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The Iranian Consensus on Self-Monitoring of Blood Glucose: An Expert Consensus

Seyed Adel Jahed[1], Amirkamran Nikoosokhan[2], Farhad Hosseinpanah[3], Alireza Esteghamati[4], Hengameh Abdi[5], Alireza Amirbaigloo[6], Mojtaba Malek[7], Sara Sedaghat[1]*

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Abstract

Background: Self-monitoring of blood glucose (SMBG) has long been a key aspect of diabetes management. However, with recent advancements in continuous glucose monitoring (CGM), high-income countries have increasingly shifted toward CGM use. In contrast, due to challenges in CGM accessibility and affordability in resource-limited settings, SMBG remains the most widely used method. The low uptake of SMBG in such contexts, despite its importance in diabetes self-management, highlights the urgent need for a national consensus in Iran.

Methods: A multidisciplinary team of Iranian experts in endocrinology and diabetes care, comprising members of the Gabric Diabetes Association, the Iranian Diabetes Society, and faculty from leading medical universities, developed the first Iranian expert consensus on SMBG. To facilitate implementation in clinical practice, the consensus was officially endorsed by the Ministry of Health and Medical Education of Iran.

Results: Given the affordability challenges in Iran, this consensus offers recommendations for both Standard and Limited Care settings to promote a more structured and effective approach to SMBG for healthcare providers and people living with diabetes.

Conclusion: A nationally developed SMBG guideline has been developed in Iran, offering frequency and timing recommendations based on diabetes type, treatment regimen, and level of glycemic control, aligned with international guidelines. Given the crucial role of SMBG in diabetes care, this national consensus aims to be implemented in clinical practice and policy-making.

Keywords: Iran, Diabetes Mellitus, Blood Glucose Self-Monitoring, Consensus, Resource-Limited Settings

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Introduction

Diabetes Mellitus (DM), affecting 10.5% of the global adult population, is an emerging public health challenge worldwide. Alarmingly, four out of five people living with diabetes (PWD) reside in lower-middle-income countries, which are projected to experience the highest relative increases in diabetes prevalence (1).

In Iran, the prevalence of diabetes rose significantly from 8.4% in 2004 to 13.2% in 2016 (2).

Self-monitoring of blood glucose (SMBG) has been established as one of the fundamentals of diabetes care for decades (3), particularly for those on insulin therapy (4-6). However, with the advancement in monitoring technology, the use of continuous glucose monitoring (CGM) is becoming increasingly widespread. Despite its benefits,

Corresponding author: *Dr Sara Sedaghat, s.sedaghat68@gmail.com*

1. Gabric Diabetes Education Association, Tehran, Iran
2. Iranian Diabetes Society, Tehran, Iran
3. Obesity Research Center, Research Institute for Endocrine Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran
4. Endocrinology and Metabolism Research Center (EMRC), Vali-Asr Hospital, Tehran University of Medical Sciences, Tehran, Iran
5. Endocrine Research Center, Research Institute for Endocrine Sciences, Shahid Beheshti University of Medical Sciences, Tehran 1985717413, Iran.
6. Practicing in Private Office, Tehran, Iran
7. Research Center for Prevention of Cardiovascular Disease, Institute of Endocrinology and Metabolism, Iran University of Medical Sciences, Tehran, Iran

↑What is "already known" in this topic:
Self-monitoring of blood glucose (SMBG) has been established as one of the fundamentals for diabetes care for decades. There are international guideline recommendations regarding the use of SMBG for various target groups of people with diabetes, predominantly based on the evidence from high-income countries.

→What this article adds:
Considering international recommendations, national economic circumstances, and reimbursement policies, the task force developed a national consensus to provide practical national recommendations on the frequency and timing of SMBG in diabetes care.

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the high cost of CGM remains a major barrier in lower-middle-income countries (7-10).

Various studies and guidelines highlight the role of SMBG in diabetes care, particularly highlighting its cost-effectiveness for individuals on insulin therapy (5, 6, 11, 12). However, since most guidelines are developed in high-income countries, there is a need to create context-specific consensus recommendations tailored to different resource settings and levels of healthcare access (4, 7-9, 11).

Despite its proven benefits in diabetes care, SMBG remains underutilized by both PWD and their diabetes care team (10, 13-15). In Iran, SMBG is the most commonly used method for glucose monitoring; however, it remains a challenge for both healthcare providers and PWD due to the lack of a nationally tailored SMBG consensus and insufficient financial support or reimbursement mechanisms.

To address the unmet need for structured SMBG practice in Iran, the Gabric Diabetes Association (GDA) and the Iranian Diabetes Society (IDS) launched a joint initiative titled the "National Iranian Consensus on SMBG." This effort led to the integration of SMBG into national insurance coverage plans. The initiative was implemented in three phases: (1) drafting the consensus, (2) obtaining approval from the Ministry of Health and Medical Education (MOHME), and (3) integrating the consensus into national clinical practice and health policy frameworks.

Methods

Consensus methodology

An extensive literature search was performed in 4 databases, including PubMed, Web of Science, Medline, and Scopus, to identify relevant consensuses and guidelines. The search was limited to the English language. The search terms 'blood Glucose Self-Monitoring. 'Diabetes Mellitus', 'Consensus', and 'Guideline' were used.

A task force of 8 expert endocrinologists and clinicians specializing in diabetes care was established by GDA, IDS, and academic centers. The team reviewed the current literature, integrated it with their clinical expertise, and developed the first draft of the consensus, tailored based on country resources. The first draft was circulated among 25 expert endocrinologists, the majority of whom were selected from faculty members of top-ranked medical universities across the country. The panel reviewed the comments and incorporated key suggestions into the final draft of the document. The consensus was reached through majority agreement.

The final draft was submitted to the MOHME of Iran. Following a comprehensive review, it was officially approved and introduced by MOHME for integration into national clinical practice.

Results

The Iranian consensus on SMBG: A Practical guide for integrating SMBG into clinical practice and policy

The consensus provides recommendations for two levels of care: "Standard care" (Table 1) and "Limited care" (Table 2). Standard care applies when either PWDs or their health insurance plan can afford the cost of SMBG. On the contrary, limited care applies when neither the PWD nor their insurance can cover the cost, making SMBG unaffordable for the patient.

The consensus defines four color-coded SMBG protocols based on frequency of monitoring:

- Low intensity: 2 times per week
- Moderate intensity: 1-2 times per day
- High intensity: 4 times per day
- Intensive: 4-6 times per day

These recommendations are tailored according to diabetes type, age, glycemic control, treatment regimen, and level of access to care. People with type 1 diabetes mellitus (T1DM), type 2 diabetes mellitus (T2DM) on insulin therapy, and pregnant individuals with either gestational diabetes mellitus (GDM) or preexisting diabetes are among the target groups requiring more intensive protocols.

Each specific protocol has been tailored for distinct target groups in both Standard and Limited care settings (Appendix Tables 1, 3, 5, 7). Given that evidence shows that structured SMBG, when applied with defined frequency and timing, leads to improved outcomes (5), each protocol in this consensus accompanies one recommended SMBG pattern (Appendix Tables 2, 4, 6, 8) to guide both clinicians and people with diabetes in practicing more structured monitoring.

Intensification and De-Intensification Process

Each protocol has been tailored to specific target groups in Standard care and Limited care settings. However, further intensification (Figure 1) is recommended if patients meet any of the following criteria:

- Newly diagnosed T1DM or T2DM: diagnosis in ≤3 months
- Newly diagnosed GDM: diagnosis in ≤2 weeks
- Failure to achieve glycemic targets
- Presence of intercurrent acute/severe illness (during sick days)
- Hospital admission
- History of severe hypoglycemia or diabetes ketoacidosis within the past month

It is important to note that this intensification is temporary, and de-intensification should follow based on ongoing patient evaluation.

These SMBG protocols are designed as starting points and should be individualized based on each patient's clinical condition, needs, and preferences.

While affordability remains a major barrier to effective SMBG implementation, other critical factors include patient adherence, competency in performing SMBG, and accurate reporting (16-19). Therefore, structured diabetes self-management education and ongoing support are essential. This education should encompass not only the operational skills for accurate measurement of blood glucose, but also interpretive skills for SMBG data analysis and behavior modification (20).

Discussion

International guidelines recommend SMBG at a varying

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Table 1. Summary of SMBG recommendations in standard care

Status		Frequency	Timing Pattern*
T_1DM	HbA_{1c} in Target, >5 years old	4 times/day	Table 6
	Children ≤ 5 years old	4-6 times/day	Table 8
	HbA_{1c} Not in Target, regardless of age	4-6 times/day	Table 8
	Pregnant	4-6 times/day	Table 8
T_2DM	HbA_{1c} in Target, on OAD with no hypoglycemia risk	2 times/week	Table 2
	HbA_{1c} in Target, on OAD with hypoglycemia risk	1-2 times/day	Table 4
	HbA_{1c} in Target, on non-MDI insulin, ± OAD	1-2 times/day	Table 4
	HbA_{1c} Not in Target, on OAD with no hypoglycemia risk	1-2 times/day	Table 4
	HbA_{1c} in Target, on MDI insulin ± OAD	4 times/day	Table 6
	HbA_{1c} Not in Target, on OAD with hypoglycemia risk	4 times/day	Table 6
	HbA_{1c} Not in Target, on non-MDI insulin, ± OAD	4 times/day	Table 6
	HbA_{1c} Not in Target, on MDI insulin ± OAD	4-6 times/day	Table 8
	Pregnant, on insulin	4-6 times/day	Table 8
GDM	HbA_{1c} in Target, only on LSM/metformin	1-2 times/day	Table 4
	HbA_{1c} Not in Target, only on LSM/metformin	4 times/day	Table 6
	On Insulin	4-6 times/day	Table 8

OAD: Oral anti-diabetes drugs, MDI: Multiple daily injections, LSM: Lifestyle modification
*Tables are included in the supplementary materials.

Table 2. Summary of SMBG recommendations in limited care

Status		Frequency	Timing Pattern**
T_1DM	HbA_{1c} in Target, > 5 years old	1-2 times/day	Table 4
	Children ≤5 years old	4 times/day	Table 6
	HbA_{1c} Not in Target, regardless of age	4 times/day	Table 6
	Pregnant	4 times/day	Table 6
T2DM	HbA_{1c} in Target, on OAD with hypoglycemia risk	2 times/week	Table 2
	HbA_{1c} in Target on non-MDI insulin, ± OAD	2 times/week	Table 2
	If possible: HbA1c in Target on OAD with no hypoglycemia risk	2 times/week	Table 2
	HbA_{1c} Not in Target, on OAD with no hypoglycemia risk	2 times/week	Table 2
	HbA_{1c} in Target, on MDI ± OAD	1-2 times/day	Table 4
	HbA_{1c} Not in Target, on OAD with hypoglycemia risk	1-2 times/day	Table 4
	HbA_{1c} Not in Target, on non-MDI insulin, ± OAD	1-2 times/day	Table 4
	HbA_{1c} Not in Target, on MDI ± OAD	4 times/day	Table 6
	Pregnant, on insulin	4 times/day	Table 6
GDM	HbA_{1c} in Target, only on LSM/metformin	1-2 times/day	Table 4
	HbA_{1c} Not in Target, only on LSM/metformin	4 times/day	Table 6
	On Insulin	4 times/day	Table 6

OAD: Oral anti-diabetes drugs, MDI: Multiple daily injections, LSM: Lifestyle modification
**Tables are included in the supplementary materials.

frequency, based on the type of diabetes, therapeutic regimen, and level of glycemic control. However, there is consistency in guidelines that daily SMBG is crucial for PWD on insulin therapy, irrespective of diabetes type (21-23). Nonetheless, its frequency is not harmonized between guidelines, even in the case of T1DM. Although recent systematic reviews and meta-analyses show the role of SMBG in non-intensive treatment in type 2 diabetes (5, 6, 12), there is an extensive difference in the use of SMBG for non-insulin treated T2DM between guidelines.

However, it has been shown that structured SMBG results in better HbA1c reduction (5, 12), SMBG timing is largely understated in recommendations.

Although the international guidelines are more focused

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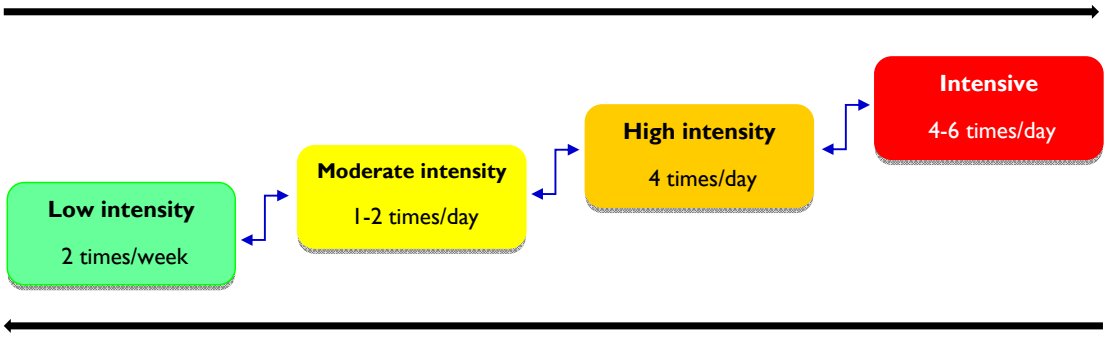

Figure 1. Intensification and de-intensification process

on high-income countries, national recommendations for resource-limited countries are more focused on affordability and level of access to care in addition to clinical factors (24, 25).

In our current consensus, we provide recommendations based on diabetes type, age, glycemic control, diabetes treatment, and level of access to care. People with T1DM, T2DM on insulin therapy, and pregnant individuals are among the target groups that need more intensive protocols. To our knowledge, this is the first national consensus that provides an intensification and de-intensification process.

It is well known that SMBG is one of the most important tools in providing patient-centered care by engaging patients to facilitate lifestyle modification and providing information for therapeutic adjustment for clinicians (3). However, affordability is one of the main issues to successful SMBG implementation, yet adherence and incompetence in performing SMBG, reliable reporting are also vital in implementing successful SMBG (16-19). Thus, providing structured diabetes self-management education and ongoing support to the PWD is essential to successful SMBG implementation. This education should cover not only the operational skills for accurate measurement of blood glucose, but also interpretive skills for SMBG analysis and behavior change (20).

Limitation

This consensus statement has several limitations. First, the consensus development process relied mainly on expert opinion due to the lack of high-quality national data on SMBG cost effectiveness. Second, the proposed recommendations have not been evaluated in clinical trials or real-world studies within the Iranian healthcare system. Third, despite considering affordability and level of access to care in developing "Standard" or "limited" care pathways, other barriers, such as regional disparities in healthcare infrastructure or variations in reimbursement plans, are not fully addressed.

Conclusion

In this paper, we present a nationally tailored SMBG guideline developed in Iran, offering frequency and timing recommendations based on diabetes type, treatment regimen, and level of glycemic control, aligned with international guidelines(21, 26, 27).

Although there is broad agreement across global guidelines that daily SMBG is essential for people with diabetes on insulin therapy, regardless of diabetes type, the exact recommended frequency is not standardized even for type 1 diabetes. In response, several countries have developed their own recommendations and expert consensus statements, which serve as viable alternatives, particularly for resource-constrained settings (24, 28). This manuscript represents one such effort.

We recommend that this consensus serve as a reference framework for policy-making in providing a national diabetes service package and in prioritizing resource allocation according to the proposed categorizations, ensuring target groups requiring more intensive SMBG protocol receive more comprehensive insurance coverage.

Authors' Contributions

Conceptualization: SAJ, AKN, SS, Data curation: SAJ, AKN, FH, AS, HA, AA, MM, SS; Methodology/formal analysis/validation: SS, AJ, AKN; Writing the original draft: SS, Writing, reviewing & editing: SAJ, AKN, FH, AS, HA, AA, MM, SS.

Ethical Considerations

Not applicable.

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Conflict of Interests

The authors declare that they have no competing interests.

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Appendix

Low intensity

This protocol recommends SMBG twice per week. Target groups include:

Table 1. Target groups for low-intensity protocol in standard and limited care settings

Target groups including		
Standard care	HbA_{1c} in Target	T2DM on OAD with no hypoglycemia risk
	HbA_{1c} not in Target	Not Recommended
Limited care	HbA_{1c} in Target	T2DM on OAD with hypoglycemia risk T2DM on non-MDI insulin, ± OAD If possible: T2DM on OAD with no hypoglycemia risk
	HbA_{1c} not in Target	T2DM on OAD with no hypoglycemia risk

Rational:
- Monitor one FBS and one postprandial every week.
- Choose different meals and days for separate weeks.
- Monitor one paired testing for the largest meal during the weekend to evaluate the impact of weekend meal planning and lifestyle.

Table 2. Low intensity SMBG pattern

	Breakfast		Lunch		Dinner		Bed Time
	FBS	Post	Pre	Post	Pre	Post	Overnight
Saturday	✓					✓	
Sunday							
Monday							
Tuesday							
Wednesday							
Thursday							
Friday							
Saturday							
Sunday	✓						
Monday		✓					
Tuesday							
Wednesday							
Thursday							
Friday							
Saturday							
Sunday	✓						
Monday				✓			
Tuesday							
Wednesday							
Thursday							
Friday							
Saturday							
Sunday							
Monday							
Tuesday							
Wednesday							
Thursday							
Friday			✓	✓			

Moderate intensity

Moderate intensity protocol recommends SMBG 1-2 times per day. Target groups include:

Table 3. Target groups for moderate intensity protocol in standard and limited care settings

Target groups including		
Standard care	HbA_{1c} in Target	T2DM on OAD with hypoglycemia risk T2DM on non-MDI insulin, ± OAD GDM on LSM/metformin only*
	HbA_{1c} not in Target	T2DM on OAD with no hypoglycemia risk
Limited care	HbA_{1c} in Target	T_1DM, >5 years old T_2DM on MDI insulin, ± OAD GDM on LSM/metformin only*
	HbA_{1c} not in Target	T_2DM on non-MDI insulin, ± OAD T_2DM on OAD with hypoglycemia risk

*Glycemic evaluation for women with GDM is based on SMBG results instead of HbA_{1c}

Rational:
- *Checkmark only Pattern is advised if we are willing to perform at least once daily SMBG reading and two readings for some days in a week.*
- If we are willing to perform SMBG readings twice daily, it is advised to add a pattern with asterixis.
- In case of GDM, it is advised to perform at least twice daily readings with a focus on postprandial readings.

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Table 4. Moderate intensity SMBG pattern

	Breakfast		Lunch		Dinner		Bed Time
	FBS	Post	Pre	Post	Pre	Post	Overnight
Saturday	✓				✓		
Sunday		✓				✻	
Monday	✓		✓				
Tuesday				✓			✻
Wednesday	✓				✻		
Thursday		✻				✓	
Friday	✓						✻

High intensity

High-intensity SMBG protocol recommends SMBG 4 times per day. Target groups include:

Table 5. Target groups for high-intensity protocol in standard and limited care settings

Target groups including		
Standard care	HbA_{1c} in Target	T1DM, >5 years old
		T2DM on MDI insulin, ± OAD
	HbA_{1c} not in Target	T2DM on OAD with hypoglycemia risk
		T2DM on non-MDI insulin, ± OAD
		GDM on LSM/metformin only*
Limited care	Children	T1DM, ≤5 years old
	Pregnancy	T1DM
		T2DM on insulin
		GDM on Insulin
		GDM on LSM/metformin only*, not in target
	HbA_{1c} not in Target	T1DM, >5 years old
		T2DM on MDI insulin, ± OAD

*Glycemic evaluation for pregnancy, either preexisting diabetes or GDM, is based on SMBG results instead of HbA_{1c}

Table 6. High intensity SMBG pattern

	Breakfast		Lunch		Dinner		Bed Time
	FBS	Post	Pre	Post	Pre	Post	Overnight
Saturday	✓	✓	✓		✓		
Sunday	✓		✓	✓	✓		
Monday	✓				✓	✓	✓
Tuesday	✓	✓	✓		✓		
Wednesday	✓		✓	✓	✓		
Thursday	✓		✓			✓	✓
Friday	✓	✓	✓		✓		

Rational:

- In case of GDM, it is advised to perform SMBG with more focus on postprandial readings.

Intensive

Intensive SMBG protocol recommends 4-6 times SMBG per day. Target groups include:

Table 7. Target groups for intensive protocol in standard and limited care settings

Target groups including		
Standard care	HbA_{1c} in Target	T_1DM ≤5 years
		Pregnant women with T_1DM or T_2DM on insulin
		GDM on Insulin
	HbA_{1c} not in Target	T_1DM, regardless of age
		T_2DM on MDI insulin, ± OAD

*Glycemic evaluation for pregnancy, either preexisting diabetes or GDM, is based on SMBG results instead of HbA_{1c}

Table 8. Intensive SMBG pattern

	Breakfast		Lunch		Dinner		Bed Time
	FBS	Post	Pre	Post	Pre	Post	Overnight
Saturday	✓	✓	✻✻	✓	✻	✓	
Sunday	✓		✓	✓	✻✻	✓	✻
Monday	✓	✓	✻	✓	✓		✻✻
Tuesday	✓	✓		✓	✻✻	✓	✻
Wednesday	✓	✻	✓	✓	✻✻	✓	
Thursday	✓	✓	✓	✻✻	✓	✻	
Friday	✓	✓	✻✻	✻	✓	✓	

Rational:

- Pattern presented only by ✓ marks is advised if we are willing to perform 4 SMBG readings every day.
- If we are willing to perform 5 SMBG readings every day in a week, it is advised to add a pattern with ✻ marks.
- If we are willing to perform 6 SMBG readings every day in a week, it is advised to add a pattern with ✻✻ marks.

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