Monitoring Your Diabetes

Purpose

This section is intended to provide information about monitoring blood glucose values and reasons for ketone testing. It includes information on the selection and care of a blood glucose meter and strips. It discusses how to take a good blood sample and keep a blood glucose record.

Objectives

At the end of this section you will be able to:

- Choose a blood glucose meter.
- Take an accurate blood sample.
- State the reason for keeping blood glucose records.
- State your blood glucose target range.
- Explain what the A1C number means.

Outline

American Diabetes Association®

*The American Diabetes Association Recognizes this education service as meeting the National Standards for Diabetes Self-Management Education and Support.

These materials were adapted from Life with Diabetes: A Series of Teaching Outlines by the Michigan Diabetes Research and Training Center, 5th Edition. American Diabetes Association, 2014.

How to choose a blood glucose meter

A glucose meter is used to monitor blood glucose levels. By applying a drop of blood to a small disposable strip, the meter will check the glucose level. The blood glucose number appears on a digital screen. Meters have different features. Your diabetes educator can help you select a meter that best matches your needs.

Points to consider:

Insurance

Private insurance companies may only cover certain meters and strips. Check with your insurance before buying a meter or accepting a free meter.

Processing time

After applying the drop of blood, most meters take approximately five seconds to determine the blood glucose value.

Meter size

Meters come in various sizes. The average size is about the size of the palm of your hand. Some are smaller. Smaller meters are easier to carry. They also have smaller buttons and display screens which may cause difficulties for people with visual or movement problems. All meters are battery powered.

Strips

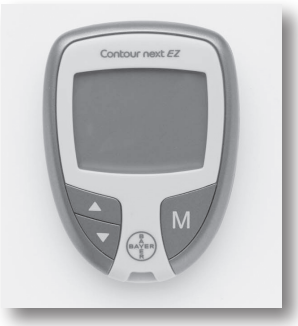
You must use the strips that are specifically designed for your meter. Some require applying a small drop of blood to an area on the strip. Others simply wick (pull) the blood onto the strip when it is held in contact with the blood. Meters are designed to keep the blood outside of the meter on the strip. Each strip is used once and then discarded. Strips should be stored at room temperature. Avoid storing in direct sunlight and areas of high humidity. Replace the top tightly after use. Do not use expired strips.

Memory

Meters have varying amounts of memory. The memory allows you to store your glucose results. In order to use the memory correctly, the time and date must be set. Any time you change the batteries in your meter the time and date need to be reset.

Data transfer

To display the glucose results, many meters can be downloaded to a computer that has diabetes management software. Additional data such as mealtime, exercise, or medicines can be added. Meters can be linked to other devices such as game boys®, iPhones® and tablets.



Meter and strip costs

- Meter costs vary considerably. Rebates are often available.
- Sometimes old meters can be traded in for newer models. If you have an older meter and would like to "trade it in", call the toll free customer service number on the back of your meter for more information.
- Strips are the major expense in monitoring blood glucose.
- The strips you buy must match with your meter.
- Most insurance companies assist with part of the cost of the strips.
- Check with your insurance company regarding coverage issues.
- The number of strips covered is usually based on the recommended frequency of monitoring. Your health care provider will recommend how often to monitor.

Lancets/lancing devices

- A lancet is the small, sharp device used to obtain a blood sample.
- Lancets are used with a lancing device for ease of handling and to protect the lancet.
- Lancing devices are adjustable to control the depth of puncture.
- Dispose of lancets as directed; check with your local government regarding regulations for disposal.
- Do not test other people's blood with a used lancet or your lancing device.
- Lancets may be used, on the same person, more than once. However reuse dulls the lancet causing more discomfort and increases the risk of infection.

Control solutions

- Are used to check the accuracy of your meter and strips.
- May or may not come with your glucose meter.
- Control solutions, like strips, must be the same brand as your meter.
- Once opened, control solutions expire in 90 days; write the date you opened the bottle on the bottle label to help you remember.

How to care for a blood glucose meter

To obtain accurate blood glucose results, you must take care of your meter. Read your meter instruction guide to learn how to care for the meter. Avoid leaving meters in very hot or cold temperatures. You will need to learn how to:

- Understand the symbols on the digital screen.
- Use control solutions to check the accuracy of your meter.
- Change batteries.
- Use the special features.

Be sure to complete and mail in the warranty card.

How to take an adequate blood sample

In order to get an accurate blood glucose check, an adequate blood drop is required.

Follow these steps:

1. Wash your hands with soap and warm water. Make sure your fingers are clean and dry.
2. Select a finger to use; frequently change which finger you use.
3. Make sure your finger is warm.
4. Gently massage your finger before using the lancet. Some people find that letting their hand hang below their waist also helps.
5. Use the side of the finger instead of the finger pad. The pad or center of your finger is more sensitive and will increase discomfort.
6. Cock the device and place the lancing device firmly on the side of your finger. Press the trigger to poke your finger.
7. If needed, to get an adequate amount of blood, gently squeeze your finger starting at the base of the finger close to the palm and move towards the fingertip.
8. You may need to lower your hand below your heart to get an adequate drop of blood.
9. When a drop of blood forms, apply the blood to the strip. This is usually done by placing the blood drop next to the strip to allow the blood to “wick in”.
10. An inadequate blood sample will give an incorrect reading or error reading.

How to keep a blood glucose record

Complete and accurate blood glucose records are a key part of obtaining and maintaining control of your diabetes. Blood glucose records are a written summary of the results of your blood glucose monitoring over a period of several days or several weeks. Your diabetes educator can supply you with a blood glucose record book and discuss what type of information to record.

Blood glucose records give you and your health care provider an overall view of patterns and trends in your blood glucose values. Looking at trends and patterns in your blood glucose values can help determine if changes in your diabetes management plan are needed.

Sample blood glucose record

Date	Blood glucose				Comments
	Breakfast	Lunch	Supper	Bedtime	
2/14				165	
2/15	103				
2/16			85		
2/17		118			
2/18				158	
2/19	108				
2/20		134			
2/21			96		
2/22	112				
2/23				201	Ate snack 1 hour before
2/24	145				
2/25			100		
2/26		128			
2/27				188	

Tips for keeping a useful blood glucose record

- Record your blood glucose value right after you monitor; this will help you see trends or patterns in your blood glucose values.
- Monitor your blood glucose:
  - First thing in the morning
  - 2 hours after the start of the meal
  - Before meals
  - Before bed
- Alternate monitoring times, so you have results from all times of the day.
- Add comments in your record to help explain changes in your blood glucose such as an illness, missed diabetes medicines, or skipped meals.

Target blood glucose levels

You will get your personal blood glucose target goal from your health care provider. Your goals may vary from the chart below.

Target blood glucose levels – American Diabetes Association

	People without diabetes	People with diabetes
Before meals	70 - 100 mg/dl	80 - 130 mg/dl
2 hours after meals	Less than 140 mg/dl	Less than 180 mg/dl
Bedtime	70 - 100 mg/dl	90 - 150 mg/dl
A1C	Less than 6%	Less than 7% or as close to normal as possible (normal is 6%) without significant hypoglycemia
eAG	126 or lower	154 or lower

These target blood glucose levels are plasma values.

Glycated Hemoglobin (A1C)

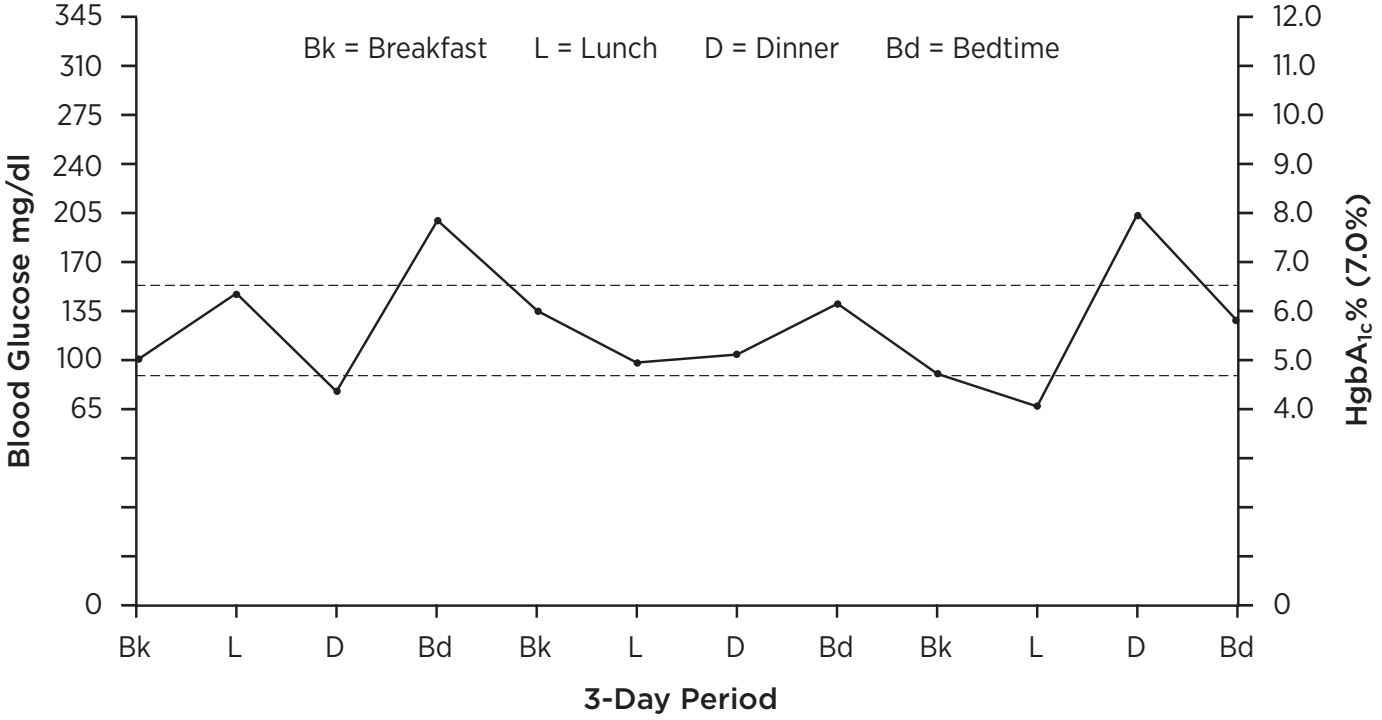
Your blood contains red blood cells. These cells usually live for about 120 days before being replaced. Hemoglobin is the part of the red blood cell that carries oxygen from the lungs to all the cells in the body. There are several types of hemoglobin found in red blood cells. One type is hemoglobin A1C.

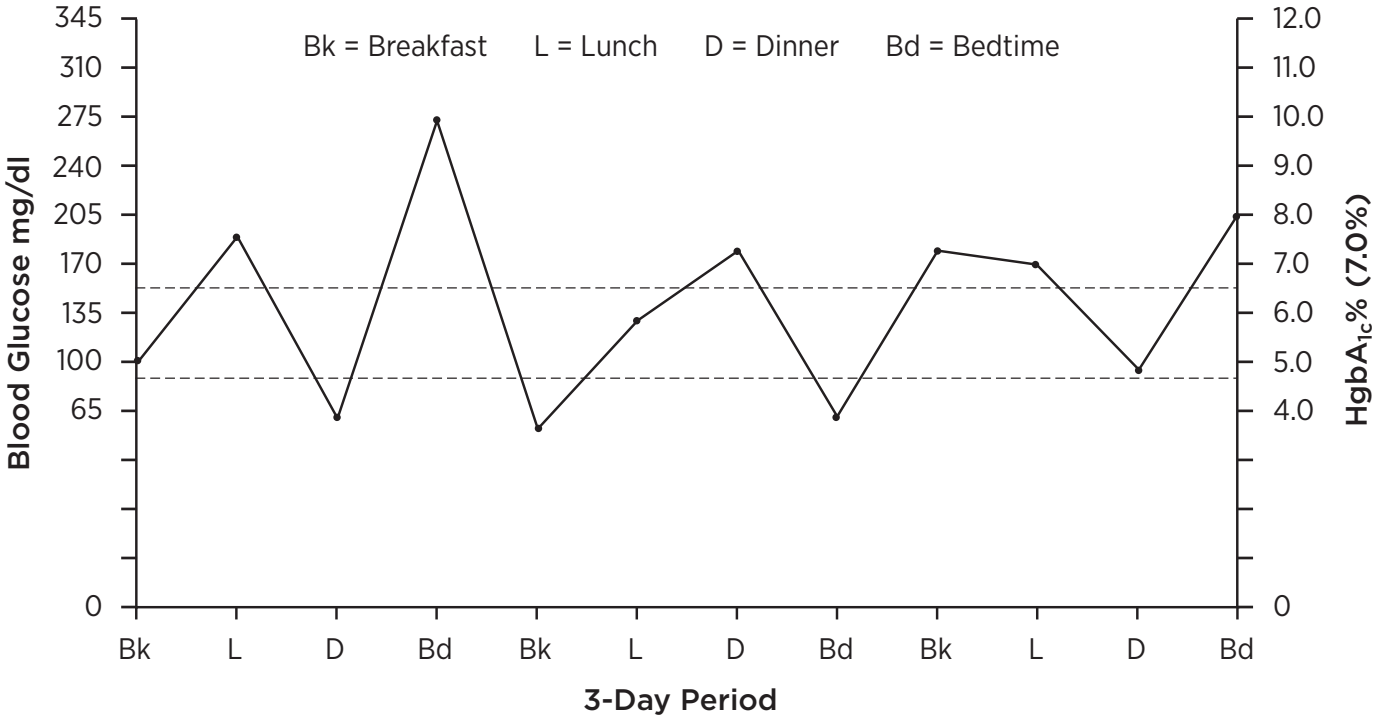
Blood glucose sticks to the A1C. The amount of glucose that sticks to the A1C depends on the blood glucose level over a period of weeks.

The A1C test is a blood test ordered by your health care provider. It gives a picture of the blood glucose levels over the last 2 to 3 months. The A1C test tells us the percent of glucose attached to the hemoglobin. The higher the glucose levels, the higher the A1C results. The A1C test alone is not enough to manage your glucose. It doesn't replace the home glucose monitoring done daily to control your diabetes.

A normal or near normal A1C may not mean your diabetes is in good control. For example the graphs on the next page show two people, both with an A1C of 7%.

Glucose and hemoglobin A1C results comparison





Notice how the bottom graph shows low and some very high readings. If you are having many low and high blood glucose readings, your diabetes is not in good control, but your A1C will reflect an average glucose in a desired range. The A1C value is most useful when used with home blood glucose monitoring results to determine your level of blood glucose control.

Using the chart below, current blood glucose readings can be compared to an A1C goal. For example, if an A1C of 7% were desired, daily glucose readings should average 154 mg/dl. If blood glucose readings have generally been between 180 to 200, an A1C of 8.0 to 8.5% would be expected.

A1C Results	eAG
5%	97 mg/dl
5.5%	111 mg/dl
6%	126 mg/dl
6.5%	140 mg/dl
7%	154 mg/dl
7.5%	169 mg/dl
8%	183 mg/dl
8.5%	197 mg/dl
9%	212 mg/dl
9.5%	226 mg/dl
10%	240 mg/dl
10.5%	255 mg/dl
11%	269 mg/dl
11.5%	283 mg/dl
12%	298 mg/dl
12.5%	312 mg/dl
13%	326 mg/dl
13.5%	341 mg/dl
14%	355 mg/dl
14.5%	369 mg/dl
15%	384 mg/dl

mg/dl – milligrams per deciliter

Estimated average glucose (eAG)

The estimated average glucose (eAG) is based on the A1C results. The eAG is a new way to report A1C results. The eAG is reported in the same units (mg/dl) seen on glucose meters and lab reports, making it easier to compare results and goals.

American Diabetes Association
The usual goal for people with diabetes is to have the A1C result under 7% to reduce the risk of eye, kidney, and nerve damage!

Ketone monitoring

What are Ketones and why do they need to be monitored?

- When the body's cells do not have enough glucose for energy, they burn fat; this process creates ketones; high amounts of ketones are harmful.
- Ketone monitoring is done by those who take insulin and is most commonly used by people who have type 1 diabetes. It is rare to have high ketone levels in type 2 diabetes. People with type 2 diabetes can develop ketones during severe physical stress caused by infections or severe injuries.
- Kidneys act like a filtering system, cleaning the blood. Urine is produced during this cleaning process; urine carries wastes out of the body, including ketones.
- Pregnant women with pre-existing diabetes are often advised to monitor urinary ketones every morning, or as directed by their provider.

To ensure accuracy

- Check the expiration date on the container of ketone strips.
- Read instructions carefully; different manufacturers may have differences in procedures.
- Store ketone monitoring supplies in a dark, cool, dry place; but not in the refrigerator.

When should you monitor for ketones in your urine?

- Monitor your ketones whenever you are ill.
- Monitor your ketones when your blood glucose level is consistently above 300 mg/dl for unexplained reasons.
- Monitor your urinary ketones regularly if you are losing weight by calorie reduction.
  - If blood glucose levels remain normal, the ketones found indicate fat breakdown and weight loss, and not a problem with your diabetes.
  - In type 1 diabetes, be aware that calorie restriction and the resulting insulin reduction can result in hyperglycemia. Urine ketones could result in ketoacidosis if insulin is reduced too much.

What should I do if I have ketones in my urine?

- Drink water or other sugar-free caffeine-free drinks to help prevent dehydration; at least 8 ounces each hour is recommended.
- Monitor blood glucose and urine ketones every 2 hours until they return to your normal levels.
- Call your health care provider if the tests remain elevated, you have concerns, or you feel sick.
- Follow your doctor's instructions for ketone monitoring and reporting.

Seek medical care immediately if you have:

- Stomach pain
- Nausea and/or vomiting
- Rapid breathing
- Sweet, fruity-smelling breath

The above symptoms are early signs of diabetic ketoacidosis (DKA), a life threatening condition. If you suspect that you are having DKA, go immediately to the emergency department or call an ambulance.

Continuous Glucose Monitoring Systems (CGMS)

A Continuous Glucose Monitoring system, or CGM, is a device that is attached to your body and constantly monitors your glucose levels.

This is a device typically worn by individuals with diabetes who take multiple daily injections of insulin and/or who may have hypoglycemia unawareness (see Section K-13, Hypoglycemia).

This device will either send a signal to a receiver or mobile device or can be read by scanning the sensor with a reader device.

Types of Continuous Glucose Monitoring Systems

Name	Highlights
Medtronic Guardian (Model 670G)	• Works with Medtronic Insulin Pump • Monitors and adjusts insulin based on sensor glucose readings • Device is worn for seven days on arm or abdomen • Device has alarms to warn of high or low glucose
Dexcom G5	• A separate CGMS that monitors glucose levels continuously • Device is worn for seven days on arm or abdomen • Device has alarms to warn of high or low glucose • Device can sync with a receiver or some mobile phones
Freestyle Libre (for personal use)	• A separate CGMS that monitors glucose levels • Device is worn on the back of the arm for up to ten days • Device works by scanning the sensor with a reader device

NOTE: A prescription from your doctor is needed to have a CGMS. Contact your primary provider for your diabetes care if you feel a CGMS would help you.