Acta Diabetol (2016) 53:57–62
DOI 10.1007/s00592-015-0745-9

ORIGINAL ARTICLE

Frequency of self-monitoring blood glucose and attainment of HbA1c target values

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Received: 15 December 2014 / Accepted: 18 March 2015 / Published online: 5 April 2015

Abstract

Aims Test strips for self-monitoring of blood glucose (SMBG) represent in Argentina, around 50 % of diabetes treatment cost; the frequency of their use is closely associated with hyperglycemia treatment. However, the favorable impact of SMBG on attainment of HbA1c goal in different treatment conditions remains controversial. We therefore attempted to estimate the relationship between use of SMBG test strips and degree of attainment of metabolic control in an institution of our social security subsector (SSS) in which provision is fully covered and submitted to a regular audit system.

Methods Observational retrospective study using information of 657 patients with T2DM (period 2009–2010) from the database of the Diabetes and Other Cardiovascular Risk Factors Program (DICARO) of one institution of our SSS. DICARO provides—with an audit system—100 % coverage for all drugs and keeps records of clinical, metabolic and treatment data from every patient.

Results The average monthly test strips/patient used for SMBG increased as a function of treatment intensification: Monotherapy with oral antidiabetic drugs (OAD) < combined OAD therapy < insulin treatment. In every condition, the number was larger in people with target HbA1c levels. Test strips represented the larger percentage of total prescription cost.

Conclusions In our population, the type of hyperglycemia treatment was the main driver of test strip use for SMBG; in every condition tested, targeted HbA1c values were associated with greater strip use. Patient education and prescription audit may optimize its use and treatment outcomes.

Keywords SMBG · Metabolic control · Treatment costs · Diabetes education · Prescription audit · Treatment targets

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Introduction

Incorporation of self-monitoring of blood glucose (SMBG) as a daily habit has represented an important step forward in diabetes care because it provides multiple benefits: (a) It helps to optimize treatment outcomes [1–3], (b) it promotes active participation of patients in the control and treatment of their disease and (c) it develops self-confidence and motivation [4, 5].

However, whereas the beneficial effect of SMBG performance on glycemic control in patients with either T1DM or T2DM treated with insulin is well recognized, this effect on patients with T2DM not treated with insulin remains controversial [6–11].

On the other hand, regular SMBG has led to a marked increase in the cost of care of diabetics everywhere [12], with a great impact on the health care budget. This is an important issue worldwide, but particularly, in developing countries where this budget is frequently unable to cover real needs. To cope efficiently with this challenge, local health authorities and decision-makers require objective data to settle an efficient and equitable strips provision program for diabetics. This program must be based on clinical, metabolic and cost-effective evidence. These data are easily obtained in developed countries but not in developing countries such as those in the Region of Latin America. In this regard, our group has reported that in Argentina, the cost of strips represents about 50 % of the total cost of provincial diabetes programs [13] and that the type of hyperglycemia treatment (oral mono or combined therapy and insulin) is the main driver of test strip use for SMBG. Additionally, test strips represent the highest percentage of total prescription cost both in Argentina [14] as well as in Brazil [15]. However, we do not yet know: (a) the possible relationship between performance of SMBG and attainment of HbA1c treatment target values and (b) if a continuous audit of strips delivery helps to optimize its usage.

In an attempt to provide this unavailable evidence, we now studied the use of test strips for SMBG and its relation with degree of metabolic control in an entity (OSPERYH) of our social security subsector (SSS).

Methods

Study design and data collection

We performed an observational retrospective study using anonymized information collected from the database of the Diabetes and Other Cardiovascular Risk Factors Program (DICARO) of the Obra Social de Trabajadores de Edificios de Renta y Horizontal (OSPERYH). This program was implemented through an agreement between OSPERYH and our group (CENEXA). All affiliates incorporated into DICARO have to attend structured diabetes education courses as part of the program, and their physician keeps regular records of clinical and metabolic follow-up characteristics as well as of treatment prescriptions (using QUALIDIAB form) [16]. The education courses make particular emphasis on the usage of SMBG as well as on the appropriate interpretation of its results. All drugs and strips prescribed by physicians have 100 % coverage, and the number of units (drugs and strips) used by each affiliate for 1 year is regularly and automatically recorded. In the DICARO program, up to 25 test strips were immediately and directly provided, whereas any prescription above that number was previously submitted to an audit. For that purpose, the physician had to fill in a short form with patient data, such as type of diabetes, last HbA1c level, type of treatment, daily blood glucose profile (1 week), type of diabetes education received and frequency of weekly hypoglycemic events.

We incorporated in the study all DICARO affiliates that have completed a QUALIDIAB form in the last year and data on strips consumption. Accordingly, data from 657 people with T2DM included drug and test strip use over 12 months (2009–2010 period), as well as clinical records and laboratory test results that were anonymously loaded into our database. Based on these data, we then estimated the relation between degree of metabolic control and number of strips used and also the impact of this use on the total cost of prescriptions for diabetes treatment. Drug and test strip costs were obtained from Alfabeta.net, a private internet database which is the main source of pharmaceutical product pricing on the Argentine market. Values were expressed in Argentine pesos ($) as of December 2012.

Data analysis

Statistical analyses were done with the Statistical Package for Social Sciences version 15 (SPSS Inc., Chicago, IL, USA). Descriptive statistics are presented as percentages with 95 % confidence intervals (CI) and mean ± standard deviation (SD). Group comparisons for continuous variables were done by ANOVA, student *t* test, Mann–Whitney *U* test and Kruskall–Wallis test according to the data distribution profile. Chi square test was used for proportions. The level of significance was established at $p \leq 0.05$.

Ethical issue

This study was developed according to Good Practice Recommendations (International Harmonization Conference) and the ethical guidelines of the Helsinki Declaration. This retrospective study involves secondary analysis of existing data that were coded and anonymously stored to protect private information. Therefore, this procedure ensured compliance with National Law 25.326 of Personal Data Protection.

Results

Population characteristics

Of the sample of 657 affiliates with T2DM, 60 % were male, with an average age of 55 years (Table 1). Average values of systolic and diastolic blood pressure as well as HDL-cholesterol were within normal range whereas LDL-cholesterol values were above those recommended by international guidelines [17].

Test strip use

The general average monthly use of test strips for SMBG was 24.6 ± 14.5. In people with T2DM, the number of test strips used varied depending on type of treatment (Fig. 1); thus, the following pattern was observed: OAD monotherapy < combined OAD therapy < insulin treatment. Within the groups of monotherapy and combined therapy with OAD drugs, achievement of HbA1c target value increased significantly the use of test strips: 38 and 22 %, respectively (Fig. 2). However, there were no significant differences in the insulin-treated group.

Table 2 shows that both cost of total treatment and of the strips varied depending on the type of treatment and HbA1c goal attainment. Significant differences were recorded among each type of treatment with greater cost associated with insulin use. Percentage of people at goal also varied depending on type of treatment being higher in the monotherapy group (69 %) and lower in the insulin-treated group (26 %).

Although not significant, cost of treatment of hyperglycemia and of strips tended to be slightly higher in people not at goal than in those at goal in the group of mono and combined therapy with OAD drugs.

Discussion

Our present results support our previous and other authorś reports that the number of strips used monthly is tightly bound to the type of hyperglycemia treatment prescribed: it is higher in people receiving insulin and lower in those treated with oral antidiabetic monotherapy [14, 18]. They also demonstrate, as other authors did previously, that a higher percentage of people with HbA1c ≤ 7 % was found

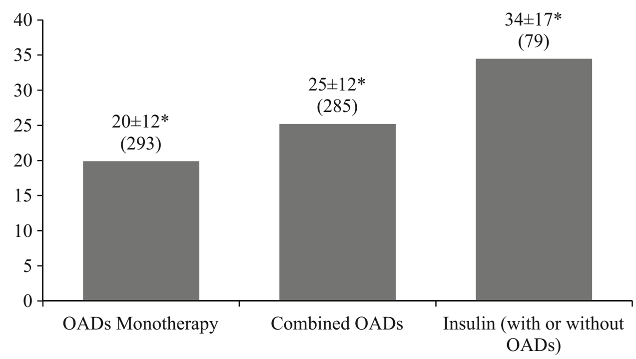

Fig. 1 Test strip use according to type of treatment. *OADs* oral antidiabetic drugs. Values represent the mean ± SD. Number of cases in brackets. *$p < 0.001$ (Kruskal–Wallis test)

Table 1 Clínical and metabolic characteristics of the OSPERYH population

Parameter	Value		Patients on target[a]	
	Mean ± SD	(*n*)	% [95% CI]	(*n*)
Age (years)	55 ± 8.5	(657)	–	
Male (%)	59.8		–	
BMI (kg/m2)	30.7 ± 5.5	(611)	10.8 [8.5–13.6]	(611)
SBP (mm Hg)	128.4 ± 14.5	(593)	50.8 [46.7–54.8]	(593)
DBP (mm Hg)	79.7 ± 9.7	(597)	23.1 [20.0–26.9]	(597)
FPG (mg/dl)	143.4 ± 61.3	(593)	22.6 [19.3–26.1]	(593)
HbA1c (%) (mmol/mol)	7.5 ± 2.1	(616)	51.6 [47.6–55.6]	(616)
	58.8 ± 23.4	(616)	–	–
Creatinine (mg/dl)	0.9 ± 0.5	(472)	–	–
Total Cholesterol (mg/dl)	200.2 ± 44.7	(533)	53.3 [48.9–57.6]	(533)
HDL-cholestrol Male (mg/dl)	44.5 ± 18.2	(297)	41.6 [35.9–47.4]	(297)
Female (mg/dl)	46.0 ± 10.3	(205)	66.7 [60.0–72.9]	(205)
LDL-cholestrol (mg/dl)	126.1 ± 43.2	(497)	24.1 [20.5–28.0]	(497)
Triglycerides (mg/dl)	152.5 ± 93.5	(520)	60.0 [55.6–64.1]	(520)

SBP systolic blood pressure, *DBP* diastolic blood pressure, *FBG* fasting blood glucose

[a] Patients on target values according to ADA guidelines [17]

among people with short diabetes duration; i.e., when some remaining β-cell function was still present [19].

Regardless of the type of treatment considered, we observed that people attaining HbA1c target values (<7 %), used a significantly larger number of test strips than those who did not. Bosi et al. [20] have also described a similar trend.

Thus, under our study conditions, achievement of HbA1c target values together with type of hyperglycemia treatment was apparently the main drivers for SMBG-strips usage. Regarding these results, other authors have reported that SMBG aids physicians and patients to achieve target glycemic control levels that prevent the development of acute and chronic complications [21, 22]. These results could be partly ascribed to the fact that high frequency of SMBG has been associated with earlier and more frequent changes in the clinician's prescription of diabetes medication [23–25]. The ROSSO-in-praxi-international study has also proved that integration of SMBG into basic T2DM therapy—treated without insulin—for monitoring the effect of lifestyle changes, improves glucometabolic control and has long-term beneficial effects [26]. Therefore, SMBG has currently become an important component of modern therapy for diabetes, and its effectiveness improves if it is used on a structured basis [6, 27]. Our data as well as the outcomes of the other reported data mentioned would suggest that higher frequency of SMBG could result in better glycemic control. Although at the time of a given drug-titration, more frequent SMBG helps to find the appropriate dosage, it remains to be demonstrated whether its frequency could ultimately be lowered without affecting control quality. The potential money-saving effect of this alternative merits the implementation of a prospective study to provide an objective and conclusive answer.

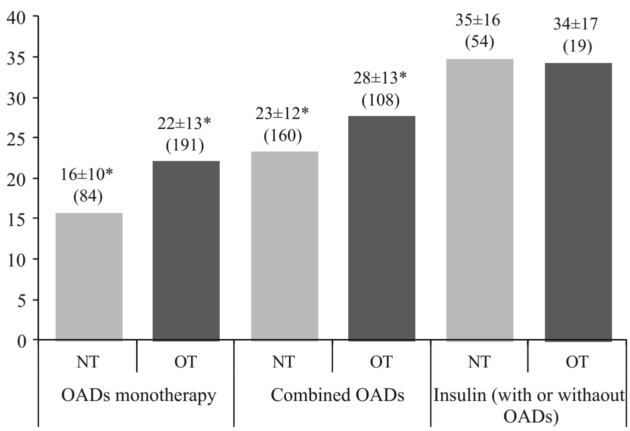

Fig. 2 Relationship between test strips use and HbA1c level. *OADs* oral antidiabetic drugs, *NT* no target, *OT* on target. Values represent the mean ± SD. Number of cases in brackets. *$p < 0.001$ (Mann–Whitney *U* test)

Despite the reported beneficial effect of regular SMBG use, data obtained from eight diabetes self-management educations (DSME) programs showed that most patients that check their blood glucose at least once daily did nothing when blood glucose was abnormally high or low, thus rendering it ineffective [27]. Their authors concluded that patients need to learn problem-solving skills along with SMBG training to achieve appropriate glycemic control. Since DSME has been strongly associated with improvement in care and control, its wide implementation could be an important goal to achieve in most health care organizations to optimize diabetes care and resource use

Table 2 Impact of test strip use for SMBG on total cost of treatment per month

Parameter	OADs monotherapy		Combined OADs		Insulin (with or without OADs)		p^a
	Mean ± SD	*n*	Mean ± SD	*n*	Mean ± SD	*n*	
Total cost of treatment per month	$ 355 ± 176	293	$ 396 ± 152^b	285	$ 693 ± 266^{b,c}	79	<0.001
At goal (HbA1c ≤ 7 %)	$ 353 ± 173	191	$ 387 ± 137^b	108	$ 717 ± 327^{b,c}	19	<0.001
Not at goal (HbA1c > 7 %)	$ 364 ± 179	84	$ 396 ± 157^b	160	$ 685 ± 254^{b,c}	54	<0.001
Cost of hyperglycemia treatment per month	$ 155 ± 79	293	$ 191 ± 80^b	285	$ 463 ± 244^{b,c}	79	<0.001
At goal (HbA1c ≤ 7 %)	$ 161 ± 79	191	$ 187 ± 73^b	108	$ 476 ± 336^{b,c}	19	<0.001
Not at goal (HbA1c > 7 %)	$ 164 ± 74	84	$ 193 ± 85^b	160	$ 461 ± 216^{b,c}	54	<0.001
Cost of strips per month	$ 116 ± 56 [76 %]	293	$ 113 ± 44 [62 %]	285	$ 155 ± 69^{b,c} [39 %]	79	<0.001
At goal (HbA1c ≤ 7 %)	$ 114 ± 55 [77 %]	191	$ 115 ± 43 [64 %]	108	$ 195 ± 108^{b,c} [48 %]	19	<0.001
Not at goal (HbA1c > 7 %)	$ 115 ± 43 [74 %]	84	$ 111 ± 44 [60 %]	160	$ 140 ± 45^{b,c} [35 %]	54	<0.001

Values represent the mean ± SD

In brackets: proportion of cost of strips versus cost of hyperglycemia treatment

[a] Kruskal-Wallis test

[b] Significant compared with OADs monotherapy group (Mann–Whitney *U* test)

[c] Significant compared with combined OADs group (Mann–Whitney *U* test)

[16, 28–30]. In fact, the number of test strips used in any type of treatment considered was significantly higher (three times) in our previous study, where neither DSME nor any audit system were used, than in the current one [14]. Other studies done in Argentina support this finding [31–33].

The progressive increase in the use and frequency of SMBG recorded in the last decade has facilitated diabetes self-management and patient empowerment but has also increased its immediate economic cost [34]. In our country, for example, the cost of strips represents about 50 % of the total cost of provincial diabetes programs [13] and the highest percentage of total prescription cost [14]. Other developing countries report the same problem [15], and for example, in India, an intersectorial committee was established to oversee the formulation of guidelines on different monitoring and treatment aspects of diabetes [35].

Controversies about the usefulness of SMBG in people with T2DM not treated with insulin, the frequency of its use without any immediate active adjustment of treatment and its high cost requires a prompt reaction to cope with all of these problems. In view of our results, it can be postulated that to assure sustained strips provision for SMBG, particularly in developing countries, it is necessary to implement: (a) a diabetes education program at every level including health authorities and auditors; (b) an effective and ethical audit of that provision; (c) a clear concept of "medicine centered on the patient's needs" and (d) an active patient attitude toward treatment adjustment to optimize both its beneficial impact on glucose control and its usage.

Although our data provide information not previously available, they should be interpreted with caution for several reasons, namely: (a) they result from an observational retrospective study of a population of one institution that belongs to our SSS rather than a general population-based study, and (b) although it was carefully controlled, the OSPERYH population sample is relatively small.

In summary, these results are the first reported evidence of test strip use related to type of treatment and HbA1c target value attainment in people with T2DM treated at an SSS in Argentina. We have previously report that education and audit positively affect diabetes outcomes, care cost and strips consumption [14, 31, 33]. Thus, altogether, they reinforce the concept that education and a systematic audit procedure can decrease test strip usage, optimizing the use of an expensive but appropriate tool for metabolic assessment and patient empowerment.

Acknowledgments The authors greatly appreciate the contribution of the Obra Social de Trabajadores de Edificios de Renta y Horizontal (OSPERYH) authorities. JE, LG, MP and ER are member of the Health Economics Research Unit at CENEXA. LG and ER are research fellows of the National University of La Plata and CONICET, respectively. JJG is a member of the Research Career of CONICET.

Conflict of interest The authors declare that they have no conflict of interest.

Human and animal rights All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Informed consent For this type of study formal consent is not required.

References

1. Garg S, Hirsch IB (2010) Self-monitoring of blood glucose. Int J Clin Pract Suppl 166:1–10
2. Klonoff DC, Blonde L, Cembrowski G, Coalition for Clinical Research-Self-Monitoring of Blood Glucose Scientific Board et al (2011) Consensus report: the current role of self-monitoring of blood glucose in non-insulin-treated type 2 diabetes. J Diabetes Sci Technol 5:1529–1548
3. Virdi N, Daskiran M, Nigam S, Kozma C, Raja P (2012) The association of self-monitoring of blood glucose use with medication adherence and glycemic control in patients with type 2 diabetes initiating non-insulin treatment. Diabetes Technol Ther 14:790–798
4. Fisher L, Polonsky WH, Parkin CG, Jelsovsky Z, Petersen B, Wagner RS (2012) The impact of structured blood glucose testing on attitudes toward self-management among poorly controlled, insulin-naïve patients with type 2 diabetes. Diabetes Res Clin Pract 96:149–155
5. Schnell O, Alawi H, Battelino T, Ceriello A, Diem P, Felton A, Grzeszczak W, Harno K, Kempler P, Satman I, Vergès B (2011) Addressing schemes of self-monitoring of blood glucose in type 2 diabetes: a European perspective and expert recommendation. Diabetes Technol Ther 13:959–965
6. Blevins T (2013) Value and utility of self-monitoring of blood glucose in non-insulin-treated patients with type 2 diabetes mellitus. Postgrad Med 125(3):191–204
7. Malanda UL, Bot SD, Nijpels G (2013) Self-monitoring of blood glucose in noninsulin-using type 2 diabetic patients: it is time to face the evidence. Diabetes Care 36:176–178
8. Parkin CG, Buskirk A, Hinnen DA, Axel-Schweitzer M (2012) Results that matter: structured vs. unstructured self-monitoring of blood glucose in type 2 diabetes. Diabetes Res Clin Pract 97:6–15
9. Benhalima K, Mathieu Ch (2012) The role of blood glucose monitoring in non-insulin treated type 2 diabetes: what is the evidence? Prim Care Diabetes 6:179–185
10. International Diabetes Federation Clinical Guidelines Taskforce and International SMBG Working Group (2009) Global guideline on self-monitoring of blood glucose in noninsulin treated type 2 diabetes. Accessed 1 March 2011 from www.idf.org
11. O'Kane MJ, Pickup J (2009) Self-monitoring of blood glucose in diabetes: is it worth it? Ann Clin Biochem 46(Pt 4):273–282
12. Tunis SL (2011) Cost effectiveness of self-monitoring of blood glucose (SMBG) for patients with type 2 diabetes and not on insulin: impact of modelling assumptions on recent Canadian findings. Appl Health Econ Health Policy 9(6):351–365
13. Caporale JE, Elgart JF, Gagliardino JJ (2011) The cost of diabetes care programs for type 2 diabetes in Argentina: a probabilistic sensitivity analysis. Prim Health Care Open Access 1:105
14. Elgart JF, González L, Rucci E, Gagliardino JJ (2014) Self-monitoring of blood glucose: use, frequency drivers, and cost in Argentina. J Diabetes Sci Technol pii: 1932296814549993

15. Cobas RA, Ferraz MB, Matheus AS, Tannus LR, Negrato CA, Antonio de Araujo L, Dib SA, Gomes MB, Brazilian Type 1 Diabetes Study Group (2013) The cost of type 1 diabetes: a nationwide multicentre study in Brazil. Bull World Health Organ 91(6):434–440
16. Gagliardino JJ, de la Hera M, Siri F, Grupo de Investigacion de la Red Qualidiab (2001) Evaluación de la calidad de la asistencia al paciente diabético en America Latina. Rev Panam Salud Publica/Pan Am J Public Health 10:309–317
17. American Diabetes Association (2014) Standards of medical care in diabetes—2014. Diabetes Care 37(Suppl 1):S14–80. doi:10.2337/dc14-S014
18. Sanyal C, Graham SD, Cooke C, Sketris I, Frail DM, Flowerdew G (2008) The relationship between type of drug therapy and blood glucose self-monitoring test strips claimed by beneficiaries of the Seniors' Pharmacare Program in Nova Scotia, Canada. BMC Health Serv Res 8:111–119
19. Stratton IM, Adler AI, Neil HA et al (2002) Association of glycemia with macrovascular and microvascular complications of type 2 diabetes, (UKPDS 35) prospective observational study. BMJ 321:405–412
20. Bosi E, Scavini M, Ceriello A, Cucinotta D, Tiengo A, Marino R, Bonizzoni E, Giorgino F, PRISMA Study Group (2013) Intensive structured self-monitoring of blood glucose and glycemic control in noninsulin-treated type 2 diabetes: the PRISMA randomized trial. Diabetes Care 36(10):2887–2894
21. Ruiz Gracia T, García de la Torre Lobo N, Durán Rodríguez Hervada A, Calle Pascual AL (2014) Structured SMBG in early management of T2DM: contributions from the St Carlos study. World J Diabetes 5(4):471–481
22. Schnell O, Hanefeld M, Monnier L (2014) Self-monitoring of blood glucose: a prerequisite for diabetes management in outcome trials. J Diabetes Sci Technol 8(3):609–614
23. Duran A, Martın P, Runkle I et al (2010) Benefits of self-monitoring blood glucose in the management of new-onset Type 2 diabetes mellitus: the St Carlos Study, a prospective randomized clinic-based interventional study with parallel groups. J Diabetes 2:203–211
24. Shiraiwa T, Takahara M, Kaneto H, Kaneto H, Miyatsuka T, Yamamoto K, Yoshiuchi K, Sakamoto K, Matsuoka TA, Matsuhisa M, Yamasaki Y, Shimomura I (2010) Efficacy of occasional self-monitoring of postprandial blood glucose levels in type 2 diabetic patients without insulin therapy. Diabetes Res Clin Pract 90:e91–e92
25. Polonsky WH, Fisher L, Schikman CH, Hinnen DA, Parkin CG, Jelsovsky Z, Axel-Schweitzer M, Petersen B, Wagner RS et al (2011) A structured self-monitoring of blood glucose approach in type 2 diabetes encourages more frequent, intensive, and effective physician interventions: results from the STeP study. Diabetes Technol Ther 13:797–802
26. Kempf K, Tankova T, Martin S (2013) ROSSO-in-praxi-international: long-term effects of self-monitoring of blood glucose on glucometabolic control in patients with type 2 diabetes mellitus not treated with insulin. Diabetes Technol Ther 15(1):89–96
27. Wang J, Zgibor J, Matthews JT, Charron-Prochownik D, Sereika SM, Siminerio L (2012) Self-monitoring of blood glucose is associated with problem-solving skills in hyperglycemia and hypoglycemia. Diabetes Educ 38(2):207–218
28. Chen R, Cheadle A, Johnson D, Duran B (2014) US Trends in Receipt of Appropriate Diabetes Clinical and Self-care From 2001 to 2010 and Racial/Ethnic Disparities in Care. Diabetes Educ pii: 0145721714546721. [Epub ahead of print]
29. Clar C, Barnard K, Cummins E, Royle P, Waugh N, Aberdeen Health Technology Assessment Group (2010) Self-monitoring of blood glucose in type 2 diabetes: systematic review. Health Technol Assess 14(12):1–140
30. Choudhary P, Genovese S, Reach G (2013) Blood glucose pattern management in diabetes: creating order from disorder. J Diabetes Sci Technol 7(6):1575–1584
31. González L, Elgart JF, Calvo H, Gagliardino JJ (2013) Changes in quality of care and costs induced by implementation of a diabetes program in a social security entity of Argentina. Clinicoecon Outcomes Res 5:337–345
32. Gagliardino JJ, Etchegoyen G, PEDNID-LA Research Group (2001) A model education program for people with type 2 diabetes: a cooperative Latin American implementation study (PEDNID-LA). Diabetes Care 24:1001–1007
33. Gagliardino JJ, Lapertosa S, Pfirter G, Villagra M, Caporale JE, Gonzalez CD, Elgart J, González L, Cernadas C, Rucci E, Clark C, PRODIACOR (2013) Clinical, metabolic and psychological outcomes and treatment costs of a prospective randomized trial based on different educational strategies to improve diabetes care (PRODIACOR). Diabet Med 30(9):1102–1111
34. Evans JM, Mackison D, Emslie-Smith A, Lawton J (2012) Self-monitoring of blood glucose in Type 2 diabetes: cross-sectional analyses in 1993, 1999 and 2009. Diabet Med 29:792–795
35. Kesavadev J, Sadikot S, Wangnoo S, Kannampilly J, Saboo B, Aravind SR, Kalra S, Makkar BM, Maji D, Saikia M, Anjana RM, Rajput R, Singh SK, Shah S, Dhruv U, Vishwanathan V (2014) Consensus guidelines for glycemic monitoring in type 1/type 2 & GDM. Diabetes Metab Syndr 8(3):187–195