

Home Blood Glucose Monitoring



SHERRI SHAFER, R.D., Certified Diabetes Educator

Self-monitoring of blood glucose (SMBG) with home blood glucose monitors is essential. The blood glucose (BG) results are used to assess the efficacy of therapy, and to provide data by which to make management decisions.

Typically, patients who use insulin should be SMBG *at least* 3-4 times per day. Some type 1's check as much as 6-8 times per day. Individuals with type 2 diabetes should SMBG, but if well controlled they may need somewhat less frequent checks. Patients on diet therapy without medications may only need to check BG a few times per week. Type 2's using oral agents should check at least 1-2 times daily, and vary the times. When BG control is sub-optimal, frequency of monitoring should be increased to provide data for therapy changes. To assure proper technique, patients should receive training on meter use.

Blood sugar monitoring provides information about how the diabetes is doing. Don't refer to the numbers as "good" or "bad." The fact that the blood sugar is checked is *good*, no matter what the results are. Refer to numbers as "in target", or "out of target". If the number is above target, one can choose to do something about it. I can't tell you how many people have come to their clinic appointments and have made up numbers to write in their logbooks. They didn't want to write the high numbers down, so they made up numbers that they thought were better. Kids do it because they want to please their parents. Adolescents do it because sometimes they forget to test or don't want to test as often as they are told to. I've even seen parents make up numbers in their child's logbook because they were afraid the medical team would judge them for not being able to better control their child's diabetes. I've seen pregnant women make up numbers to fool the team because they didn't want to go on insulin. Some adults have done it because they didn't know how to work the monitor and were too embarrassed to ask for help. There is no shame in having diabetes. Truthful, accurate blood sugar logs are *critical* in making decisions regarding treatment. It is so easy for the individual with diabetes to identify themselves with their numbers, and feel bad about themselves when the blood glucose isn't in control. *We all* need to treat the data non-judgmentally.

Why Monitor the Blood Sugar?

Blood glucose levels change throughout the day in relation to meals, medications, and activity. Stress, pain, and illness can also cause blood glucose fluctuations. Checking the blood glucose at various times of the day can provide a snapshot view of what's happening. Assuring that the blood glucose is well controlled is critical in preventing diabetes-related complications. The hemoglobin A1c test provides important information and this test should be done every 3 months, but not in lieu of home blood glucose monitoring.

Choosing a Meter

There are many meters on the market. They are all pretty small and easy to use, some easier than others. Most meters have a memory and retain a record of blood glucose results. Some meters are downloadable and can provide computer printouts and graphs. Other meters have data management systems that allow input of data such as meal carbohydrate grams eaten, exercise, or insulin doses received. Meters are available for the visually impaired. A clear, step-by-step voice prompts the visually impaired person through the testing procedure. The technology is impressive.

Many insurance companies dictate which meter and supplies they will cover. Given the cost of strips (approximately .75 per strip), it is important to find out which meter that they will cover.

Considerations when choosing or prescribing a meter:

- Ease of use.
- Required blood sample size: Sample size varies from 1/3 microliter to 15 microliters.
- BG range meter is capable of reading: Most meters read in the range of 20-600 mg/dl.
- Time to wait for results: Meters vary between 5 and 45 seconds.
- Size of display numbers
- Size and style of meter
- Number of values stored in memory: Between 10 and 450 values, depending on meter.
- Ability to download meter data to computer software for printouts.
- Calibration (whole blood versus plasma referenced).
- Test strip technology: capillary strips versus placing drop of blood on target on strip.
- Hematocrit range that meter can operate within.
- Capacity for alternative site testing (such as forearm, hand, thigh).
- Ability to reapply blood to the strip when sample size insufficient.
- Ability of meter to check for serum ketones.
- Type of battery required.

Meters operate within a reasonable margin of error; typically plus or minus 5-10 percent. Some meters come with a special check strip that can be inserted into the meter

to make sure the electronics are working correctly. Control solutions are available to use with test strips to check meter accuracy. Meters should be checked periodically to assure they are working properly. I usually advise patients to run control solutions every 3 months. Most meters require a “code” to be programmed into the meter to match the current batch of test strips. The code must be changed with every new bottle of strips. Failing to do so can interfere with the meter’s ability to provide accurate results. Test strips need to be kept in the vial or package they came in. Exposure to light and moisture can ruin them.

When to test:

The optimal time and frequency of SMBG depends on the patient's age, type of diabetes, type and timing of medication, co-morbidities, treatment goals, and history of glycemic control.

Possible times to check blood glucose:

- Fasting blood glucose.
- Before meals.
- 1-2 hours after meals for peak postprandial value.
(*Before and after meal* blood sugar checks are important to show the response to the foods eaten.)
- Occasionally, check at 2-3 AM. This check can ensure that medication doses are correct, and expose nocturnal hypoglycemic episodes that may be going unnoticed.
- Before and after exercise to see individual response to various forms of activity. This check will provide the individual with type 1 diabetes needed information for adjustments to the regimen. Type 2's will find it very rewarding to see how exercise can improve blood sugar levels.
- Before driving a car for anyone on insulin or oral hypoglycemic agents. This is especially critical for teens, and for anyone with hypoglycemia unawareness, or a history of low blood sugar.
- When experiencing symptoms of hypoglycemia.
- When drinking alcohol, given the increased risk for hypoglycemia since alcohol inhibits gluconeogenesis.
- Increase the frequency of monitoring during illness.
- Increase the frequency of monitoring to assess changes in therapy.

Blood glucose targets for non-pregnant individuals with diabetes

	<u>Normal</u>	<u>Goal</u>	<u>Additional Action Suggested</u>
Preprandial	< 110	90-130	< 90, >150
Postprandial	< 140	140-180	> 180
Bedtime	< 120	110-150	< 110, >180

* Individual targets should be established with the input of the medical provider. It may be prudent to set the targets higher for certain patient populations, such as young children given the risks that hypoglycemia can affect cognitive development, the elderly who are at risk for falling, patients with hypoglycemic unawareness or other complications.

** The above values are plasma referenced and expressed in mg/dl. (Most blood glucose monitors are plasma referenced. For meters that provide readings as whole blood values, the numbers would be 10-15 percent lower.)

*** If you are more familiar with millimoles per liter, you can convert mg/d to mmol/l by dividing by 18.

Record Keeping

No one wants to review a meter's memory, number by number, and try to make sense of the information. A written logbook offers the added benefit of organizing blood sugar readings into the various times of the day. It allows both the patient and the health-care team to see glycemic patterns. When a reproducible pattern is observed, a treatment plan can be instituted. I advise patients to call when they notice a pattern that indicates inadequate control. All too often patients check their blood glucose levels, write down the numbers (or not), without using the information to problem solve. Patients have to be taught what to do with the numbers, and when to contact their healthcare providers. On the flip side, we health care providers must look at the blood glucose logbooks and interact with our patients regarding the numbers. Nothing is more frustrating for patients than to keep records and then have the healthcare team ignore the data.

Computer printouts from the downloaded meter data are helpful, but shouldn't replace keeping written records. If patients just download their meter information the day of their appointment, then it's likely that they have not been reviewing the data on a daily and weekly basis, and are less likely to see patterns of control.