

Living with Diabetes: Keeping Track of Your Blood Glucose¹

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Living well with diabetes involves setting goals, making lifestyle adjustments to meet treatment goals, evaluating progress, and adjusting practices as needed. One key goal of diabetes management is to attain glycemic (blood glucose) control to reduce 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 persons with diabetes to learn how their bodies respond to certain foods and physical activity so they can make adjustments to better attain blood glucose goals. This fact sheet describes how **patient self-monitoring** and **hemoglobin A1C testing** are used to help persons with diabetes attain 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. The primary method currently used by individuals with diabetes to monitor their blood glucose is self-monitoring of blood glucose (SMBG) using a blood glucose meter.

How SMBG Works

There are many types of blood glucose meters, but they all work in a similar way to measure current blood glucose concentration. Actually, most modern meters measure glucose in plasma, which is the liquid portion of blood, rather than 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 fed into the monitor. The monitor measures blood glucose

concentration and expresses the value as milligrams per deciliter (mg/dl).



When to Self-Test

The American Diabetes Association (ADA) recommends that persons using either multiple insulin injections, or insulin pump therapy, test their blood glucose three or more times per day. For persons using fewer insulin injections,

adjunct therapies, or only medical nutrition therapy, blood glucose testing can serve as a guide to reaching 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 with their health care team the optimal frequency and timing of SMBG for them.

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Benefits of Regular Testing

Meters today store many blood glucose values, which can be downloaded by the physician or other health care provider at the next appointment. By reviewing blood glucose measurements taken at various times of the day over a period of time, the patient and health care provider can 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 the person with diabetes.

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. Attached to the sensor is a transmitter that sends glucose readings to an insulin pump or monitor that is worn on a belt or waistband.

The monitor or pump is programmed to sound an alarm when glucose levels are above or below a set concentration. This can alert the patient to a potential high or low and action can be taken to avoid a potentially 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 blood glucose reading 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. They also can be fairly complicated for some people to use which can be a barrier to their use. It takes time to learn how to use the system and calibrating the monitor and changing the sensor at least weekly is time consuming. In addition, CGM provides a lot of data that could be overwhelming for some people.

Hemoglobin A1C Testing

Hemoglobin A1C (A1C) is an indicator of blood glucose control over the past two to three months and is an indicator of potential diabetes complications. A1C is expressed as a percent: the percent of hemoglobin that has glucose attached, which is related to blood glucose concentration. This test is generally conducted by a health care provider, although 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 two times a year. For those who are not in good control or who have had their therapy changed, quarterly testing is suggested. Health care providers consider many factors when recommending a testing schedule for an individual patient.

Estimated Average Glucose

A1C correlates fairly well with mean (average) plasma glucose. Since 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)
5	97
5.5	111
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 quite different from average blood glucose downloaded from a blood glucose meter.

Summary

Blood glucose testing is critical for successful management of 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 is predictive of diabetes complications. Estimated average glucose expresses blood glucose in mg/dl, the same units used in daily monitoring, which may improve understanding of glycemic control.

All persons with diabetes should discuss with their healthcare provider the optimal schedule of blood glucose testing to help them reach their treatment goals.

Web Sites for More Information

National Diabetes Education Program

<http://www.ndep.nih.gov/>

University of Florida 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>