Self-monitoring of blood glucose (SMBG) levels in selected Latin American countries — how does it measure up to major glucose monitoring guidelines?

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Background

- Diabetes is a leading cause of morbidity and mortality in Latin America, with a substantial clinical and economic impact.[1]
- Patients track their glucose levels using self-monitoring of blood glucose (SMBG). SMBG is an important tool in helping to manage their diabetes and maintain their target blood glucose levels.
- Both clinical and payer guidelines recognize the value and need for regular glucose monitoring using SMBG, especially in insulin-using patients with diabetes (Table 1).
- Evidence from Latin American countries also supports the clinical benefits of SMBG use in insulin-dependent patients with diabetes.[13]
- A recent study showed that only 58% of patients in Latin America combined SMBG with self-adjustment of insulin dose,[14] and patients often do not perform SMBG at the frequency recommended by guidelines (Table 1). This can be explained by:
  - common barriers to SMBG adherence, such as pain, invasiveness, or social stigma (Table 2)
  - reimbursement for SMBG in Latin American countries varying between public and private systems (Table 3).
- Newer glucose monitoring technologies, such as flash glucose monitoring using the FreeStyle Libre system, can overcome many of the barriers associated with SMBG and may improve adherence to glucose testing guidelines.[19,20]
- Real-world data from 470 643 FreeStyle Libre system readers indicated that as the number of scans increased, time in the target glycemic range and estimated glycated hemoglobin (HbA_{1c} [eA_{1c}]) levels both improved (Figure 1).[21]

Table 1. SMBG testing recommendations according to international and regional guidelines.

Country/region	Diabetes management/treatment	No. of SMBG tests/day	Organization
International	T1DM: twice-daily insulin or basal bolus insulin regimen	4	**IDF**[2]
Latin America	T2DM: insulin (MDI)	2–6	**ALAD**[3]
Argentina	T1DM: insulin (MDI) T2DM: insulin	≥ 3 Tailored to the patient[a]	**SAD**[4,5]
Brazil	T1DM and T2DM: insulin (MDI or CSII)	≥ 4	**SBD**[6]
Mexico	T1DM in children/adolescents: insulin T2DM	≥ 4 Tailored to the patient[b]	**CENETEC**[7,8]
UK	T1DM in children/adolescents: insulin (MDI or CSII) T1DM in adults (MDI)	≥ 5 ≥ 4, up to 10	**NICE**[9,10]
USA	MDI insulin	6–10 Tailored to the patient[c]	**ADA**[11,12]

[a]SMBG is recommended in many patients to improve HbA_{1c} levels and reduce the risk of hypoglycemia. [b]Set by the patient's health team according to the specific characteristics of each patient, treatment goals, metabolic control and insulin treatment. [c]Before meals and snacks, at bedtime, occasionally postprandially, before exercise, when low blood glucose is suspected, after treating low blood glucose until they are normoglycemic, and before critical tasks such as driving.
ADA, American Diabetes Association; ALAD, Asociación Latinoamericana de Diabetes; CENETEC, Centro Nacional de Excelencia Tecnológica en Salud; CSII, continuous subcutaneous insulin infusion; HbA_{1c}, glycated hemoglobin; IDF, International Diabetes Federation; MDI, multiple daily injections, NICE, National Institute for Health and Care Excellence; SAD, Sociedad Argentina de Diabetes; SBD, Sociedade Brasileira de Diabetes; SMBG, self-monitoring of blood glucose; T1DM, type 1 diabetes mellitus; T2DM, type 2 diabetes mellitus

Table 2. Reasons for poor SMBG adherence from published studies.

Reasons for poor SMBG adherence	Source
Pain, inconvenience, interference, invasiveness	Vincze *et al.*, 2004[15], Wagner *et al.*, 2005[16]
Social stigma	Tak-Ying Shiu *et al.*, 2003[17]
Lack of time, not remembering, self-consciousness	Moström *et al.*, 2017[18]

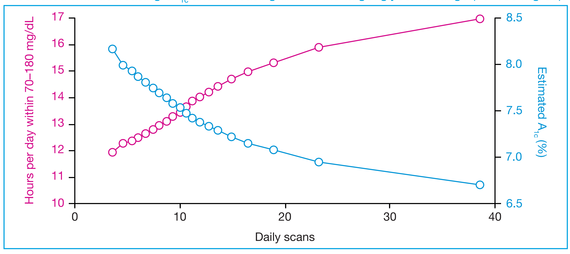
SMBG, self-monitoring of blood glucose

Table 3. SMBG reimbursement across Latin America.

Country	Type of reimbursement	Number of strips reimbursed	Restrictions/criteria for reimbursement
Argentina	Private: private HMOs Public: public HMOs; public system for people without formal coverage	Non-intensive insulin with/without OADs: 400/year Intensive insulin: 1500/year Intensive, special situations[a]: 1800/year OADs only: Met/DPP4is: 50/year SU: 100/year	National diabetes law secures coverage to patients with diabetes
Brazil	Private: almost no private reimbursement for strips or diabetes treatment Public: patient programs performed at a state level with decisions being made at the state or City Hall level	Public system: strips are reimbursed on a per patient basis, which differs across municipalities, at an average of 3/day (T1DM or T2DM with insulin or OADs)	Public system: state-level patient programs display poor control of strip distribution
Chile	National reimbursement with both private reimbursement or public reimbursement in public hospitals	Pediatric patients with: T1DM, 5–8/day T1DM and T2DM using insulin only, 4–5/day T2DM using insulin and OADs, 1–4/day	Treatment centers must have enough strips to match the daily clinical testing guidelines
Colombia	Public reimbursement funded through HMOs and not directly from national government or local authorities	T2DM using basal insulin: 50/month T1DM and T2DM using MDI therapy: 100/month	Reimbursement is allowed for any patient that the medical practitioner feels will benefit from SMBG; typically, these are insulin users
Mexico	Both private and public reimbursement and a national (centralized public system) and state reimbursement system	Public system: strips are only reimbursed during patient hospitalization Private system: treatment reimbursed only if patient agrees to pay the deductible according to their policy	Private system: strips are reimbursed depending on type of policy contracted

[a]These include intensified treatment with frequent risk of hypoglycemia, intensified treatment with an insulin pump, pregnant women with pregestational or gestational diabetes using insulin, or women with diabetes planning pregnancy.
DPP4i, dipeptidyl peptidase-4 inhibitor; HMO, health maintenance organization; MDI, multiple daily injections; Met, metformin; OAD, oral antidiabetic drug; SMBG, self-monitoring of blood glucose; SU, sulfonylurea; T1DM, type 1 diabetes mellitus; T2DM, type 2 diabetes mellitus

Figure 1. Global real-world database results showing that increasing number of scans is associated with decreasing eA_{1c} and increasing time in the target glycemic range (70–180 mg/dL).



Lang *et al.* 2019[21]
eA_{1c}, estimated glycated hemoglobin

Objective

- The main objective of this analysis was to evaluate:
  - patients' glucose monitoring behaviors, with SMBG and newer glucose monitoring technologies, in selected Latin American countries
  - the impact of glucose monitoring frequency on glycemic control.

Methods

Frequency of SMBG in Latin American countries

- To evaluate the frequency of SMBG in Latin American countries, an online literature search for glucose monitoring behavior in Latin American countries was conducted in November 2018 and the following databases were interrogated:
  - Allied & Complementary Medicine, Analytical Abstracts, BIOSIS Previews, Embase, EMCare, International Pharmaceutical Abstracts, MEDLINE, and ToxFile.
- Search results were limited to documents published in the past 10 years.

Impact of new technologies on blood glucose monitoring behavior

- To assess the impact of new technologies on blood glucose monitoring behavior, and the subsequent glycemic outcomes, de-identified data from FreeStyle Libre system readers (Abbott Diabetes Care) were collected.
- Users were situated in Argentina, Brazil, and Chile. The data from 27 628 readers with completed sensors (> 120 hours of operation) were analyzed and compared.
- The data collected were:
  - daily scans: mean scans per day per reader
  - eA_{1c}: mean glucose converted by A_{1c}-derived average glucose (ADAG) study formula[22]
  - time in range: hours per day with blood glucose levels within 70–180 mg/dL (3.9–10.0 mmol/L).
- Results from readers were divided by daily scan rate into 10 rank-ordered groups.

Results

Frequency of SMBG in Latin American countries

- In total, 60 publications were identified and four were found to be relevant, as shown in Table 4.

Table 4. Key findings of SMBG behavior from literature review.

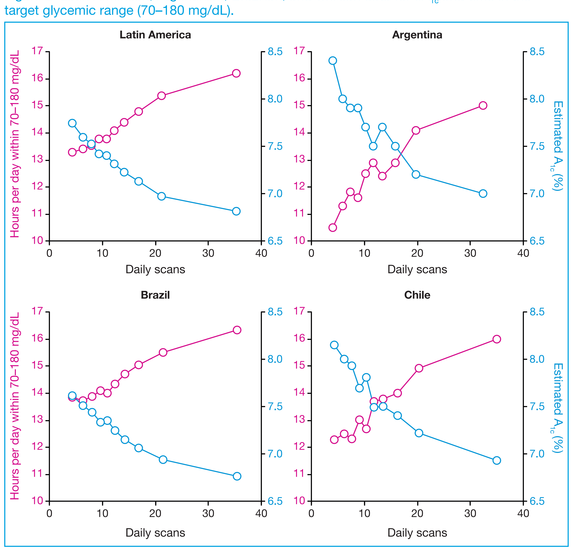
Country/region	Population	Key findings on SMBG behavior
Latin America[23]	T2DM	38.5% of patients reported regularly performing SMBG
Argentina[24]	T2DM, treated with insulin with or without OADs	Mean (± SD): 34 (17) SMBG strips per patient, per month
Brazil[25]	T1DM	42.86% perform SMBG three times a day 65.22% adjusted insulin dose based on SMBG readings 52.63% correctly knew the target HbA_{1c} range
Mexico[26]	T2DM, 34% insulin users	22.5% never performed SMBG 8.8% performed SMBG once daily

HbA_{1c}, glycated hemoglobin; OAD, oral antidiabetic drugs; SD, standard deviation; SMBG, self-monitoring of blood glucose; T1DM, type 1 diabetes mellitus; T2DM, type 2 diabetes mellitus

FreeStyle Libre system impact assessment

- As the FreeStyle Libre daily scan rate increased, the eA_{1c} levels of patients in the Latin American region improved. Similar results were also seen in individual Latin American countries: Argentina, Brazil, and Chile (Figure 2).
  - The 10% of patients with the highest scan rates had a time in range of around 16 hours/day and an eA_{1c} < 7.0%, regardless of country.
  - Patients in Brazil spent the longest time in the target range (70–180 mg/dL), compared with the other countries, with a mean of 13.7 hours/day at the lowest daily scan rate.
  - Patients in Argentina spent the lowest time in range compared with the other countries, with 50% of Argentinian patients spending ≤ 12.5 hours/day in the target glycemic range.

Figure 2. Latin American, Argentinian, Brazilian, and Chilean data for eA_{1c} and time in the target glycemic range (70–180 mg/dL).



eA_{1c}, estimated glycated hemoglobin

Discussion

- Our literature review indicates that SMBG adherence in Latin America is low, with people either not performing SMBG frequently enough, or not appropriately acting upon the readings taken.
- Newer technologies such as the FreeStyle Libre system can lead to more frequent blood glucose monitoring. This can improve patients' adherence to glucose monitoring, resulting in better glycemic control.[21,27]
- In Latin America, the reimbursement for glucose monitoring technologies is limited in some countries, which requires special attention from decision makers, considering the currently increasing incidence of diabetes, and the increasing cost of diabetes management, in the region.[1]
- Better patient access to these devices may improve compliance to glucose monitoring and diabetes management, and thus reduce the overall cost of care.[28]
- This will become increasingly important in the future because, by 2045, it is projected that the total cost of diabetes management will be US$22.5 billion in Brazil,[29] US$2.2 billion in Chile,[30] US$2.8 billion in Colombia,[31] and US$16.6 billion in Mexico.[32] Accessibility to newer technologies may help reduce these costs.

Conclusions

- Current adherence to SMBG in Latin America is low, leading to poor diabetes-related outcomes.
- Newer technologies such as the FreeStyle Libre system remove barriers associated with poor SMBG adherence. Therefore, improving access to this innovative technology across Latin America may help patients to better manage their glucose levels and experience better short- and long-term outcomes.

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