



A survey of blood glucose monitoring in patients with type 2 diabetes: are recommendations from health care professionals being followed?

William H. Polonsky, Lawrence Fisher, Danielle Hessler & Steven V. Edelman

To cite this article: William H. Polonsky, Lawrence Fisher, Danielle Hessler & Steven V. Edelman (2011) A survey of blood glucose monitoring in patients with type 2 diabetes: are recommendations from health care professionals being followed?, Current Medical Research and Opinion, 27:sup3, 31-37, DOI: [10.1185/03007995.2011.599838](https://doi.org/10.1185/03007995.2011.599838)

To link to this article: <http://dx.doi.org/10.1185/03007995.2011.599838>



Published online: 23 Nov 2011.



Submit your article to this journal [↗](#)



Article views: 307



View related articles [↗](#)



Citing articles: 1 View citing articles [↗](#)

Original article

A survey of blood glucose monitoring in patients with type 2 diabetes: are recommendations from health care professionals being followed?

William H. Polonsky

Department of Psychiatry, University of California, San Diego, USA
Behavioral Diabetes Institute, San Diego, USA

**Lawrence Fisher
Danielle Hessler**

Department of Family and Community Medicine, University of California, San Francisco, USA

Steven V. Edelman

Division of Endocrinology and Metabolism, University of California, San Diego, and Veterans Affairs Medical Center, San Diego

Address for correspondence:

William H. Polonsky, PhD, CDE, PO Box 2148, Del Mar, CA 92014, USA.
Tel.: +1 760-525-5256; Fax: +1 760-942-5780; whp@behavioraldiabetes.org

Key words:

Adherence – Blood glucose monitoring – Type 2 diabetes

Accepted: 21 June 2011; published online: 23 November 2011
Citation: Curr Med Res Opin 2011; 27:31–37

Abstract

Objective:

To survey the self-reported use of self-monitoring of blood glucose (SMBG) among patients with type 2 diabetes (T2DM), both insulin users (IUs) and non-insulin users (NIUs), in the United States and to examine: how often patients test; what SMBG instructions patients report receiving from their health care providers (HCPs); how the frequency of testing conforms with reported HCP recommendations for testing; and what is done with the results of testing. Differences between IUs and NIUs were also investigated.

Methods:

A convenience sample of 886 T2DM participants at a series of one-day conferences across the United States completed a survey on current and recommended SMBG frequency, how SMBG results were used, and how HCPs reportedly talked about SMBG issues with the patient. IUs (65% of the sample) and NIUs (35%) were examined separately.

Results:

IUs and NIUs reported testing significantly less frequently than was recommended (in both cases, $p < 0.001$), with wide variations within both groups. Many IUs (42%) and NIUs (50%) did not bring SMBG data regularly to medical visits, and 54% of IUs and 56% of NIUs did not respond regularly to out-of-range SMBG readings. HCPs were generally supportive and responsive to SMBG data. More frequent SMBG was associated with more regular HCP attention to SMBG records, for IUs ($p = 0.02$) and NIUs ($p = 0.004$).

Conclusions:

Self-reported SMBG use is common in T2DM, though frequency is lower than HCP recommendations. Wide variations in actual and recommended SMBG were observed. HCP support for SMBG is reportedly common, and is associated with greater SMBG frequency. While SMBG data can be valuable, recommendations are often not followed and data often goes unused by both HCPs and patients.

Introduction

Self-monitoring of blood glucose (SMBG) is widely viewed as a cornerstone of personal diabetes management. Frequent SMBG is associated with better glycemic control, especially among patients on insulin¹, but its value with insulin-naïve patients with type 2 diabetes (T2DM) remains uncertain^{2–9}. Regardless of insulin status, it seems likely that the true value of SMBG is directly related to the degree to which patients and their health care professionals (HCPs) use the information gathered by SMBG^{10–13}. But to what degree are SMBG data actually being collected and used in the T2DM population?

Recent evidence suggests that many T2DM patients do not follow their HCPs' recommendations for SMBG practice¹⁴. For T2DM patients in the United States and the United Kingdom, it is estimated that approximately 90% of insulin users are engaged in ongoing SMBG use, averaging 13–14 strips/week^{15,16}. In T2DM populations using only oral hypoglycemic agents, regular SMBG use is substantially lower (36–60%)¹⁶, with strip consumption averaging only 3–5 strips/week^{15,16}. However, regardless of how often T2DM patients test, qualitative studies suggest that many patients do not understand or use their results in an effective manner^{17,18}. We know little about what recommendations T2DM patients receive from their HCPs regarding SMBG, how often and under what circumstances patients practice SMBG, and what they and their HCPs do with the collected data. The studies of Peel and her colleagues^{17,18} suggest that a variety of psychosocial factors, especially patient–provider communication, are critical contributors to SMBG frequency, but we found no other empirical data on the topic and no study has yet examined these relationships comprehensively.

To address this gap, we conducted a comprehensive survey of SMBG among T2DM patients in the United States to address four questions: how often do patients test; what instructions about SMBG do patients report receiving from their health care providers (HCPs); how does the frequency of testing conform with reported provider recommendations for testing; and what is done with the results of testing?

Patients and methods

Study sample

Patients attending a one-day conference for people with diabetes (Taking Control of Your Diabetes) conducted at seven major urban centers across the United States in 2009 (San Diego, CA; San Antonio, TX; Augusta, GA; Raleigh, NC; Honolulu, HI; Indianapolis, IN; Santa Clara, CA) received a packet containing a brief, anonymous survey, an informed consent and a separate contact information sheet at the start of the event. Program speakers briefly described the project at several points throughout the day and invited patients with type 2 diabetes to complete the packet, and to deposit it at a collection box staffed by a project representative. Interested patients unable to complete the packet on that day could obtain a stamped envelope in which to mail back the completed materials to the project office. Patients who completed the questionnaire and informed consent received a \$10 gift certificate by return mail. The inclusion criteria were: self-reported T2DM, 18 years of age or older, ability to read/write English, and T2DM duration of 12 months or longer. Of note, the seven sites were selected to assure a

diverse sample with a broad range of patient demographics. The study was approved by the Institutional Review Board at University of California, San Francisco.

Measures

The survey instrument consisted of four sections:

Demographic data

This section included personal characteristics (age, gender, years of education, ethnicity) and items about diabetes duration and treatments.

SMBG practices

Two items assessed current frequency and timing of SMBG (days/week, number of times/day) and two items assessed how frequently their HCP recommended SMBG testing (days/week, number of times/day). Frequency and timing items were multiplied to obtain a weekly index of total reported SMBG and total recommended SMBG.

Use of SMBG results

Four items described what patients do with SMBG results: share results with their HCP, use results to adjust medications, physical activity levels or what they eat. Each item was rated on a four point scale from 1 = 'never' to 4 = 'I do this regularly.'

HCP response to SMBG

Four items described how HCPs reportedly talked about SMBG issues with the patient: HCP reviewed the results, offered helpful feedback, congratulated the patient for monitoring, encouraged further SMBG. Each item was rated on a four point scale from 1 = 'never' to 4 = 'S/he does this regularly.'

Statistical analyses

Insulin users (IU, taking insulin with or without any number of oral medications) and non-insulin users (NIU, taking one or more oral medications and/or injectable incretins) were examined separately. Statistical analysis included examination of each study measure to document range and distribution for IU vs. NIU patients separately. Associations between demographic variables, testing frequency, use of results, and HCP behavior were assessed with multiple regression. Analyses were run separately for IUs and NIUs, except when insulin groups were compared directly. Between-group contrasts were undertaken with chi-square, *t*-test, or multiple regression when controls for demographic variables were required. Site was not

controlled in any analysis because sites were selected initially to ensure a broad range of patient demographics.

Results

Description of the sample

Of an estimated 3036 patients attending the seven TCOYD programs who listed themselves as having type 2 diabetes, 1007 returned completed surveys (33%). Due to incomplete or problematic data, 30 surveys were excluded. An additional 94 patients reported that they did not currently manage their diabetes with any oral or injectable medications. Since blood glucose testing recommendations likely differ for patients managing their diabetes with diet and exercise only, these patients were not included. The final sample consisted of 886 patients, 571 (65%) NIUs and 315 (35%) IUs.

As seen in Table 1, the majority was female (63%), Non-Hispanic White (60%) and relatively well educated (45% had completed college). Mean age was 60.8 (± 11.4) years and mean time since diagnosis was 11.0 (± 9.1) years. As expected, IUs had a longer diabetes duration than NIUs ($p < 0.0001$) and also comprised a larger number of women than NIU ($p < 0.001$).

SMBG frequency

IU

The mean reported HCP recommendation for frequency of SMBG/week was 22 (± 11) tests, and the mean reported number of tests/week actually completed was 19 (± 12).

On average, IUs tested significantly less often than was recommended (mean difference, 3.0 tests/week; $t = 4.26$, $p < 0.001$). However, there were wide variations in both reported HCP recommendations and reported SMBG frequency. For example, 13% of IUs were reportedly advised to check 13 or fewer times/week, while 13% were told to complete 35 or more tests/week. Regarding actual SMBG use, 28% of IUs reported 0–14 tests/week, and 14% indicated that they tested 35 or more times/week. It is noteworthy that only 2% reported not being told to test regularly and no one reported that they never tested.

NIU

For non-insulin users, the mean reported HCP recommendation for frequency of SMBG/week was 14 (± 9) tests, and the mean reported number of tests/week actually completed was 10 (± 9). Similar to IUs, NIUs tested significantly less often than was recommended (mean difference, 3.7 tests/week; $t = 3.53$, $p < 0.001$), although again there were wide variations in reported HCP recommendations and in reported SMBG frequency. For example, 7% of NIUs were advised to check less than once weekly, while 11% were told to complete 28 or more tests/week. Regarding actual SMBG use, 12% of NIUs reported testing less than once/weekly, and 7% indicated that they tested 28 or more times/week. Of note, 5% of NIUs reported they were not told to test, only 3% reported never testing.

As expected, IUs were directed to test significantly more often than NIUs ($t = -11.14$, $p < 0.001$), and IUs reported that they actually did so ($t = -12.22$, $p < 0.001$). For both groups, patients who had been diagnosed for a longer period were told to test more frequently

Table 1. Sample description by medication category (insulin users vs. non-insulin users).

	Total Sample	NIU ^a	IU ^b
<i>n</i>	886	571 (65%)	315 (35%)
Patient characteristics			
Age ^c	60.8 (11.4)	60.5 (11.8)	61.2 (10.5)
Gender (male)*	324 (37%)	195 (34%)	129 (41%)
Education level			
≤ 12 th grade	195 (22%)	128 (22%)	67 (22%)
Completed some college	285 (33%)	180 (32%)	105 (33%)
Completed college or graduated degree	392 (45%)	256 (45%)	136 (43%)
Years since diagnosis ^{c***}	10.99 (9.1)	8.49 (8.1)	15.50 (9.0)
Ethnicity			
Non-Hispanic White	532 (60%)	358 (63%)	174 (55%)
African American	113 (13%)	66 (12%)	47 (15%)
Hispanic	57 (6%)	36 (6%)	21 (7%)
Asian or Pacific Islander	107 (13%)	65 (11%)	42 (13%)
Native American	40 (5%)	25 (4%)	15 (5%)
Mixed race	10 (1%)	6 (1%)	4 (1%)
Other	19 (2%)	11 (2%)	8 (2%)

^aNon-insulin users.

^bInsulin users.

^cMeans and standard deviations are listed.

Comparing insulin users vs. non-insulin users (t -test or χ^2): * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

IUs: $\beta = 0.15$, $p < 0.05$; NIUs: $\beta = 0.13$, $p < 0.01$) and in practice they reported testing more often than those with shorter diabetes duration (IUs: $\beta = 0.18$, $p < 0.001$; NIUs: $\beta = 0.09$, $p < 0.05$). Associations between SMBG frequency with other demographic and diabetes status variables did not differ between the IU and NIU groups. In summary, SMBG was relatively common in both groups, but patients were generally tested less than had been reportedly recommended and, quite notably, there were wide variations within both groups in actual as well as recommended SMBG frequency.

Patient use of SMBG results

IU. Of those insulin users who reported any testing, only 58% indicated that they brought their SMBG data regularly to medical visits (Table 2). In response to high or low SMBG readings, only 36% reported that they regularly adjusted what they ate, while smaller percentages of patients reported that they adjusted their physical activity (15%) or medications (22%). In total, more than half of IUs (54%) indicated that they did not respond regularly to high or low SMBG readings by adjusting medication, diet or exercise.

NIU. Of those NIUs who reported any testing, 51% stated that they regularly brought SMBG results to medical visits. In response to high or low SMBG readings, 39% regularly adjusted what they ate, 19% adjusted their physical

activity and 6% regularly adjusted their medications. Overall, 56% of IUs noted that they did not respond regularly to high or low SMBG readings by adjusting medication, diet or exercise.

The IU and NIU groups differed significantly in actions taken in response to SMBG data. Adjusting for testing frequency, in comparison to NIUs, IUs adjusted their exercise ($\beta = -0.13$, $p < 0.01$) or diet ($\beta = -0.13$, $p < 0.001$) less frequently, but adjusted their medication more frequently ($\beta = 0.28$, $p < 0.001$). There were no consistent relationships between demographic variables and SMBG behaviors for IUs or NIUs. In summary, though there were important differences between IUs and NIUs, patients in both groups used SMBG data to titrate care relatively infrequently. Approximately half of patients in both groups did not regularly bring SMBG data to medical visits, and the majority in both groups did not respond regularly to out-of-range SMBG readings through any self-care adjustments.

Patient-reported HCP responses to SMBG data

IU. Of the 58% of IUs who brought SMBG data regularly to medical visits, 92% reported that their HCP regularly reviewed their results, 86% stated that they regularly received helpful feedback, 83% that they received encouragement to keep checking, and 63% reported that their HCP regularly congratulated them for checking BGs (Table 3).

Table 2. Patient-reported use of SMBG data, by medication category (insulin users vs. non-insulin users). Limited to patients who reported at least occasional SMBG use.

Of those patients who reported at least occasional SMBG use:	NIU ^a	IU ^b
<i>n</i>	554	315
Bring SMBG data regularly to medical visits	50%	58%
In response to highs and lows, regularly adjust what they eat***	39%	36%
In response to highs and lows, regularly adjust their physical activity**	19%	15%
In response to highs and lows, regularly adjust their medications***	6%	22%
In response to highs and lows, regularly take no action	56%	54%

^aNon-insulin users.
^bInsulin users.
Comparing insulin users vs. non-insulin users: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 3. Patient reports of HCP responses to SMBG data, by medication category (insulin users vs. non-insulin users). Limited to patients who reported that they regularly bring SMBG data to medical visits.

Of those who reported bringing SMBG data regularly to medical visits:	NIU ^a	IU ^b
<i>n</i>	286	182
HCP regularly reviewed the results	87%	92%
HCP regularly provided helpful feedback**	75%	86%
Regularly received encouragement from HCP to keep checking	77%	83%
Regularly received congratulations from HCP for checking BGs	58%	63%

^aNon-insulin users.
^bInsulin users.
Comparing insulin users vs. non-insulin users: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

NIU. Of the 50% of non-insulin users who brought SMBG data regularly to medical visits, 87% reported their HCP regularly reviewed SMBG results, 75% received helpful feedback on a regular basis, 77% received regular encouragement to continue SMBG, and 58% were regularly congratulated them for checking BGs.

Adjusted for overall testing frequency, more IUs than NIUs reported receiving helpful feedback ($\beta=0.16$, $p<0.01$). There were no consistent associations between patient-reported HCP responses and patient demographics for IUs or NIUs. In summary, for both IUs and NIUs who brought in SMBG results regularly, HCPs were characterized as broadly and commonly supportive in response to SMBG data.

Associations between SMBG frequency and patient-reported HCP support

For both IUs and NIUs, more frequent SMBG use was associated with patient reports of more frequent HCP review of their SMBG records (IUs: $\beta=0.13$, $p=0.02$; NIUs: $\beta=0.09$, $p=0.04$). For IUs only, more frequent SMBG use was also linked to more frequent congratulations by HCP for SMBG data collection ($\beta=0.13$, $p=0.02$) and to more frequently receiving helpful HCP feedback in response to SMBG data ($\beta=0.10$, $p=0.07$).

Discussion

In this large sample of patients with T2DM, we find that self-reported SMBG use was relatively common. Almost all patients reported at least occasional SMBG use, although – as expected – IUs test significantly more often than NIUs. For both groups, frequency of SMBG is significantly lower than what patients describe as recommended by their HCP. However, there are wide variations among both IUs and NIUs in the reported frequency of actual use and in the reported HCP recommendation for use. Variations in reported HCP recommendations may reflect real differences in how HCPs think about and/or value SMBG and in their perceptions of the needs of their diverse patient populations. These patients vary considerably in type of medication regimen, requirements for out-of-pocket costs for SMBG supplies and hypoglycemic risk¹⁴. Variations in patient SMBG frequency may be due not only to differences in patient motivation for diabetes self-care, but also to a lack of a consistent message from the health care community about the value of SMBG and its potential contribution to improved glycemic control. Adding to the confusion, there are at present no well accepted, definitive guidelines or standards for SMBG use in T2DM.

In both groups, reported SMBG frequency is somewhat higher than rates found in previous studies, both from UK databases¹⁶ and US self-report surveys¹⁵. Despite the higher frequency, it is surprising that so few of these IUs and NIUs actually make use of the SMBG data they collect. Among those who test, only about half of each group bring SMBG data regularly to medical visits, and a majority of these patients do not respond regularly to high and low SMBG readings with any self-care adjustments. We find that self-care adjustments, when they do occur, differ between NIUs and IUs. Adjusted for overall testing frequency, IUs report more frequent medication adjustments and less frequent diet and exercise adjustments than NIUs. Since HCP/patient conversations concerning SMBG results do not occur regularly in approximately half of the patient sample, it is likely that the adjustments patients' make to self-care regimens based on SMBG data are often ineffective.

It is important to note that effectively structured SMBG data that are shared with HCPs can be a valuable resource for improved glycemic control¹³. One of the critical ingredients of effective SMBG is the collaborative use of SMBG data as part of an ongoing HCP–patient conversation. In the current study, we find that those patients who regularly share SMBG with their HCP report receiving good support for doing so. The majority of IUs and NIUs indicate that their HCPs regularly review the results and provide helpful feedback and encouragement. While causality cannot be determined, we speculate that ongoing HCP support encourages patients to test and to bring SMBG data to medical visits. Indeed, receiving more frequent support is positively associated with SMBG frequency. In particular, for both groups, those patients who note that their HCP takes the time to review their SMBG data regularly report higher levels of testing. For IUs only, more frequent HCP feedback regarding SMBG data and more regular HCP encouragement to continue testing were both linked to patient reports of more frequent testing.

For patients with T2DM, it appears that SMBG data are often collected unsystematically and that SMBG data frequently goes unused or may be used ineffectively. This parallels the qualitative findings reported by Peel and her colleagues^{17,18}. Given recent studies showing the clinical value of structured SMBG in improving glycemic control among patients with type 2 diabetes, efforts should be undertaken to counter the underuse of SMBG in clinical practice. For example, in a recent RCT, we found that long-term glycemic control in NIUs can be improved when patients and HCPs are trained in the careful use of a structured SMBG approach¹³. In this context, we suspect that ongoing HCP support and application of time-efficient, structured, episodic SMBG protocols to address specific BG patterns will promote more frequent SMBG use and lead to better glycemic outcomes. Other efforts might include educating both HCPs and patients on how

collaborative use of SMBG can improve overall disease management and glycemic control, and providing third-party resources for episodic testing that thoughtfully address specific BG patterns in need of remediation.

Several limitations of this study are noteworthy. First, although large and diverse, this was a convenience sample of patients who were sufficiently motivated to attend a 1-day diabetes program. As described above, the relatively modest acceptance rate may have added further motivational bias. This may be why reported SMBG rates were somewhat higher than seen in previous surveys, both in the UK¹⁶ and the US¹⁵. Second, all of these data are based on patient report. We were not able to determine how accurately patients reported their HCP recommendations and support for SMBG, and how honestly they reported their own SMBG behavior. Third, the noted variability in patient report may reflect a host of other potentially confounding factors: system of care, access to care, practice style and culture, and other social context influences. Taken together our findings concerning the limited use of SMBG readings by patients and HCPs may be conservative, suggesting that the actual use of SMBG in T2DM is most likely substantially less than we report.

Conclusions

Self-reported SMBG use is relatively common in T2DM, though reported frequency is significantly lower than what patients indicate has been recommended by their HCPs. Wide variations in what is reportedly recommended as well as wide variations in actual SMBG frequency were observed. When SMBG data are made available to HCPs, support and encouragement from HCPs are common, and such support is associated with greater SMBG frequency. While SMBG data can be valuable, we find that it very often goes unused or, we suspect, it may be used ineffectively. We suggest the development of more focused efforts to provide clear, structured and targeted SMBG guidelines so that SMBG data can serve as a more valuable resource to improve glycemic control in T2DM patients.

Transparency

Declaration of funding

This study was supported by an unrestricted educational grant from Roche Diagnostics. The investigators had independent access and control of the data, and the authors have 100% responsibility for the manuscript and its content.

Declaration of financial/other relationships

W.H.P. has received fees for lectures, consulting and advisory board memberships from sanofi-aventis, Eli Lilly, Roche Diagnostics, Novo Nordisk, Abbott Diabetes Care, Animas and

Amylin Pharmaceuticals, and unrestricted research grants from Roche Diagnostics. L.F. has received fees for lectures and consulting from Roche Diagnostics and has participated in advisory boards for Eli Lilly. D.H. has disclosed that she has no significant relationships with or financial interests in any commercial companies related to this study or article. S.V.E. has received fees for lectures, consulting and advisory board memberships from Eli Lilly, Novo Nordisk, Sanofi-Aventis, Abbott Diabetes Care, Dexcom, Johnson and Johnson, Merck and Amylin Pharmaceuticals.

References

- Schütt 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. *Exp Clin Endocrinol Diabetes* 2006;114:384-8
- 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;49:271-8
- Guerri B, Drouin P, Grange V, et al. Self-monitoring of blood glucose significantly improves metabolic control in patients with type 2 diabetes mellitus: the Auto-Surveillance Intervention Active (ASIA) study. *Diabetes Metab* 2003;29:587-94
- Schwedes U, Siebolds M, Mertes G. Meal-related structured self-monitoring of blood glucose: effect on diabetes control in non-insulin-treated type 2 diabetic patients. *Diabetes Care* 2002;25:928-32
- Karter AJ, Parker MM, Moffet HH, et al. Longitudinal study of new and prevalent use of self-monitoring of blood glucose. *Diabetes Care* 2006;29:1757-63
- Barnett AH, Krentz AJ, Strojek K, et al. The efficacy of self-monitoring of blood glucose in the management of patients with type 2 diabetes treated with a gliclazide modified release-based regimen. A multicentre, randomized, parallel-group, 6-month evaluation (DINAMIC 1 study). *Diabetes Obes Metab* 2008;10:1239-47
- Farmer A, Wade A, Goyder E, et al. Impact of self monitoring of blood glucose in the management of patients with non-insulin treated diabetes: open parallel group randomised trial. *BMJ* 2007;335:132-9
- Davidson MB, Castellanos M, Kain D, et al. The effect of self monitoring of blood glucose concentrations on glycated hemoglobin levels in diabetic patients not taking insulin: a blinded, randomized trial. *Am J Med* 2005;118:422-5
- O'Kane MJ, Bunting B, Copeland M, et al. Efficacy of self monitoring of blood glucose in patients with newly diagnosed type 2 diabetes (ESMON study): randomised controlled trial. *BMJ* 2008;336:1174-7
- Blonde L, Karter AJ. Current evidence regarding the value of self-monitored blood glucose testing. *Am J Med* 2005;118:20S-26S
- Sarol JN, Nicodemus NA, Tan KM, et al. Self-monitoring of blood glucose as a part of a multi-component therapy among non-insulin requiring type 2 diabetes patients: a meta-analysis (1966–2004). *Curr Med Res Opin* 2005;21:173-82
- Polonsky W, Fisher L, Schikman C, et al. The value of episodic, intensive blood glucose monitoring in non-insulin treated persons with Type 2 Diabetes: design of the Structured Testing Program (STeP) study, a cluster-randomised, clinical trial [NCT00674986]. *BMC Fam Pract* 2010;11:37-46
- Polonsky WH, Fisher L, Schikman CH, et al. Structured SMBG significantly reduces HbA1c levels in poorly controlled, non-insulin-treated type 2 diabetes: results from the STeP Study [NCT00674986]. *Diabetes Care* 2008;34:262-7
- Farmer A, Balman E, Gadsby R, et al. Frequency of self-monitoring of blood glucose in patients with type 2 diabetes: association with hypoglycaemic events. *Curr Med Res Opin* 2008;24:3097-104

15. SMBG International Working Group. Self-monitoring of blood glucose in type 2 diabetes: an inter-country comparison. *Diabetes Res Clinical Pract* 2008;82:e15-e18
16. Belsey JD, Pittard JB, Rao S, et al. Self blood glucose monitoring in type 2 diabetes: a financial impact analysis based on UK primary care. *Int J Clin Pract* 2009;63:439-48
17. Peel E, Parry O, Douglas M, et al. Blood glucose self-monitoring in non-insulin-treated type 2 diabetes: a qualitative study of patients' perspectives. *Br J Gen Pract* 2004;54:183-8
18. Peel E, Douglas M, Lawton J. Self monitoring of blood glucose in type 2 diabetes: longitudinal qualitative study of patients' perspectives. *BMJ* 2007;335:493-8