

Living with Diabetes: Keeping Track of Your Blood Glucose¹

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Living with diabetes involves setting goals, adjusting your lifestyle to meet your treatment goals, evaluating your progress, and changing practices as needed. One key goal of diabetes management is to attain glycemic (blood glucose) control to reduce the risk of health complications. Healthy lifestyle practices, such as eating well, engaging in physical activity, and using medications as prescribed, contribute to glycemic control and to an overall healthy life.

Keeping track of blood glucose allows people with diabetes to learn how their bodies respond to certain foods and physical activity so they can adjust to better attain their blood glucose goals. This fact sheet describes how **patient self-monitoring** and **hemoglobin A1C testing** are used to help people with diabetes reach their treatment goals.

Patient Self-Monitoring

Patients can monitor their blood glucose using a blood glucose monitor (meter) or a continuous glucose monitoring (CGM) system. Most people with diabetes commonly self-monitor their blood glucose (SMBG) using a blood glucose meter.

How Self-Monitoring of Blood Glucose (SMBG) Works

Many types of blood glucose meters are available, and they all work in a similar way to measure current blood glucose concentration. Most modern meters measure glucose in

plasma, which is the liquid portion of blood, rather than using whole blood.

To begin, the patient sticks a clean finger or other recommended site with a needle called a lancet. With most meters, the tiny blood sample is dropped onto a test strip, which is then fed into the meter. The meter measures blood glucose concentration and expresses the value as milligrams per deciliter (mg/dl).



Figure 1. Today's blood glucose meters use only a tiny amount of blood. Credits: iStockphoto

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When to Self-Test

The American Diabetes Association (ADA) recommends that people who use multiple insulin injections or insulin pump therapy test their blood glucose six to eight times per day. This includes testing prior to meals and snacks, occasionally after meals (postprandial), and at bedtime. For persons using fewer insulin injections, adjunct therapies, or only medical nutrition therapy, blood glucose testing can serve as a guide to reach treatment goals. Testing two hours after beginning a meal or snack (postprandial) helps patients know if they are eating appropriate types and amounts of food. Patients should discuss the optimal frequency and timing of SMBG with their health care team.



Figure 2. Testing plasma glucose after a meal or snack (postprandial) provides information about how your body reacts to certain foods. Credits: BananaStock

Benefits of Regular Testing

Today's meters store many blood glucose values, and these can be downloaded by the patient and the physician or other health care provider at a patient's appointment. Using this data, the patient and health care provider can review the daily blood glucose measurements and make decisions about self-care practices to improve glycemic control. In this way, keeping track of blood glucose on a daily basis can be empowering for people with diabetes.



Figure 3. Blood glucose meters store test results that your health care provider can download at your appointments. Credits: iStockphoto

How Continuous Glucose Monitoring (CGM) Works

Continuous glucose monitoring is a method of measuring glucose at short intervals using a three-part system. CGM measures interstitial fluid glucose, which correlates well with plasma glucose. CGM systems include a sensor, transmitter, and monitor. The sensor is inserted under the skin and remains in place for several days or up to a week. A transmitter attached to the sensor sends glucose readings to an insulin pump or monitor worn on a belt or waistband.

The monitor or pump sounds an alarm when glucose levels are above or below a set concentration. This alerts the patient to a potential high or low glucose level so they can take action to avoid a dangerous situation.

Using a CGM system does not eliminate the need to test blood glucose using a meter. The CGM device has to be calibrated against plasma glucose readings from the meter, and highs or lows need to be verified the same way before action is taken to lower or raise blood glucose. CGM readings should not be used as a basis for treatment changes.

Potential Barriers to Using CGM

CGM systems are fairly expensive and may not be covered by insurance. Another barrier is they can be complicated for some people to use. It takes time to learn how to use a CGM system, and calibrating the monitor and changing

the sensor at least weekly are time-consuming. In addition, CGM systems provide a lot of data that could overwhelm some people.

Hemoglobin A1C Testing

Hemoglobin A1C is an indicator of blood glucose control throughout several months. High A1Cs can be used to predict potential diabetes complications. A1C is expressed as a percent—it is the percent of hemoglobin that has glucose attached and is related to the blood glucose concentration. Health care providers usually conduct A1C tests, but home test kits are available.

When to Test

The ADA recommends that patients who are meeting their treatment goals and have stable glycemic control have their A1C tested at least twice a year. Quarterly testing is suggested for those who are not in good control or those who had their therapy changed. Health care providers consider many factors when recommending a testing schedule for an individual patient.

Estimated Average Glucose

There is a strong correlation between A1C and average plasma glucose. Because patients are used to blood glucose being expressed as mg/dl, expressing A1C the same way may have an advantage. Therefore, recent consumer materials from the ADA use the term *estimated average glucose* (eAG) to express glycemic control as measured by the A1C test (Table 1).

Table 1. Estimated average glucose (eAG) that expresses glycemic control as measured by the A1C test

A1C (%)	eAG (mg/dl)
6	126
6.5	140
7	154
7.5	169
8	183
8.5	197
9	212
9.5	226
10	240
10.5	255
11	269
11.5	283
12	298

Keep in mind that eAG calculated from the A1C test may be different from average blood glucose downloaded from a blood glucose meter.

Summary

Blood glucose testing is critical for successfully managing diabetes. SMBG and CGM are two ways that individuals can test their blood glucose on a daily basis. Either method provides feedback that can be useful in adjusting treatment to attain better glycemic control.

A1C testing provides a longer-term picture of glycemic control and helps predict risk for diabetes complications. Estimated average glucose expresses blood glucose in $\mu\text{mol/L}$, the same units used in daily monitoring, which may improve understanding of glycemic control.

All people with diabetes should speak with their health care providers to determine the optimal schedule of blood glucose testing to help them reach their treatment goals.

For More Information

- National Diabetes Education Program - <http://www.ndep.nih.gov/>
- UF/IFAS Extension - <http://solutionsforyourlife.ufl.edu>
- American Association of Clinical Endocrinologists - <http://www.aace.com>
- American Association of Diabetes Educators - <http://www.diabeteseducator.org>
- American Diabetes Association - <http://www.diabetes.org>
- Joslin Diabetes Center - <http://www.joslin.harvard.edu>