

Protocols of SMBG in Various Insulin Regimens- A Practical Guide for Titration and Control

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Self-monitoring of blood glucose (SMBG) has become one of the mainstays of modern diabetes management. SMBG helps to provide information about blood sugar values in a patient at different points of time, thereby enabling identification of patterns and tailoring of treatment regimens to the individual's requirements.

The following are the benefits of SMBG:

- It helps in planning antidiabetic drug regimens and in optimizing existing regimens
- It helps in the recognition of hypoglycemic and hyperglycemic episodes and improves quality of life
- It serves as a motivational and educational aid to patients, by encouraging them to adhere to the lifestyle and drug prescription

Several randomized controlled trials have demonstrated the efficacy of SMBG. In type 1 diabetes patients, SMBG has been shown to be associated with improved health outcomes (1). Moreover, increasing frequency of SMBG has been shown to be linearly correlated with reductions in glycated hemoglobin (HbA1c) levels in type 1 diabetes patients. Similar results have been obtained in type 2 diabetes patients (2) However, some studies have shown little or no correlation between SMBG and level of glycemic control (3). Nevertheless, most diabetologists today recommend SMBG as part of the diabetes treatment plan.

Who should do SMBG?

The following categories of patients might be expected to benefit the most from SMBG (4).

- Type 1 diabetes patients
- Type 2 diabetes patients on multiple daily doses of insulin
- Pregnant diabetic patients on insulin
- Patients on insulin pump therapy

In a developing country like India, other factors like affordability and availability of glucometers and strips should also be considered before recommending SMBG.

How often should one perform SMBG?

There is, as yet, no consensus regarding the optimal frequency and timing of SMBG in patients with type 1 and type 2 diabetes. The guidelines issued by the International Diabetes Centre Global Consensus Conference on Glucose Monitoring offer the most practical aid to clinicians and patients (5). Based on these guidelines, we offer below some practical guidelines for SMBG in various insulin regimens.

In type 1 diabetes patients

Patients with type 1 diabetes, whether on multiple daily doses of insulin or insulin pump therapy, should perform SMBG at least thrice a day. At the time of initiation of insulin therapy, it would be more practical to check the before-meal values (fasting, pre-lunch and pre-dinner) (Fig.1). This will help one to fix the dose of the intermediate or long-acting insulin (or the basal infusion rate in case of the insulin pump). Once the preprandial values are at target, one can concentrate on the post-meal values. This in turn will help in setting the dose of

Fig. 1
SAMPLE SMBG REGIMEN- Type 1 Diabetes
Initial Phase

Day	Fasting	After breakfast	Before lunch	After lunch	Before dinner	After dinner	3 a.m.
Monday	✓		✓		✓		
Tuesday	✓		✓		✓		✓
Wednesday	✓		✓		✓		
Thursday	✓		✓		✓		
Friday	✓		✓		✓		
Saturday	✓		✓		✓		✓
Sunday	✓		✓		✓		

the rapid acting insulin (or the bolus dose in the case of insulin pump)(Fig.2)

Fig. 2
SAMPLE SMBG REGIMEN- Type 1 Diabetes
Optimisation Phase

Day	Fasting	After breakfast	Before lunch	After lunch	Before dinner	After dinner	3 a.m.
Monday	✓	✓		✓			
Tuesday	✓			✓		✓	
Wednesday	✓	✓				✓	
Thursday		✓		✓			✓
Friday	✓			✓		✓	
Saturday	✓	✓				✓	
Sunday		✓		✓			✓

Once a stable insulin regimen is established, the three point testing schedule can be continued, now with a judicious mix of preprandial and postprandial readings. In general, if the HbA1c is 8.4% or less, the postprandial sugars contribute more to the hyperglycemia and should be preferentially tested. If HbA1c is more than 8.4%, one should concentrate on normalizing the fasting and preprandial values before attempting control of postprandial hyperglycemia.

Occasionally, patients with type 1 diabetes should also check their blood sugars at 3 a.m. This will help in the detection of unrecognized hypoglycemia in the night when blood sugars tend to drop and is particularly important in the evaluation of unexplained fasting hyperglycemia (Somogyi syndrome).

Patients should perform SMBG more often than mentioned above under certain circumstances. Hypo- or hyperglycemic symptoms, hypoglycemia unawareness, intercurrent illness, gastroparesis, pregnancy, use of drugs like steroids, changes in antidiabetic regimen and strenuous physical activity all warrant more frequent SMBG.

In type 2 diabetes patients

Patients on intensive multiple dose insulin regimens

should follow the same guidelines as type 1 patients for SMBG.

Patients on less intensive therapy need to test less often. If the HbA1c is above target, one should monitor at

Fig.3
SAMPLE SMBG REGIMEN- Type 2 Diabetes
HbA1c above target

Day	Fasting	After breakfast	Before lunch	After lunch	Before dinner	After dinner	3 a.m.
Monday	✓	✓					
Tuesday	✓			✓			
Wednesday	✓					✓	
Thursday	✓	✓					
Friday	✓			✓			
Saturday	✓					✓	
Sunday	✓	✓					

Fig.4
SAMPLE SMBG REGIMEN- Type 2 Diabetes
Multiple tests per Day

Day	Fasting	After breakfast	Before lunch	After lunch	Before dinner	After dinner	3 a.m.
Monday							
Tuesday	✓	✓	✓	✓			
Wednesday							
Thursday							
Friday							
Saturday							
Sunday							

Fig.5
SAMPLE SMBG REGIMEN- Type 2 Diabetes
Tests staggered over a week

Day	Fasting	After breakfast	Before lunch	After lunch	Before dinner	After dinner	3 a.m.
Monday	✓						
Tuesday		✓					
Wednesday				✓			
Thursday	✓						
Friday						✓	
Saturday				✓			
Sunday		✓					

least two times daily. Ideally the two tests should consist of one pre-meal and one post-meal reading; the exact timings may be varied from day to day. (Fig.3)

Patients whose HbA1c value is at target need to check preferably daily, but at least four times a week. They can check their sugars at different times on each day, thereby enabling them to build up a 24-hour glucose profile over the course of a week or so (Fig.4). Conversely, they can check all the values (fasting, postbreakfast, prelunch, postlunch, predinner and post dinner) on the same day on a weekly basis, but this involves multiple pricks on a single day and may not be acceptable to most patients (Fig.5).

Using the data obtained from SMBG

For a patient to obtain maximum benefit from SMBG, the data so obtained should be recorded, analysed and acted upon in the form of alterations in the medications as well as non-pharmacological therapies.

Several of the newer glucometers have memory functions and data analysis software which help in storing and graphically representing the collected data. Patients using older glucometers should maintain a diary in which records of the SMBG are entered and these should be presented to the clinician at the time of follow-up. The clinician's role is to carefully study the reports and to ascertain patterns, if any, in the readings. If the blood sugars or HbA1c seem not to be at target, these patterns will assist him in altering the antidiabetic regimen rationally in order to smoothen out the patient's blood glucose profile.

Depending on the comprehension level and motivation, patients can also be trained to look for patterns and can be encouraged to make minor alterations in their antidiabetic regimens by themselves.

Conclusion

SMBG is a useful tool in the management of both type 1 and type 2 diabetes. Used properly, it provides a wealth of information regarding the blood sugar profile of the patient and helps in improving glycemic control. Optimal regimens for SMBG are largely a matter of personal

preference and patient factors like affordability. To derive maximal benefit from SMBG, the patient and clinician should work in tandem to analyse the information obtained and take action based on the information, whenever indicated.

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