessels. If your nerves are damaged, you might not notice an injury to your leg or foot. And if your blood vessels are damaged, injuries to your feet and legs won't heal quickly. Overlooked and slow-to-heal, even a very small injury—such as a scrape, stubbed toe, or blister—can become serious.

Inspecting your legs and feet every day—and getting regular check-ups with your healthcare provider—will help you detect problems early and avoid serious complications.