

Self-Monitoring of Blood Glucose (SMBG) in Diabetes

Self-Monitoring of Blood [Glucose](#) (SMBG) is an approach whereby people with diabetes measure their blood sugar (glycemia) themselves using a glycemic reader (glucose meter). SMBG has multiple advantages including:

1-It gives diabetic patients the ability to check the impact of different elements ([diet](#), [exercise](#), [insulin](#), [antidiabetics](#), [stress](#), [illness](#)) on their blood glucose and make adequate adjustments, if necessary.

2-It completes the information provided by [glycated hemoglobin \(HbA1C\)](#).

3-It gives diabetic patients the ability to identify, quickly treat and prevent [hypoglycemia](#) or [hyperglycemia](#).

4-It empowers patients to develop self-confidence and autonomy.

A major diabetes trial conducted in community pharmacies which involved free distribution of blood glucose monitors, education on use, and ongoing monitoring demonstrated improved diabetes control.

However, to fully benefit from self-monitoring, adequate training by a specialized health professional is *essential and should include the following elements*:

1-The technical aspects of self-monitoring.

2-Blood glucose targets.

3-When and how often to measure blood glucose.

4-What action to take based on the readings obtained.

5-Re-evaluating (every 3 to 6 months) when, and how often, to self-monitor, based on your clinical condition and readings.

In addition, it is crucial that health care providers be aware of the differences in accuracy among glucose meters: only U.S. Food and Drug Administration–approved meters should be used with unexpired strips, purchased from a pharmacy, or licensed distributor.

FREQUENCY OF SMBG

ADA recommendations concerning the frequency of SMBG are as follows:

1-In patients with type 1 diabetes (T1D) or with type 2 diabetes (T2D) on intensive insulin therapy (multiple daily injections) or on insulin pump: At least 4 blood glucose readings per day (before meals and at bedtime and, in certain circumstances, 2 hours after a meal and when any other situation presents a risk of hypoglycemia).

2-In pregnant women with pre-existing or gestational diabetes, morning fasting and post-prandial (1 or 2 hours post meals) readings are recommended. Some pregnant patients with pre-existing diabetes should also test pre-prandially.

3-In patients with T2D being treated with a single insulin injection per day and anti-diabetic medication: At least 1 blood glucose reading per day at different times of the day (fasting, before meals, 2 hours after a meal or at bedtime)

4-In patients with T2D not being treated with insulin, evidence is considered insufficient to recommend specific routine SMBG except circumstances (*cf next statement*)

5-Certain situations may require a diabetic patient to measure blood glucose more often: A recent diabetes diagnosis, starting a new treatment, Not reaching target blood glucose levels, at first signs of hypoglycemia and A medical condition or drug that could affect blood glucose control.

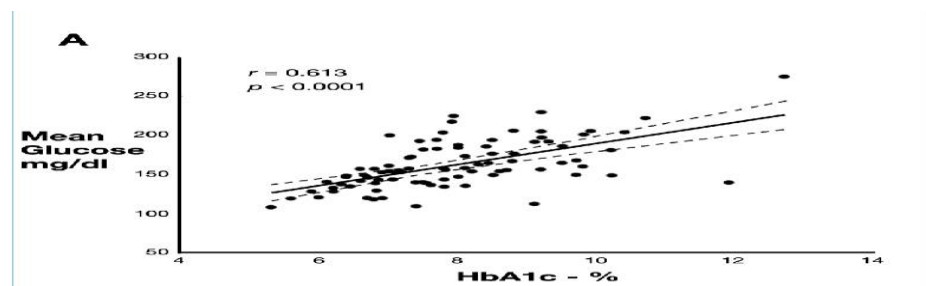
Major clinical trials of insulin-treated patients have included self-monitoring of blood glucose (SMBG) as part of multifactorial interventions to demonstrate the benefit of intensive glycemic control on diabetes complications. SMBG is thus an integral component of effective therapy of patients taking insulin.

EVALUATION OF SMBG

There are several methods for evaluating SMBG results, including manual review of patient diaries or logbooks, use of meter memory histories and computation, and electronic meter downloads with external software analysis. Regardless of method, there are five standard goals for a systematic review:

- Estimate the average blood glucose control and variation throughout the day.
- Identify patient safety with regard to hypoglycemic trends or events.
- Understand the factors influencing blood glucose control.
- Suggest strategies for achieving improved blood glucose control.
- Provide reinforcement to patients that this information is valuable and useful in their care.

The average or mean blood glucose (using at least a 3-day history) can provide an idea of diabetes control and allow for counseling on factors that may have affected blood glucose, including diet, physical activity, and medications. Mean blood glucose has been shown to have good correlation with A1c measurement (cf fig 1)



Glucose	mg/dl	mmol/l
• Pre-prandial	70-130	3.9-7.2
• 1h PP	100-180	5.6-10
• 2h PP	80-150	4.4-8.3

In older diabetic patients or in the presence of co-morbidities targets should be individualized.

Suitable BG targets in healthy young diabetics

CORRELATION WITH HbA1c

HbA1C test is an indirect measure of average glycemia over approximately 3 months. This test remains the major tool for assessing glycemic control and has strong predictive value for diabetes complications, thus, A1C testing should be performed routinely in all patients with diabetes.

A1c measurement, however, is subject to some limitations: as with any laboratory test, there is some variability in the measurement of A1C. Also, conditions that affect red blood cell turnover (hemolytic and other anemias, glucose-6-phosphate dehydrogenase deficiency, recent blood transfusion, use of drugs that stimulate erythropoiesis, end-stage kidney disease, and pregnancy) may result in discrepancies between the A1C result and the patient's true mean glycemia. Particularly during pregnancy, A1c levels are lower compared to non-pregnant state mainly due to decreased erythrocyte lifespan.

Generally, A1C levels and SMBG correlate well, on the other hand A1C does not provide a measure of glycemic variability or hypoglycemia. A1C may also inform the accuracy of the patient's SMBG.

CONTINUOUS GLUCOSE MONITORING (CGM) SYSTEMS

CGM devices are now available for home use for patients with diabetes. CGM has evolved rapidly in both accuracy and affordability with readings displayed every 5 minutes.

CGM measures interstitial glucose (which correlates well with plasma glucose).

Some real-time systems require calibration by the user, which varies in frequency depending on the device.

*Assessment of **Time in range (TIR)** using CGM devices was shown to be associated with the risk of microvascular complications. TIR is increasingly used for assessment of glycemic control. Additionally, time below target (<70 and <54 mg/dL [3.9 and 3.0 mmol/L]) and time above target (>180 mg/dL [10.0 mmol/L]) are useful parameters for reevaluation of the treatment regimen.*

Few randomized controlled trials (RCTs) have been performed using real-time CGM devices and showed improvement in time spent in hypoglycemia.

When prescribing continuous glucose monitoring (CGM) devices, robust diabetes education, training, and support are required for optimal CGM device implementation and ongoing use.

People using CGM devices need to have the ability to perform self-monitoring of blood glucose in order to calibrate their monitor and/or verify readings if discordant from their symptoms.

SUMMARY

For many people with diabetes, glucose monitoring is key for the achievement of glycemic targets. SMBG is an integral component of effective therapy of patients taking insulin. Although SMBG in patients on noninsulin therapies has not shown clinically significant reductions in A1C, it may be helpful in a treatment adjustment program.

In recent years, CGM has emerged as a complementary method for the assessment of glucose

levels. While A1C is currently the primary measure guiding glucose management and a valuable marker of the risk of developing diabetes complications, integrating SMBG and CGM results with A1c measurements provide for a much more personalized diabetes management plan. The patient's specific needs and goals should dictate SMBG frequency and timing or the consideration of CGM use.

REFERENCES

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