

# Self-monitoring of Blood Glucose (SMBG): Cornerstone of Diabetes Management- Bangladesh Perspective: A Recommendation

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## Summary:

*SMBG is a crucial factor in diabetes management. It offers a quick check of glycemic status, helps to identify hypoglycemia and hyperglycemia. In addition SMBG assists in clinical decision making and as such it complements HbA1c. But due to many reasons SMBG is not practiced properly and adequately. In recent years several international guidelines highlighted the importance of SMBG for diabetes management. Very few diabetic patients in Bangladesh actually perform SMBG regularly at home.*

## Background

As one of the most common chronic diseases, diabetes mellitus (DM) has wide-ranging effects involving millions of people all over the world<sup>1</sup>. It is a major global public health problem that negatively impacts health status of the patients that is rapidly getting worse. After cancer and heart disease, Diabetes is the third leading cause of death<sup>2</sup>. Apart from individual suffering, diabetes also incurs huge health expenditure both for the patients and the society. Being a lifelong disease, it requires continuous monitoring and strict adherence to physician recommended treatment. In 2006, the General Assembly of the United Nations unanimously adopted a resolution (61/225) which recognizes that diabetes is a global pandemic posing a serious threat to global health, acknowledging it to be a chronic, debilitating, and costly disease associated with major complications<sup>3</sup>. Diabetic patients need to modify their lifestyle for a better prognosis and must be involved in self-management of their disease.

Currently there are 382 million people suffering from diabetes worldwide, which is approximately 8.3% of the total adult population<sup>4</sup>. International Diabetes Federation predicts that by 2035 the number of people with diabetes will rise to 592 million, this equates to approximately three new cases every 10 seconds, or almost 10 million per year<sup>4</sup>. Among all the cases of

*The awareness of the benefits of SMBG is also low. There is no uniformity in SMBG practice among the patients as there is no local guideline to help the physicians in determining the optimum SMBG frequency for their patients. So a working guideline on SMBG is the call of the day. This article is an attempt in that direction. Exploring international guidelines and evaluating their applicability in local context a number of recommendations have been proposed.*

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diabetes, about 10% are type 1 while the rest are type 2 DM<sup>4</sup>. Eighty percent of the people with diabetes are currently living in middle and low income countries, where the epidemic is rising at an alarming rate. About 175 million people with diabetes remain undiagnosed, progressing silently to macro vascular and micro vascular complications<sup>4</sup>. Around 5 million people in 2013 died of diabetes or related complications, that is one person in every six seconds. In South-East Asia the disease is growing fast, accounting for one-fifth of total cases worldwide<sup>4</sup>. People with diabetes in India, Bangladesh, and Sri Lanka make up 98.8% of the Region's total diabetes population. In 2013 there were 72.1 million cases of diabetes; by 2035 it is set to reach 123 million, a staggering 71% increase<sup>4</sup>.

Bangladesh is a United Nations-designated least developed country (LDC) with a disproportionately high diabetes population<sup>5</sup>. Among all people living with diabetes in the 48 LDCs, more than one-third live in Bangladesh<sup>5</sup>. The national prevalence of diabetes is 5.52% with more than 12% of the adult population affected by diabetes or Prediabetes<sup>6</sup>. Almost 50% of the population with diabetes is undiagnosed<sup>6</sup>. Among those with diabetes, only 1 in 3 people is treated, and roughly 1 in 4 achieves treatment targets<sup>7</sup>.

The principal target of diabetes management is to bring down hyperglycemia to a level designated by international guideline. Numerous clinical studies showed reduction in diabetic complications as a result of improved blood glucose control<sup>8</sup>. Achievement and

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maintenance of glycemic goal helps to prevent or slow the progression to different complications of DM. All the existing diabetes management guidelines, e.g. of IDF, ADA, CDA, AACE emphasize on control of blood glucose, albeit there is a slight difference in their approaches to attainment of target glycemic level. Better implementation of these approaches is essential for the patients to understand and accomplish the desired glycemic target set out by these guidelines.

Health professionals working with diabetes and scientific societies concerned with evaluation of management strategies overwhelmingly agree that self-monitoring of blood glucose (SMBG) adds valuable information and complements the use of glycosylated hemoglobin (HbA<sub>1c</sub>)<sup>9</sup>. HbA<sub>1c</sub> is an index of long term glycemic control and a useful predictor of microvascular, macrovascular and neurological complications of DM<sup>10</sup>. However, because HbA<sub>1c</sub> is based on time-averaged result and does not provide real time feedback, it has limitations. In contrast, SMBG can distinguish between fasting, pre-prandial, and postprandial hyperglycemia; detect glycemic excursions; identify and monitor resolution of hypoglycemia; and provide immediate feedback to patients about the effect of food choices, activity, and medication on glycemic control. SMBG can also help to determine the effectiveness of the oral antidiabetic agents permitting better adjustment of the doses of these drugs than is possible with HbA<sub>1c</sub> alone<sup>11</sup>. So SMBG is an indispensable component of diabetes management. Technology has made SMBG very easy and simple to perform. Educational and supportive programs with the use of SMBG based on principles of self-management have been advocated by clinicians and educators alike<sup>12</sup>. But this approach is often underutilized because of the nature of the procedure which may be perceived as distressing by many patients.

In type 1 diabetes and insulin treated type 2 diabetes, the utility of SMBG is irrefutable. However the frequency of SMBG in non-insulin treated type 2 diabetes is less intense<sup>13, 14</sup>, although it has been demonstrated that SMBG may be associated with a healthier lifestyle and/or better disease management<sup>15</sup>. Regular and frequent SMBG also reduces HbA<sub>1c</sub> in T1DM and T2DM patients who are on insulin therapy and improves control in T2DM patients receiving oral antidiabetic drugs. A number of international guidelines

have been published specifically on SMBG, including IDF and ADA guidelines. Many countries, like Canada, Australia, India have all developed their own recommendations on SMBG on the basis these guidelines. As the timing and frequency of SMBG vary among them, a consensus statement on SMBG has also been advanced. However, there is still no uniformity in prescribing SMBG among physicians dealing with diabetes.

In Bangladesh the scenario is worse. There is no large scale population based study to assess the practice of SMBG. A study (DIABCARE) conducted in various branches of Diabetic Association revealed that the proportion of patients practicing home blood glucose monitoring was low at 31 (21.1%)<sup>7</sup>. Majority of patients 109 (77.9%) prefer blood glucose monitoring test done at the doctor's office only<sup>16</sup>, even though World Health Organization (WHO) strongly suggests that patients should continue blood glucose monitoring at home, keep the records and bring that to their physicians during consultation<sup>13</sup>. The condition of the rest of the country is most likely to be similar. The reason for the low utilization of SMBG cannot be exactly pinpointed. But it can be safely assumed that lack of awareness and motivation are important factors for such a poor SMBG practice. Many diabetic patients in Bangladesh are also uncomfortable with the idea of performing SMBG multiple times daily and may find it somewhat problematic to keep track of SMBG results in order to inform the physician about their blood glucose values in the subsequent visit. Patient reluctance also makes the some physician unwilling to prescribe

SMBG, based on the belief that their patients may not follow their advice. So there is a deficiency from the perspective of both the physician and the patients that lead to lack of proper SMBG practice as suggested by global recommendations.

Therefore a strong thrust is necessary to the direction of SMBG to make both physicians and patients aware of the importance of proper SMBG practice. There are several international recommendations but all of these may not be applicable for Bangladesh considering cultural and social differences. So it is imperative to adapt the global strategy in the local setting by appropriate modification of the published guidelines. A set of recommendations regarding SMBG in Bangladesh

must also reflect the fact that substantial disparity exist between actual and recommended frequency of SMBG testing<sup>17</sup>. A local SMBG guideline needs to incorporate these issues, bridge the gap between global and local practice of SMBG, addresses the barriers to SMBG testing and identify the most convenient frequency and timing of glucose monitoring for Diabetic patients.

### **Rationale for a local guideline on SMBG**

Institutional measurement of blood glucose (fasting or post prandial), along with assessment of HbA<sub>1c</sub> has been commonly used as the convenient means of evaluating glycemic control in patients with diabetes. However, clinic-based measurements of blood glucose may not offer an accurate picture of the glycemic pattern for a particular patient, since the settings under which the test is conducted are quite different from those prevailing at the patients home. Also, most of these tests are done in the morning hours, leaving clinicians none the wiser as to what happens to the glucose levels after the other two main meals of the day (lunch and dinner)<sup>23</sup>. Understanding the glycemic variability is crucial for the physicians in order to design treatment protocol for individual patients. Formal assessment of glycemic variability requires sophisticated methods like continuous glucose monitoring (CGM) which is not available in our country and may be difficult to implement in our existing management practice. A more practical solution is regular SMBG should give the clinician a general idea of the swings in blood glucose level in a particular patient. A number of observational studies support this claim<sup>23-25</sup>. Therefore, incorporation of SMBG into the self-management regimen with an effective educational intervention can minimize the risk of complications in diabetic patients. Consequently, most diabetologists today recommend SMBG as part of the diabetes treatment plan to the majority of their patients.

There is clear evidence concerning the value of SMBG in diabetic patients treated with insulin<sup>18-19</sup>. However, in people with type 2 diabetes who are not taking insulin, the evidence is equivocal<sup>20</sup>. McAndrew and colleagues<sup>21</sup> conducted a systematic review of relevant studies on the impact of SMBG on A1C levels in people with type 2 diabetes from 1990 to 2006 and found that evidence from the cross-sectional and longitudinal studies was inconclusive. On the contrary, a meta-analysis by Poolup and colleagues<sup>22</sup> assessing the

expediency of SMBG in individuals with type 2 diabetes demonstrated that SMBG was effective in reducing A1C levels in non-insulin-treated type 2 diabetes. Nevertheless, a global consensus conference on SMBG has found that this method is the best way for people with diabetes, as well as healthcare professionals (including diabetes educators), to assess the ongoing efficacy of all aspects of the diabetes management regimen, including, but not limited to, medication and patient behavior<sup>23</sup>.

In Bangladesh physicians themselves usually play the role of diabetes educators for their patients. A national guideline on SMBG succinctly delineating role and practice of SMBG will immensely assist them in their desire to achieve improved quality of life for individual diabetic patients. Several clinical practice guideline committees around the world have made recommendations regarding SMBG. Although IDF has prepared and disseminated a global version of SMBG recommendations, many countries develop their own SMBG strategy applicable to their situation because the ground situation may be less than ideal to implement global guideline, so it needs to be modified. The same is true for Bangladesh where reality demands adaptation of the international standards of SMBG practice to conform prevalent state of affairs. Based on the IDF, ADA recommendations and the statement of global consensus conference on SMBG, we in Bangladesh can develop our own guideline that will define the place of SMBG in diabetes care and its use within the existing health care infrastructure, in context of the social setting of our country. This will go a long way to greatly improve the health of diabetic patients from their current level, ensuring a better prognosis and longer complication free period.

So a national SMBG guideline in line with global standard is the need of the day. It is a prerequisite for management of diabetes, regardless of whether the patients use insulin or not, although the regularity and scheduling of SMBG is not identical for these two groups. A national agreement on SMBG practice will guide the physicians in preparing a management plan for their patients and to organize educational programs for them. Such a guideline is strongly linked to a patient-centric approach of care, the cornerstone of diabetes management. This will work to raise the current standard

of care in Bangladesh and guarantee that patients receive the treatment according to their clinical requirement.

### **International Guidelines: Summary**

In general, these guidelines unanimously acknowledge the benefit of SMBG in individuals with type 1 diabetes using insulin. However, the guideline committees all noted that further study is needed in cases of type 2 diabetes patients on oral antidiabetic agents. Available literature provides no clear guidance due to differences in study designs, populations and interventions.

International Diabetes Federation (IDF)<sup>24</sup> recommended that SMBG should also be considered as part of ongoing diabetes self-management education to assist people with diabetes to better understand their disease and provide a means to actively and effectively participate in its control and treatment modifying behavioral and pharmacologic interventions as needed. SMBG should be used when individuals with diabetes and/or their healthcare providers have the knowledge, skills and willingness to incorporate SMBG and therapy adjustment into their care plan in order to attain agreed treatment goals. SMBG protocols (intensity and frequency) should be individualized to address each individual's specific educational/ behavioral/clinical requirements (identify/prevent/manage acute hyper- and hypoglycemia) and provider requirements for data on glycemic patterns and monitor impact of therapeutic decision making. The purpose(s) for performing SMBG should be agreed between the person with diabetes and the healthcare provider. These agreed upon purposes/goals and actual review of SMBG data should be documented. An easy procedure for patients to regularly check on their glucose meter performance should be a requirement for SMBG use.

Various other guidelines are suggested by ADA<sup>25</sup> (American Diabetes Association), AACE<sup>26</sup> (American Association of Clinical Endocrinologists), NICE<sup>27</sup> (National Institute for Health and Clinical Excellence, UK), Canadian Diabetes Association<sup>28</sup>, Australian Diabetes Association<sup>29</sup> for their own people.

In addition there is a global consensus statement on SMBG<sup>30</sup>. According to it SMBG is recommended 3-4 times daily

for patients at or above target receiving multiple daily insulin injections or using an insulin pump, more than 2 times daily for patients above target using insulin or

oral agents or insulin plus oral agents, 2 times daily for patients at target managed with once daily insulin alone or oral agents alone. 1-2 times daily for patients at target managed with oral agents plus once daily insulin. Recommended frequencies should be varied for individual patients especially those not at glycaemic target or in the setting of other special clinical circumstances.

### **Recommendations:**

Pre- and postprandial glucose targets of the patient should be selected by healthcare provider. Individuals with diabetes should attempt to achieve and maintain target blood glucose levels. Also Individuals with diabetes (and/or their care-givers) and their healthcare providers should cultivate the knowledge, skills and willingness to incorporate SMBG monitoring and analyzing data to identify patterns of glycemic excursions, assessing any influential factors, and implementing appropriate action(s); performing ongoing SMBG to assess the impact of any therapeutic changes made. SMBG should be considered at the time of diagnosis as well as part of ongoing self- management education to enhance the understanding of diabetes as part of individuals' education and to facilitate timely treatment initiation and titration optimization. The purpose(s) of performing SMBG and using SMBG data should be agreed between the person with diabetes and the healthcare provider. Furthermore, with the availability of SMBG and glycated protein testing, routine laboratory blood glucose testing by health care providers should no longer be used to assess glycemic control except to supplement information obtained from other testing methods and to test the accuracy of SMBG. Comparisons between results from patient self-testing of blood glucose in the clinic and simultaneous laboratory testing are useful to assess the accuracy of patient results. An ongoing educational enterprise should be designed to reinforce the knowledge of SMBG use and test result interpretation by healthcare professionals. SMBG should also be integrated in the existing educational setup. Finally, urine glucose testing is not a replacement of SMBG and is restricted to those rare situations when there is no access to SMBG devices for testing.

Regarding frequency of SMBG, for patients receiving  $\geq 3$  insulin injections every day (MDI), 2-3 times daily

with full glucose profile on holiday i.e. Friday. Additionally they should check blood glucose prior to exercise, when they suspect low blood glucose, after treating low blood glucose until they are normoglycemic, and prior to critical tasks such as driving. The frequency of testing may be increased on the basis of decision of the physician. For patients receiving only 1-2 insulin injections every day/ only oral antidiabetic medications/combination of both, SMBG should be performed 1-2 times daily (Appendix B). The frequency of testing may be increased on the basis of physician's discretion. Pregnant women with insulin-treated diabetes should check their blood glucose at least 3 times daily, pre meal SMBG on alternate days and 3 post meals in the intervening days. Diabetic patients treated with only lifestyle modification, SMBG should be conducted at least weekly. SMBG practices (intensity and frequency) should be adapted to each individual's specific educational/behavioural/clinical requirements (to identify/ prevent/manage acute hyper- and hypoglycaemia) and provider requirements for data on glycaemic patterns and to monitor impact of therapeutic decision making. Patients 'should preserve accounts of home blood glucose test results and convey these to the physician in the next visit.

Regarding testing procedure SMBG use requires an easy procedure for patients to regularly monitor the performance and accuracy of their glucose meter. Plasma calibrated meters provides more accurate results compared to non-plasma calibrated meters. Meters that provide average glucose profile along with pre and post prandial values are better.

### Conclusion:

Diabetes is a significant and growing worldwide concern with potentially devastating consequences<sup>4</sup>. Optimal management of glycaemia can reduce the risk of development and progression diabetic complications. Profiling of blood glucose through self-monitoring at various times of the day is therefore essential to get an overall picture of glycemic status of the individual. When used properly, SMBG provides a wealth of information regarding the blood sugar profile of the patient and helps in improving glycemic control by reducing hyperglycemic peaks and hypoglycemic troughs and by minimizing glycemic variability.

SMBG should always be considered as complementary to measurement of glycated hemoglobin. Each provides different information which is essential for designing better patient care. The optimal regimen for SMBG has to be individualized for the particular patient and is a function of many variables including personal preference and affordability. To derive maximal benefit from SMBG, the patient and clinician should work in tandem to analyze the information obtained and take action based on the information.

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