Published in final edited form as:

Diabetes Res Clin Pract. 2008 December ; 82(3): e15–e18. doi:10.1016/j.diabres.2008.08.021.

Short Communication:

Self-monitoring of blood glucose in type 2 diabetes: An inter-country comparison

The SMBG International Working Group

Abstract

Aim—To compare the use, reimbursement policies and cost of self-monitoring of blood glucose (SMBG) in people with type 2 diabetes in 13 countries from Europe, North and South America, Africa, Asia and Australia.

Methods—Cross-sectional survey of SMBG International Working Group members. Application of the United Nations 2006 purchasing power parities (PPP) conversion factors from the local currency to the international dollar to facilitate inter-country glucose strip price comparison.

Results—There were no published data for half the countries surveyed, and no country had data available at the national level. For type 2 patients using insulin, the prevalence of SMBG-use was >80 % in most countries with data, except for the Asian countries. The lowest use of SMBG was in India where there is no reimbursement and the relative cost of a strip is the highest amongst the countries surveyed. Only two countries provided free strips to patients taking oral antidiabetic drugs (OAD). These reported the highest prevalence of SMBG-use. Nevertheless, in half the countries the majority of OAD-treated patients use SMBG. The difference in frequency of strip use between countries was marked, even within the insulin-treated group. Reimbursement policies differed not only by country, but by region, health insurance status, and the means of the patient.

Conclusions—This study finds SMBG a common practice in type 2 diabetes globally, with some exceptions, and highlights the need for more rigorous and systematic data collection across countries to ensure evidence-based use of SMBG, particularly in non-insulin-using diabetic patients.

Keywords

Self-monitoring of blood glucose; type 2 diabetes; non-insulin treated

Introduction

Those involved in the care of persons with type 2 diabetes must be puzzled by the ever increasing number of controversial studies, analyses, comments and guidelines on the proper use of self-monitoring of blood glucose (SMBG), in particular in patients not treated with insulin[1-3]. This lack of scientific consensus is reflected by wide variation in reimbursement policies for costs of glucometers and glucose strips.

A balanced description and discussion of the available evidence is required to take the debate forward. As one step towards this aim we undertook a survey among the members of the SMBG International Working Group to determine the prevalence and frequency of SMBG in patients with type 2 diabetes and reimbursement policies at a global level.

Methods

We conducted a cross-sectional survey in 2007 of current Group members on the use of SMBG by people with type 2 diabetes, frequency of strip use, glucose strip reimbursement policies (by diabetes treatment) and the unsubsidized cost of a glucose strip in their countries. A detailed questionnaire was used and additional comments were invited. To facilitate inter-country price comparison, we applied the United Nations 2006 purchasing power parities (PPP) conversion factors from the local currency to the international dollar (I \$)[4].

Results

The Table gives an overview of the use of SMBG in type 2 diabetes for 13 countries. There were no published data for half these countries, and no country had data available at the national level. For type 2 patients using insulin, the prevalence of SMBG-use was above 80 % in most countries with data, except for the three Asian countries. The lowest prevalence of SMBG-use was in India (0.2%) where there is no reimbursement and the relative cost of a strip is the highest amongst the countries surveyed. SMBG-use is also likely to be low in Tanzania but there are no confirmatory data available. Only two countries (Norway and the UK) provided free strips to patients taking oral antidiabetic drugs (OAD), and these reported the highest prevalence of SMBG-use. Nevertheless, in half the countries surveyed, the majority of OAD-treated patients use SMBG.

The frequency of monitoring in patients who used SMBG varied markedly between countries (see Table and Figure), even within the insulin-treated group. In India, only insulin-treated type 2 diabetic patients used SMBG and then only once every two weeks, on average, whilst such patients in Argentina and Germany monitored 18-20 times/week. SMBG frequency in insulin-treated type 2 patients ranged from 2-14 times/week in the remaining countries with data. Amongst OAD-treated patients, those living in India did not monitor at all whereas those from Argentina and Germany did so 14 times/week (or twice/day) although there was only partial reimbursement of test strips. In the other countries with data, OAD-treated patients monitored between 1-6 times/week. Diet-treated patients living in India and Pakistan did not monitor at all, whilst German patients monitored 14 times/week. In other countries, the rate for diet-treated patients ranged between 1-4 times/week. Norway, despite full reimbursement of the cost of glucose strips, did not have SMBG frequency data available.

Reimbursement policies for SMBG varied considerably not only by country, but by region, health insurance status, health benefit structure and the means of the patient. For example, in Norway SMBG is free to patients if they have a prescription from a doctor. In the UK, SMBG is free for patients if prescribed, but there are constraints on the prescriber thus

limiting use in some districts to those using insulin secretagogues or insulin. In Australia, the co-payment amount is dependent on the patient's means and whether he/she is a member of the National Diabetes Services Scheme (membership is free). India, Pakistan and Tanzania have no reimbursement for SMBG, whilst in China there is no reimbursement or it is partial and variable. In the USA, reimbursement is dependent on health insurance status and the type of coverage (pharmacy benefit or durable medical equipment benefit). In Canada, reimbursement policy varies by province, ranging from full coverage under a total pharmaceutical benefits programme with co-payments and deductibles to no coverage at all. In Argentina the amount of reimbursement depends on the health coverage system. Reimbursement in Germany varies by region and health insurance system, but, in general, a limited number of strips is reimbursed for patients on conservative insulin therapy and more strips for those on intensive insulin therapy. Some strips may also be reimbursed during the period when the patient is put on oral therapy for better dosing of OADs. Reimbursement varies by region in Italy, but those on insulin are completely reimbursed. In Hungary, 85% of the cost of strips is reimbursed for insulin-treated patients only, whilst in the Netherlands strips are fully reimbursed for insulin-users, but the reimbursement is partial and variable for non-insulin-users.

The unsubsidized cost of a glucose strip varied from I\$0.35 in Australia to up to I\$3.11 in India, nine times higher, whilst the relative cost to the patient ranged from nothing to I\$3.11. Strip-cost appears to be a major barrier to use with the lowest use occurring in countries with the highest relative cost (i.e. Argentina, China, India and Pakistan).

Discussion

Our data suggest that factors influencing SMBG-use in people with type 2 diabetes include i) country/region of residence, ii) diabetes treatment type and iii) relative cost to the patient. The paucity of national-level data on SMBG-use is surprising given its high cost. National guidelines unanimously recommend SMBG in insulin-treated type 2 diabetes[1], and the prevalence of SMBG-use is generally high, even in countries without full reimbursement, except for the three Asian countries with data. In view of the lack of consensus in the value of SMBG in non-insulin-users, it is remarkable that the majority of OAD-treated patients used SMBG in half the countries surveyed, indicating that treating physicians and/or patients support self-monitoring.

This *ad hoc* survey has understandable gaps, but has highlighted the need for more rigorous and systematic data collection across and within countries to ensure the evidence-based use of SMBG, particularly in non-insulin-using diabetic patients.

Acknowledgements

Working Group members who contributed to the data presented in Table 1: S. Bot, T.M.E. Davis, W.A. Davis, A. Farmer, J. J. Gagliardino, C. Giorda, P. Home, G. Jermendy, L. Ji, J. Johnson, A.J. Karter, H. Kolb, S. Martin, V. Mohan, A. Nicolucci, M. Porta, A. Ramachandran, K.L. Ramaiya, J. H. Shah, A. S. Shera, S. Skeie.

Abbreviations

I\$	international dollar
PPP	purchasing power parity
SMBG	self-monitoring of blood glucose

References

- [1]. Burgers JS, Bailey JV, Klazinga NS, et al. Inside guidelines. Comparative analysis of recommendations and evidence in diabetes guidelines from 13 countries. *Diabetes Care*. 2002; 25:1933–1939. [PubMed: 12401735]
- [2]. Ipp E, Aquino RL, Christenson P. Point: Self-monitoring of blood glucose in type 2 diabetic patients not receiving insulin. The sanguine approach. *Diabetes Care*. 2005; 28:1528–1530. [PubMed: 15920087]
- [3]. Davidson MB. Counterpoint: Self-monitoring of blood glucose in type 2 diabetic patients not receiving insulin. A waste of money. *Diabetes Care*. 2005; 28:1531–1533. [PubMed: 15920088]
- [4]. United Nations Statistics Division. Millenium Development Goals Indicators. Purchasing power parities (PPP) conversion factor, local currency unit to international dollar. 2007. Available from <http://mdgs.un.org/unsd/mdg/SeriesDetail.aspx?srid=699>, accessed 17 August 2007
- [5]. Karter AJ, Chan J, Parker MM, et al. Longitudinal study of new and prevalent use of self-monitoring of blood glucose. *Diabetes Care*. 2006; 29:1757–1763. [PubMed: 16873776]
- [6]. Johnson JA, Pohar SL, Secnik K, Yurgin N, Hirji Z. Utilization of diabetes medication and cost of testing supplies in Saskatchewan, 2001. *BMC Health Services Research*. 2006; 6:159. [PubMed: 17164006]
- [7]. Gagliardino JJ, de la Hera M, Siri F. Preliminary evaluation of quality of care of people with diabetes. *Rev Soc Argent Diabetes*. 2001; 35:121–133.
- [8]. Martin S, Schneider B, Heinemann L, et al. Self-monitoring of blood glucose in type 2 diabetes and long-term outcome: an epidemiological cohort study. *Diabetologia*. 2006; 49:271–278. [PubMed: 16362814]
- [9]. Schutt M, Kern W, Krause U, et al. Is the frequency of self-monitoring of blood glucose related to long-term metabolic control? Multicenter analysis including 24,500 patients from 191 centers in Germany and Austria. *Experimental and Clinical Endocrinology and Diabetes*. 2006; 114:384–388. [PubMed: 16915542]
- [10]. Franciosi M, Pellegrini F, de Berardis G, et al. The impact of blood glucose self-monitoring on metabolic control and quality of life in type 2 diabetic patients. An urgent need for better educational strategies. *Diabetes Care*. 2001; 24:1870–1877. [PubMed: 11679449]
- [11]. Davis WA, Bruce DG, Davis TME. Is self-monitoring of blood glucose appropriate for all type 2 diabetic patients? The Fremantle Diabetes Study. *Diabetes Care*. 2006; 29:1764–1770. [PubMed: 16873777]
- [12]. Mohan V, Deepa R, Shefali AK, Poongothai S, Monica M, Karkuzhali K. Evaluation of One Touch HORIZON--a highly affordable glucose monitor. *Journal of the Association of Physicians of India*. 2004; 52:779–782. [PubMed: 15909854]

Figure.

Average weekly strip use in patients who self-monitor their blood glucose by country of residence and diabetes treatment

Table

SMBG-use in type 2 diabetes by country of residence

Country	USA[5]	Canada[6]	Argentina[7]	Germany[8, 9]	Hungary [‡]	Italy[10]	Netherlands [*]	Norway [*]	UK ^{*,†}	Australia[11]	India[12] [†]	Pakistan ⁱ	China [*]	Tanzania [‡]
SMBG-use (%):														
All	62.2	49.9	35 (range 11-51)	unknown	50	62.4	47.2	70.3	74	70.0	0.2	58	35.0	unknown
Diet & exercise	31.0	22.4	unknown	5-10	10	38.8	17.4	44.9	54	66.4	0	0	14.3	unknown
OAD only	64.3	62.5	unknown	35	30	59.9	36.6	72.7	73	69.7	0	34.5	23.3	unknown
Insulin or insulin plus OAD	87.8	83.1	unknown	90	90	88.7	94.8	96.2	93	81.7	2.4	68.6	50.2	unknown
Average strip use/week:														
All	8.5	3.46	10	unknown	3	3.17	4.98	unknown	unknown	3.9	0.5	2.3	2.5	unknown
Diet & exercise	4.4	0.96	2-3	14.0	2	1.43	2.29	unknown	<2	3.1	0	0	3.0	unknown
OAD only	5.2	3.84	14	14.0	3	2.47	2.88	unknown	2-6	3.5	0	1.2	2.0	unknown
Insulin or insulin plus OAD	13.6	9.13	18-20	18.9	10	5.69	6.90	unknown	7-14	8.5	0.5	3.4	2.2	unknown
SMBG reimbursement policy:														
Diet & exercise	variable	none-full	partial & variable	none	none	variable	partial & variable	full	full but variable	partial but uniform	none	none	none-partial & variable	none
OAD only	variable	none-full	partial but uniform	partial & variable	none	variable	partial & variable	full	full but variable	partial but uniform	none	none	none-partial & variable	none
Insulin or insulin plus OAD	variable	none-full	full	full	partial but uniform	full	full	full	full but variable	partial but uniform	none	none	none-partial & variable	none
Comments	Reimbursement dependent on health insurance status and benefit structure	Reimbursement dependent on region	Reimbursement amount depends on health coverage system	Reimbursement dependent on region & insurance status	85% cost of strips reimbursed for insulin-treated patients	Reimbursement dependent on region		Prescription from doctor required	Constraints on prescriber	Reimbursement amount dependent on means of patient				Urgent need to establish appropriate database
Cost/strip	US\$0.48-1.22	C\$0.45-0.96	ARS2.40-3.00	e0.40-0.70	HUF 49	€0.65-1.00	€0.50-1.00	NOK5.83	£0.30-0.32	A\$0.52	INR24-30	PKR24.29	¥4-5	299-364 shillings

Country	USA[5]	Canada[6]	Argentina[7]	Germany[8, 9]	Hungary [‡]	Italy[10]	Netherlands [*]	Norway [*]	UK ^{*,‡}	Australia[11]	India[12] [‡]	Pakistani	China [*]	Tanzania [‡]
PPP conversion factor (2006) (12)	1	1.244630	1.059523	0.901240	123.049977	0.838502	0.927817	9.83229	0.600832	1.496358	9.654549	19.01225	2.084942	539.9578
Cost/strip (I\$)	I\$0.48-1.22	I\$0.36-0.77	I\$2.27-2.83	I\$0.44-0.78	I\$0.40	I\$0.78-1.19	I\$0.54-1.08	I\$0.59	I\$0.50-0.53	I\$0.35	I\$2.49-3.11	I\$1.28	I\$1.92-2.40	I\$0.55-0.67

^{*} unpublished data;

[‡] guidelines;

[‡] personal assessment