Memorial Sloan Kettering Cancer Center

PATIENT & CAREGIVER EDUCATION

Diabetic Ketoacidosis (DKA) and Ketone Urine Testing

This information describes what diabetic ketoacidosis (DKA) is. It explains how to test for it using a ketone urine test. It also explains the symptoms of DKA and the steps you can take to prevent it.

What is diabetic ketoacidosis?



DKA is a medical emergency that can be life-threatening. If you have DKA or think you have DKA, call for medical attention right away. Call your diabetes healthcare provider, go to your local emergency room, or call 911.

Causes of diabetic ketoacidosis

DKA is a medical emergency that happens when your body does not have enough insulin. Insulin is a hormone that lets glucose (sugar) go from your bloodstream into your cells. The cells in your body use glucose for energy. Cells need energy to live.

If your body does not have enough insulin, glucose cannot get into your cells. It will stay in your bloodstream where it can cause hyperglycemia (high blood sugar).

If your body cannot use glucose for energy, it uses fat instead. This happens slowly so it can make you feel tired and run down. As your body turns fat into energy, ketones (blood acids) form and enter your bloodstream. Ketones leave your body through your urine (pee).

You can test your body's ketone levels at home using urine ketone test strips. Read the "Testing your ketone levels" section of this resource for more information.

Ketosis

Ketosis (kee-TOH-sis) is when some ketones build up in your bloodstream. This can happen if you suddenly lose your appetite or lose weight. This is common for people going through treatment for cancer.

Having some ketones in your bloodstream can be normal and does not always mean you have DKA. Talk with your diabetes healthcare provider about what level of ketones is safe, and when to call for medical help.

Some diets, such as the 'keto diet', use ketosis as a tool for losing weight. This can be unsafe for people who are ill or have diabetes. Talk with your healthcare provider about whether a keto diet is safe for you.

Ketoacidosis

Ketoacidosis (KEE-toh-A-sih-DOH-sis) is when too many ketones build up in your bloodstream. This makes your blood acidic, which can be dangerous.

Risk factors for diabetic ketoacidosis

You may be at a higher risk for DKA if:

- You have new diagnosis of type 1 diabetes (T1DM). For people with cancer, T1DM can be a rare side effect of some immunotherapy treatments.
- You missed insulin doses, or if your body needs more insulin. Follow your diabetes healthcare provider's instructions for taking insulin. **Never change your insulin dose without talking with your diabetes healthcare provider first.**
- Your insulin has expired or has gone bad. This can happen if your insulin gets too hot or too cold.
- Your insulin pump stops working as it should.
- You take steroid medications, such as prednisone or dexamethasone.
- You have an infection or a stressful medical condition. For example, DKA can happen after surgery, which is a stressful procedure.

DKA is more common in people with T1DM. Far less often, DKA can happen if you have type 2 diabetes (T2DM). But at least one of these other things also must be true:

- You have severe pancreatitis (PAN-kree-uh-TY-tis), which is inflammation (swelling) of the pancreas.
- You take steroid medications.
- You take a sodium-glucose cotransporter-2 (SGLT2) inhibitor medication, or a combination medicine that includes:
    - Invokana® (canagliflozin)
    - Farxiga® (dapagliflozin)
    - Jardiance® (empagliflozin)
    - Steglatro® (ertugliflozin)
    - Brenzavvy® (bexagliflozin)

Read the “Euglycemic DKA (EDKA)” section of this resource for more information.

Signs and symptoms of diabetic ketoacidosis

DKA often happens quickly, sometimes within a few hours. You may get very sick quickly, even before you notice any symptoms.

Talk with your healthcare provider to make a sick day plan. Follow their instructions for checking your blood glucose and taking diabetes medication when you’re not feeling well. Read *How to Manage Diabetes When You’re Sick* (www.mskcc.org/pe/manage-diabetes-when-sick) to learn more.

A high blood glucose level often is one of the first signs of DKA. Other early symptoms of diabetic ketoacidosis are:

- Dry mouth.
- Dry skin.
- Extreme thirst (feeling thirsty even after drinking a lot of fluids).
- Urinating (peeing) often.

If not treated, symptoms of DKA can get worse, including:

- Suddenly feeling weak or tired.
- Nausea (feeling like you’re going to throw up) or vomiting (throwing up).
- Belly pain.
- Confusion or trouble thinking.
- Fruity-smelling breath.
- Trouble breathing.
- Flushed skin (skin that feels warm and is red or splotchy).

Euglycemic DKA (EDKA)

EDKA is a rare condition. This happens when you have DKA, but your blood glucose is normal or near normal (less than 250 mg/dL). Having normal or near normal blood glucose levels can make it easy to miss an EDKA diagnosis.

You are more likely to get EDKA if:

- You take a SGLT2-inhibitor.
- You have T1DM and you miss insulin doses or take too little insulin.

If you take an SGLT2-inhibitor and have any signs or symptoms of DKA, tell your diabetes healthcare provider right away. Do this even if your blood glucose level is normal or near normal.

SGLT2-inhibitors and diabetic ketoacidosis

If you have diabetes, your healthcare provider may prescribe SGLT2-inhibitors. These help your body get rid of extra glucose by causing you to urinate more. This helps lower your blood glucose.

When you urinate more, you may become dehydrated. This can raise your risk of EDKA. Talk with your healthcare provider about drinking more fluids while taking SGLT2-inhibitors.

Your risk of EDKA also goes up if you take SGLT2-inhibitors and:

- You're eating or drinking less than normal for you. This can happen if you're fasting before surgery, or have a poor appetite, nausea, or vomiting.
- You had a general surgery or other procedure, such as a colonoscopy.

If you're having surgery or a procedure, follow your healthcare provider's instructions for taking an SGLT2-inhibitor. You may need to stop taking it several days ahead of time.

Testing for ketones

Ketones are usually in your urine or blood. They leave your body through your urine. Your healthcare provider may test for ketones in your blood. You can also test your body's ketone levels at home using urine ketone test strips. You can buy these at your local pharmacy without a prescription.

When to test for ketones

You should test for ketones if any of these things applies to you:

- You have symptoms of DKA.
- Your blood glucose is more than 250 mg/dL right after you wake up and before you've eaten.
- Your blood glucose is more than 250 mg/dL for 2 tests in a row, such as before breakfast and lunch.
- You cannot take your usual insulin dose because you are not eating or drinking as you normally would.
- You cannot take your usual insulin dose because you are not feeling well. This includes if you have a cold, infection, nausea, or vomiting.
- You take an SGLT2-inhibitor and are not eating or drinking, even if your blood glucose is less than 250 mg/dL.

How to test your ketone levels

Here are general steps for how to test your ketone levels. Follow the instructions on the bottle or box of test strips if they're not the same as these steps:

1. Collect a fresh urine sample.
2. Dip a ketone test strip into the urine sample.
3. Wait for the number of seconds it says in the instructions. The color of the pad on the strip will change if there are ketones in your urine.
4. Compare the color of the pad to the color chart on the bottle or box (see Figure 1). The test results will be either negative or positive.
    - A negative result means there are no ketones in your urine.
    - A positive result means there are ketones in your urine. A positive result is measured as a small, moderate, or high level of ketones.

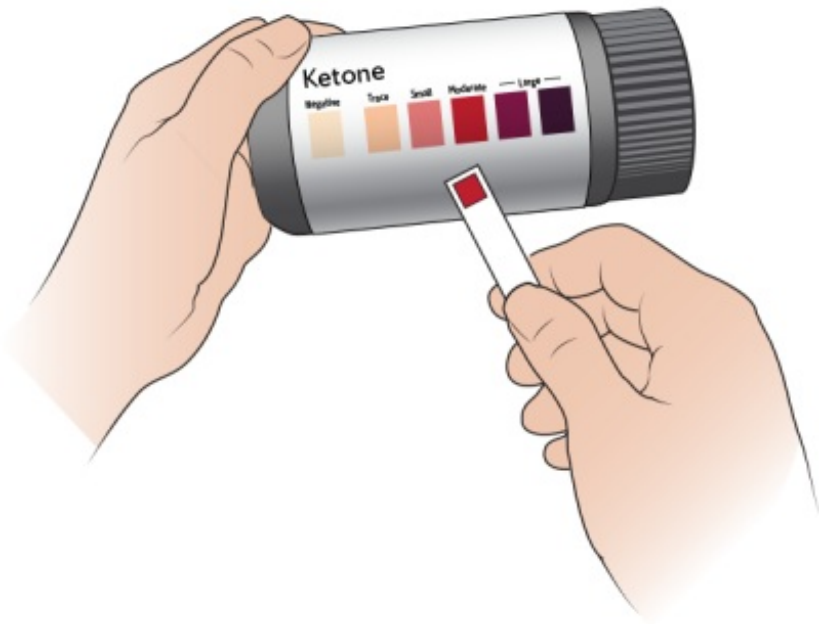


Figure 1. Ketone testing strip and results chart

What to do if you your ketone levels are high



If your ketones are moderate or high, call your diabetes healthcare provider right away.

- Drink extra water or zero-calorie drinks.
- Avoid sugary drinks, such as juice or soda.
- For people with T1DM, follow your sick day plan. This often includes checking your blood glucose level and testing for ketones every 3 to 4 hours or as instructed.
- Take insulin as instructed.
- **If you take an SGLT2-inhibitor, do not take any more doses**. Call your diabetes health care provider right away. They will tell you what to do if you have a positive ketone test.
- Do not exercise if your blood glucose is over 250 mg/dL and you have a positive ketone test result.

How to prevent DKA

- Tell your diabetes healthcare provider if your blood glucose levels are over 200 mg/dL for 3 days in a row.
- Always follow your diabetes healthcare provider's instructions for taking your medications exactly as prescribed.
- Check your blood glucose often. Follow your diabetes healthcare provider's instructions.
- Never stop eating all carbohydrates without being monitored by your care team. Examples of carbohydrates (carbs) include bread, rice, fruit, and pasta.
- If you take insulin or an SGLT-2 inhibitor, tell your diabetes healthcare provider if you have any surgery or procedures planned.

For people with type 1 diabetes (T1DM)

Create a sick day plan with your diabetes healthcare provider. They may tell you to take small doses of insulin often, even if you cannot eat or drink. Talk with them about any procedures you're planning to have.

When to call your healthcare provider

Contact your diabetes healthcare provider right away if you have any of the following:

- Your urine test shows moderate to high levels of ketones.
- Your blood glucose levels are higher than 400 mg/dL.
- You're vomiting, or you have diarrhea more than 3 times in 24 hours (1 day).
- You're not sure if you should take your diabetes medications because you're not feeling well.
- A fever of 101° F (38.3° C) or higher.

Go to your local emergency room or call 911 if you cannot contact your healthcare provider right away.

If you have questions or concerns, contact your healthcare provider. A member of your care team will answer Monday through Friday from 9 a.m. to 5 p.m. Outside those hours, you can leave a message or talk with another MSK provider. There is always a doctor or nurse on call. If you're not sure how to reach your healthcare provider, call 212-639-2000.

For more resources, visit www.mskcc.org/pe to search our virtual library.

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