Effective Health Care Program

Medicines for Type 2 Diabetes

A Review of the Research for Adults

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Is This Information Right for Me?

Yes, if:

- Your doctor or health care provider has told you that you have type 2 diabetes and have high blood sugar.
- Your doctor or health care provider recommends that you take medicine to help lower or control your blood sugar.

No, if:

- You are younger than 18 years old.
- You have a different kind of diabetes called type 1 diabetes.
- You are pregnant and have a different kind of diabetes called gestational diabetes.

What is covered in this research summary?

This summary covers the research on the benefits and possible side effects of medicines to lower or control your blood sugar. It will help you talk with your doctor or other health care professional to decide which medicines are best for you.

Where does the information come from?

The information in this summary comes from a review of many studies about type 2 diabetes medicines. The review was conducted by an independent research center in 2007 and again in 2011. Read the full report at www.effectivehealthcare.ahrq.gov/diabetesmeds.cfm.

Understanding Your Condition

What is type 2 diabetes?

- Insulin is a hormone, or chemical, made by the body. It is needed to change food into energy.
- Type 2 diabetes means that your body cannot make enough insulin or that the cells in your body do not use insulin well. This causes blood sugar to get too high.

Why treat type 2 diabetes?

- If your blood sugar level stays high for a long time, you may have a greater chance of a heart attack, a stroke, kidney damage, or blindness. You may also need to have a toe, foot, or leg removed because of poor blood flow.
- Keeping your blood sugar at a good level might lower your chance of having these problems.

How is type 2 diabetes treated?

- The first step in controlling your blood sugar is to eat a balanced diet and be more active. Even small changes in exercise can make a big difference.
- Many people also need medicine to help keep their blood sugar under control.

How do I know the amount of sugar in my blood?

There are two common tests for blood sugar. They can help you and your doctor check how well your blood sugar is under control.

Finger stick

One test is a finger (or forearm) stick that you can do yourself. This test is done one or more times a day. You can do it in the morning before you eat (fasting) or at other times of the day, like after a meal. This test tells what your blood sugar level is at that moment in time. The fasting number should be between 80 to 120. After a meal, the target is usually less than 180.

Blood test

The other test is a blood test called hemoglobin (Hb) A1C. This test is done at your doctor's office or at a lab a few times a year. The A1C test shows your average blood sugar level over the past 2 to 3 months. Usually the goal is for your A1C to be around 7. This means that your finger-stick blood sugar level has been in the "good" range over the past 2 to 3 months. If the A1C level is higher than this, changing your medicine might help.

Understanding Your Options

Are all diabetes medicines the same?

There are many types of diabetes medicines. Each type works in a different way to control blood sugar.

How well can medicines lower my blood sugar?

All the medicines in this summary lower blood sugar. The lab test for blood sugar level (A1C) is the best way to tell how well the medicines work.

- Most diabetes medicines can lower your A1C by about 1 point. This means that if you start with an A1C level of 8, taking one of these medicines could bring it down to 7.
- Combining two kinds of diabetes medicines can lower blood sugar more than taking just one kind. Most combinations of medicines can bring it down about 1 extra point. This means if you start with an A1C level of 9 and can bring it down to 8 with one kind of medicine, you might be able to lower it to 7 by adding a second medicine.
- There is not as much research on some drugs: nateglinide (Starlix®), exenatide (Byetta®), and sitagliptin (Januvia®). This means that we do not know as much about how these drugs compare with other diabetes medicines.

Medicines for Type 2 Diabetes – Benefits

Type of Medicine Generic Name	Brand Name	Benefits
Biguanides *Block the liver from making sugar*		
Metformin	Glucophage®	■ Lowers A1C by about 1 point ■ Lowers "bad" cholesterol more than other types
Sulfonylureas *Raise the amount of insulin in the body*		
Glimepiride	Amaryl®	■ Lowers A1C by about 1 point
Glipizide	Glucotrol®	
Glyburide	Diabeta® Glynase Prestab® Micronase®	
Meglitinides *Raise the amount of insulin in the body*		
Repaglinide	Prandin®	■ Lowers A1C by about 1 point
Nateglinide	Starlix®	
Thiazolidinediones (TZDs) *Help the body use insulin better*		
Pioglitazone	Actos®	■ Lowers A1C by about 1 point ■ Lowers triglycerides (a kind of fat in your blood) more than other types ■ Might protect kidney function
Dipeptidyl Peptidase-4 (DPP-4) Inhibitors *Raise the amount of insulin in the body after a meal*		
Sitagliptin	Januvia®	■ Lowers A1C by less than 1 point
Saxagliptin	Onglyza®	
Glucagon-Like Peptide-1 (GLP-1) Receptor Agonists *Raise the amount of insulin in the body*		
Exenatide	Byetta®	■ Less weight gain than other medicines ■ Less is known about how well this medicine lowers A1C compared with other medicines
Liraglutide	Victoza®	
Combinations		
Glyburide/metformin		■ Lowers A1C by about 2 points ■ Metformin/pioglitazone lowers triglycerides
Metformin/pioglitazone		
Metformin/sitagliptin		
Metformin/saxagliptin		
Metformin + GLP-1 receptor agonists		■ Metformin + GLP-1 receptor agonists may cause less weight gain than other combinations of medicines
Metoformin + basal insulin		
Metformin + premixed insulin		

Some of the combinations of medicine may come in a single pill, and are shown with a "/" symbol between them. Others are taken together but are separate medicines, and are shown with a "+" symbol.

Medicines for Type 2 Diabetes – Possible Side Effects

Type of Medicine Generic Name	Brand Name	Possible Side Effects
Biguanides		
Metformin	Glucophage®	■ Some risk for low blood sugar ■ Less weight gain than other medicines ■ Higher risk for stomach problems (gas, diarrhea)
Sulfonylureas		
Glimepiride	Amaryl®	■ May cause weight gain ■ 3 to 5 times more likely to cause low blood sugar ■ May cause stomach problems
Glipizide	Glucotrol®	
Glyburide	Diabeta® Glynase Prestab® Micronase®	
Meglitinides		
Repaglinide	Prandin®	■ May cause weight gain ■ Risk for low blood sugar
Nateglinide	Starlix®	
Thiazolidinediones (TZDs) *		
Pioglitazone	Actos®	■ May cause weight gain ■ Some risk for low blood sugar ■ Can add to risk of heart failure or make it worse ■ Increases the risk for fracture, especially in women ■ May cause bladder cancer when used longer than 1 year
Dipeptidyl Peptidase-4 (DPP-4) Inhibitors		
Sitagliptin	Januvia®	■ Not enough is known about the side effects of these medicines
Saxagliptin	Onglyza®	
Glucagon-Like Peptide-1 (GLP-1) Receptor Agonists		
Exenatide	Byetta®	■ Not enough is known about the side effects of these medicines
Liraglutide	Victoza®	
Combinations		
Glyburide/metformin		■ Some combinations with drugs such as sulfonylureas may increase the risk of low blood sugar ■ Pioglitazone combinations may cause more weight gain than other medicines ■ Pioglitazone combinations can add to the risk of hip and non-hip fractures, especially for women ■ Some combinations with metformin increase the risk of stomach problems, but not as much as metformin alone
Metformin/pioglitazone		
Metformin/sitagliptin		
Metformin/saxagliptin		
Metformin + GLP-1 receptor agonists		
Metformin + basal insulin		
Metformin + premixed insulin		

*NOTE: Your doctor has received an alert from the United States Food and Drug Administration (FDA) that TZDs (pioglitazone or rosiglitazone) should not be taken by patients with serious or severe heart failure. Rosiglitazone also increases the risk for heart attack and stroke. According to the FDA, rosiglitazone is to be used only if other drugs do not work to lower your blood sugar. Talk with your doctor.

Why is information about cholesterol and triglycerides listed in the chart?

Diabetes medicines are mainly for lowering blood sugar. Research shows that a few of them can also affect cholesterol and triglycerides.

Cholesterol

- Everyone should try to keep "bad" cholesterol (LDL cholesterol) as low as possible. Bad cholesterol can clog your arteries and lead to a heart attack or stroke. People with diabetes have a greater risk for these problems. Your doctor can tell if your LDL is too high.
- Most diabetes medicines do not raise or lower your "good" cholesterol (HDL) enough to affect your health. Good cholesterol helps your body and does not clog your arteries or cause heart problems.

Triglycerides

- "Triglycerides" (try-GLIS-uh-rides) are a kind of fat in your blood. The body makes triglycerides. They are also in food. Your body needs this kind of fat, but it is best to keep the level of your triglycerides low. Less than 150 is usually the goal.

What else should I know about serious side effects?

The most common side effects of type 2 diabetes medicines are weight gain and stomach problems. The chart on page 5 lists other side effects that are not common but can be serious. Here is more information about some of them so that you can talk with your doctor about your concerns.

Low blood sugar

Sometimes, the medicines can lower your blood sugar too much. This is called "hypoglycemia" (high-po-gly-SEE-mee-ah). Low blood sugar can cause you to feel dizzy, cold and sweaty, confused, shaky, and weak.

- Low blood sugar is more likely when you take two or more kinds of diabetes medicines.

Warning: If you think you may have low blood sugar, eat or drink something with sugar in it right away. If you have symptoms while driving or using a machine, pull to the side of the road or turn off the machine. You may wish to keep juice or candy with you until you are comfortable with your medicine. Ask your doctor.

Lactic acidosis

Taking diabetes medicines can raise the chance of a rare condition called "lactic acidosis" (lak-tik a-suh-DOE-sis). This condition is more likely for people who take diabetes medicines and have kidney or liver problems. Each year, about 1 out of 10,000 people taking diabetes medicine will have lactic acidosis. Common signs of lactic acidosis are:

- Trouble breathing.
- Vomiting or stomach pain.
- Weakness or unusual muscle pain.
- Chills or feeling light-headed.

The chance of having lactic acidosis is about the same for all diabetes medicines.

Warning: If you have any signs of lactic acidosis, call your doctor or nurse right away.

Heart failure

Congestive heart failure, or heart failure, is when the heart cannot pump enough blood to the rest of the body. Pioglitazone (Actos®) might cause congestive heart failure or make it worse. Call your doctor or nurse if you suddenly notice these symptoms of heart failure:

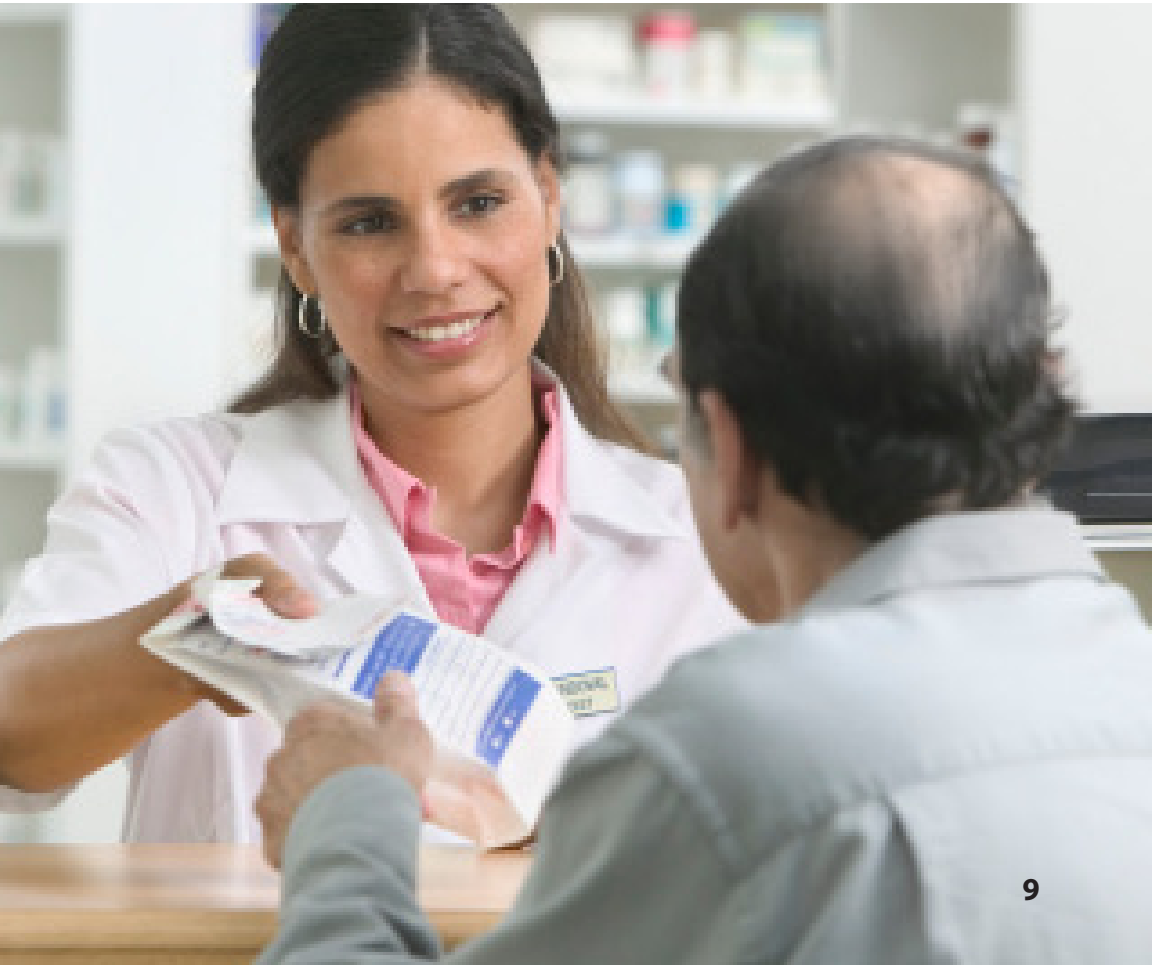
- Gain weight quickly.
- Tired and weak.
- Irregular heart beat.
- Swelling of your belly, ankles, or feet.
- Lose your appetite or are sick to your stomach.
- Shortness of breath when you exercise or lie down.

How much do these medicines cost?

The cost to you depends on several things, including:

- What type of insurance plan you have and what medicines it covers.
- How much medicine you need.
- Whether you use generic or brand-name medicines.

Most medicines for type 2 diabetes are covered by health insurance and come in a generic form. The chart on the next page lists the average cost to the pharmacy for each generic and brand-name medicine mentioned in this summary. The doses are similar to those used in the research studies.



Average Wholesale Prices for Diabetes Medicines

Drug Type			Price for 1-Month Supply	
Generic	**Brand**	**Dose**	**Generic**	**Brand**
Biguanides				
Metformin	Glucophage®	500 mg once a day	$25	$35
		500 mg twice a day	$50	$70
		500 mg three times a day	$75	$105
		850 mg once a day	$40	$60
		850 mg twice a day	$80	$115
		850 mg three times a day	$120	$175
		1,000 mg once a day	$45	$70
		1,000 mg twice a day	$90	$140
	Glucophage XR®	500 mg once a day	$25	$35
		1,000 mg once a day	$50	$70
		1,500 mg once a day	$75	$105
		2,000 mg once a day	$100	$140
Second-Generation Sulfonylureas				
Glimepiride	Amaryl®	1 mg once a day	$15	$20
		2 mg once a day	$25	$35
		4 mg once a day	$40	$60
		8 mg once a day	$80	$120
Glipizide	Glucotrol®	5 mg once a day	$15	$25
		10 mg once a day	$25	$40
		10 mg twice a day	$50	$80
		20 mg twice a day	$100	$160
	Glucotrol XL®	5 mg once a day	$15	$25
		20 mg once a day	$65	$90
Glyburide	Diabeta® Micronase®	2.5 mg twice a day	$40	$45
		5 mg once a day	$30	$40
		5 mg twice a day	$60	$80
	Glynase PresTab®	1.5 mg once a day	$9	$30
		3 mg once a day	$18	$45
		6 mg twice a day	$72	$145

Average Wholesale Prices for Diabetes Medicines *(continued)*

Drug Type			Price for 1-Month Supply	
Generic	**Brand**	**Dose**	**Generic**	**Brand**
Meglitinides				
Repaglinide	Prandin®	0.5 mg three times a day	NA	$255
		1 mg three times a day	NA	$255
		4 mg three times a day	NA	$505
Nateglinide	Starlix®	60 mg three times a day	NA	$195
		120 mg three times a day	NA	$200
Thiazolidinediones				
Pioglitazone	Actos®	15 mg once a day	NA	$180
		30 mg once a day	NA	$275
		45 mg once a day	NA	$300
Dipeptidyl Peptidase-4 (DPP-4) Inhibitors				
Sitagliptin	Januvia®	100 mg once a day	NA	$230
Saxagliptin	Onglyza®	2.5 mg to 5 mg once a day	NA	$220
Glucagon-Like Peptide-1 (GLP-1) Agonists				
Exenatide	Byetta®	Injection of 5 mcg twice a day	NA	$300
		Injection of 10 mcg twice a day	NA	$330
Liraglutide	Victoza®	Injection of 0.6 mg once a day	NA	$160
		Injection of 1.2 mg once a day	NA	$315
		Injection of 1.8 mg once a day	NA	$470
Combinations				
Glyburide/ metformin	Glucovance®	2.5 mg / 500 mg twice a day	$85	$90
		5 mg / 500 mg twice a day	$85	$90
Metformin/ pioglitazone	Actoplus Met®	500 mg / 15 mg twice a day	NA	$275
		850 mg / 15 mg twice a day	NA	$275
Metformin/ sitagliptin	Janumet®	500 mg / 50 mg twice a day	NA	$230
		1,000 mg / 50 mg twice a day	NA	$230
Metformin/ saxagliptin	Kombiglyze XR®	500 mg / 5 mg once a day	NA	$220
		1,000 mg / 2.5 mg once a day	NA	$220

These prices are the Federal median price for generic medicines and the average wholesale price for brand-name medicines. The prices have been rounded to the next $5. These prices come from Red Book: Pharmacy's Fundamental Reference, 2011 Edition.

XR/XL = extended release
NA = not available as a generic

How often will I need to take these medicines?

- Some diabetes medicines are taken once a day. Others need to be taken more often or with meals.
- No matter which medicines you need, follow the directions for each of them.
- Keep taking your medicines until your doctor tells you to stop. Not taking the medicines, or only taking them for a short time, will NOT help you lower or control your blood sugar.
- Check your blood sugar every day with your glucose monitor, and get your A1C blood tests when your doctor schedules them.

Where can I get more information about type 2 diabetes?

For more information about diabetes, visit the Medline Plus Web site: www.nlm.nih.gov/medlineplus/diabetes.html.

Ask Your Doctor

Talk with your doctor or health care provider about the information in this research summary.

1. Why are you choosing this diabetes medicine instead of the other medicines?
2. Will this medicine make me feel bad, gain weight, feel different, or cause changes to my body?
3. What is my current A1C number, and what would you like it to be?
4. How often should I check my blood sugar and at what times?
5. How will this medicine affect my daily activities, like working, sleeping, or taking care of my family?

Write other questions here:

Write the answers here:

Source

The information in this summary comes from the report *Oral Diabetes Medications for Adults With Type 2 Diabetes: An Update.* It was produced by the Johns Hopkins University Evidence-based Practice Center through funding from the Agency for Healthcare Research and Quality (AHRQ). For a copy of the report or for more information about AHRQ and the Effective Health Care Program, go to www.effectivehealthcare.ahrq.gov/diabetesmeds.cfm.

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AHRQ Pub. No. 11-EHC038-A
Replaces Pub. No. 07(08)-EHC010-2A
June 2011