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REVIEW ARTICLE

Blood Glucose Pattern Management in Diabetes: Creating Order from Disorder

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Abstract

Background:

Self-monitoring of blood glucose (SMBG) is the most accessible way to assess glycemic patterns, and interpretation of these patterns can provide reasons for poor glycemic control and suggest management strategies. Furthermore, diabetes management based on blood glucose (BG) patterns is associated with improved patient outcomes. The aim of this review is therefore to evaluate the impact of pattern management in clinical practice.

Methods:

We included a review of available literature, a discussion of obstacles to implementation of SMBG and pattern management, and suggestions on how clinicians and patients might work together to optimize this management feature.

Results:

The literature review revealed eight publications specifically describing structured approaches to SMBG and pattern management. Specific information on how SMBG might be structured to detect BG patterns, however, remains limited. Barriers to pattern management include not just practical reasons, but emotional and psychological reasons as well.

Conclusions:

Patterns are not always easy to detect or interpret, but on-meter and web-based tools can support both patients and clinicians. Ultimately, successful pattern management requires education and mutual commitment from the clinician and patient—ongoing collaboration is needed to obtain, review, and interpret SMBG values and to make changes based on the patterns.

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Abbreviations: (ACG) active control group, (BG) blood glucose, (CGM) continuous glucose monitoring, (DCT) data collection tools, (HbA1c) hemoglobin A1c, (HCP) health care provider, (SMBG) self-monitoring of blood glucose, (STeP) Structured Testing Program, (STG) structured testing group, (T1DM) type 1 diabetes mellitus, (T2DM) type 2 diabetes mellitus

Keywords: glycemic variability, pattern management, self-monitoring of blood glucose, tools

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Introduction

Glycemic control, i.e., correction of hyperglycemia without hypoglycemia, is a major objective of diabetes management. Intensive glycemic control has been associated with reduced rates of microvascular complications in both type 1 and type 2 diabetes mellitus (T1DM, T2DM).[1,2] However, these benefits come at the cost of a higher risk of severe hypoglycemic episodes.[3–5] Fear of hypoglycemia is a recognized obstacle to improving glycemic control,[6–8] driving patients and clinicians to be cautious in their treatment. The ability to predict hypoglycemic episodes opens up the opportunity to prevent them[8] and could alleviate this fear.

Intraday glycemic variability, i.e., the occurrence of hypoglycemic or hyperglycemic episodes, makes insulin dose adjustments necessary. However, achieving intensive glycemic control is complicated by the *interday* glycemic variability observed in some patients, which obscures glycemic patterns and makes insulin dose adjustment difficult.[9–11] The only way to detect glycemic variability and blood glucose (BG) patterns is by frequent measurement and documentation of BG or continuous glucose monitoring (CGM). While CGM provides a more complete view of BG values, this technology is not yet widely available. In this review, we focus on self-monitoring of blood glucose (SMBG), as this is the most widely used way to assess patterns of BG and determine changes in therapy.[12] A BG pattern (high or low pattern) may be defined as a series of BG readings taken at the same time each day that fall outside the individual's target range. Analysis of BG patterns can guide on a daily basis the treatment needed to stabilize BG and improve hemoglobin A1c (HbA1c) levels. Unlike HbA1c, which provides a long-term perspective, BG patterns can be used to analyze day-to-day and within-day glycemic fluctuations.[13,14] A number of studies have based interventions on data from 3 consecutive days, with readings taken at the same time of day, although the specific timing and complexity of patterns varied.[15–17] By looking for patterns in SMBG data, one can create order from disorder.

Programs for individuals with T1DM[18–21] and T2DM[15] that include a structured approach to SMBG and education on how to act on these data have demonstrated that it is possible to improve glycemic control without the increased rate of severe hypoglycemia seen in the Diabetes Control and Complications Trial. In real life, however, patients often do not regularly measure BG or adjust diet or therapy in response to out-of-range BG values, even after appropriate education,[20,22] due to a variety of barriers, which can be due to practical, emotional, or psychological reasons.[23–25]

This review evaluates the impact of pattern management based on SMBG in clinical practice. We present a review of the literature relating to structured approaches to SMBG and pattern management, discuss obstacles to implementation of SMBG and pattern management, and offer suggestions for how physicians and patients can work together to make the most of this key feature of diabetes management.

Review of Literature: Method

A structured approach to SMBG and pattern management is crucial in diabetes management. However, there is no consensus in the literature as to how SMBG should be structured to provide the necessary data to detect BG patterns. A search on PubMed was executed using the search terms "pattern(s) management diabetes SMBG," "structured testing diabetes SMBG," and "pattern(s) analysis diabetes SMBG." Limiting the search to publications written in the English language over June 2002–June 2012 (excluding published conference abstracts), we found 23 publications. From these, we selected those publications that described results of clinical trials assessing structured SMBG, either prospectively or retrospectively. The resulting eight publications are summarized in **Table 1** and later. The remaining papers were reviews or opinion articles.

Much of the information that is currently available about how SMBG might be structured to optimize outcomes comes from the Structured Testing Program (STeP) study. The STeP study was a multicenter trial involving 483 individuals with poorly controlled, insulin-naive T2DM from 34 primary care practices in the United States. The practices were cluster randomized to an active control group (ACG) with enhanced usual care or a structured testing group (STG) with enhanced usual care and at least quarterly use of structured SMBG results. STG patients used a paper tool that

Table 1.
Summary of Clinical Studies Assessing Pattern Management

First author	Number of study participants, study duration	Comparators	Main outcomes
Polonsky[16]	• 483 poorly controlled insulin naive T2DM (from 34 U.S. practices) • Study duration: 12 months	Cluster randomized to structured testing using a paper tool and seven-point testing + education or active control receiving routine care (ACG)	• Significant reduction in HbA1c in both groups, but effect was larger in the STG (-1.2 ± 0.09% versus -0.9 ± 0.10% in insulin tolerance test analysis; -1.3 ± 0.11% versus -0.8 ± 0.11% in per protocol analysis) • STG: significant reductions in seven-point SMBG profile, more treatment change recommendations, greater general wellbeing
Polonsky[26]	• 483 poorly controlled insulin naive T2DM (from 34 U.S. practices) • Study duration: 12 months	Cluster randomized to structured testing (STG) using a paper tool and seven-point testing + education or active control receiving routine care (ACG)	• Greater treatment modifications in the STG • Greater reduction in HbA1c in the STG versus ACG (-1.2% versus -0.9%) • Two times more patients started on insulin in the STG
Polonsky[27]	36 primary care professionals and 25 internists	• Evaluation of clinician ability to identify patterns • Analysis of case studies of patients with T2DM reviewing HbA1c and episodic SMBG to identify patterns and evaluate decision making	• 78% of primary care professionals correctly identified glucose patterns • 53% of primary care professionals found SMBG data of equal value than that of HbA1c, and 33% found them of greater value • Three-day, seven-point glucose profile and standard log book most favorable formats (78.7%)
Lalic[28]	• 266 individuals with T1DM or T2DM with baseline HbA1c ≥8.0%; 38 individuals had a baseline HbA1c <8.0% • Study duration: 3 months	Structured glucose monitoring and lifestyle adjustments: seven-point SMBG profile on three consecutive days prior to baseline and months 1, 2, and 3; routine BG test (≥1 test per day); use of Accu-Chek 360°	• Significant reduction in mean HbA1c (-1.2 ± 1.6%; $p < .001$) • Significant reduction in mean BG (-36.4 ± 52.5 mg/dl; $p < .001$) • Significant changes in seven-point BG values, lipid parameters, and blood pressure • Significant difference between T1DM and T2DM individuals in changes in weight, body mass index, and blood pressure but not in HbA1c reduction • Accu-Chek 360° acceptance was high among participants (>80%) and HCPs (87.5%)
Rodbard[29]	288 clinicians: 40% family physicians, 38% internists, and 22% nurse practitioners	Review of 30 cases with either: structured SMBG data, structured SMBG with decision support tool, structured SMBG with DVD, or structured SMBG with decision support tool + DVD	• More clinicians correctly identified the pattern and glucose abnormality and selected the appropriate therapeutic option with the decision support tool + DVD or both than in the control group
Cox[30]	• 100 individuals with T1DM and 79 with T2DM • Duration: 6 months (for participants with T1DM	Retrospective evaluation of SMBG data to look for prediction of severe hypoglycemia events	• Severe hypoglycemia associated with increase in low BG index in 24 h prior to severe hypoglycemia in both participants with T1DM and T2DM • Algorithm predicted 58–60% of imminent episodes of severe hypoglycemia; this increased if five readings per day were present
Kempf[31]	• 327 individuals with T1DM_ • Study duration: 12 weeks	SMBG + lifestyle intervention: seven-point SMBG profile at baseline and at weeks 4, 8, and 12; healthy diet and physical activity; make changes to lifestyle based on SMBG results	• Significant reduction in weight (-2.3 kg; $p < .001$) and HbA1c (-0.3%; $p < .001$) • Significant improvement in cardiovascular disease risk factors • Significant increase in quality of diet, physical activity, general wellbeing, and physical and mental health • Correlation between weight reduction and change in HbA1c: each kilogram of weight loss associated with a mean HbA1c reduction of 0.05%
Hansen[32]	1076 individuals with T1DM	• Retrospective evaluation of SMBG data • Adherence, and characteristics associated with adherence, to SMBG • Questionnaire included SMBG frequency, motives for performing SMBG, hypoglycemia experience and awareness, demography, lifestyle	• Suboptimal adherence to SMBG: 3% did not perform SMBG at all, 33% did not perform routine tests, 61% did not do the test on a daily basis • Association between higher test frequency and age, insulin regimen, lower HbA1c, and hypoglycemia awareness

graphed seven-point glucose profiles over 3 consecutive days while physicians received a treatment algorithm based on SMBG patterns. The primary endpoint was HbA1c level measured at 12 months. Findings from the study[16,26] revealed that appropriate use of structured SMBG data led to earlier, more frequent, and more effective treatment modification recommendations and improved glycemic control in these patients. Compared with ACG patients, significantly more STG patients received treatment modification recommendations, experienced significantly greater reductions in HbA1c, and received more timely/aggressive treatment changes. Polonsky and coauthors[27] explored whether primary care physicians could utilize data collection tools (DCTs), consisting of SMBG data presented in five different formats, to identify glycemic abnormalities accurately in structured, episodic SMBG data and whether use of these data would influence their therapeutic decisions. The five formats were as follows: DCT A, 3-day, seven-point glucose profile; DCT B, 3-day fasting and three post-prandial readings; DCT C, 7-day fasting with postprandial supper; log sheet A, standard log book with two facing pages containing a daily seven-point testing profile (premeal, postmeal, and bedtime) for each day of the week, with daily values aligned vertically; and log sheet B, standard log book on one page containing a daily seven-point testing profile (premeal, postmeal, and bedtime) for each day of the week, with daily values aligned horizontally, with additional space for the patient to calculate and record differences between preprandial and postprandial values. Next, data were presented in different formats to primary care physicians who were asked to evaluate the cases based on HbA1c data alone and then combined with SMBG data, looking for specific glucose patterns, and to determine and select specific therapeutic changes. Most (78%) identified the same primary BG feature identified by diabetes specialists, and 94% agreed with the diabetes care specialists regarding the need for therapy modification. The study showed that primary care physicians were able to use SMBG data appropriately. Correct identification was higher, with more specific formats. Lalic and coauthors[28] explored whether a modified version of the STeP intervention could be used in a real-world clinical setting. Individuals with T1DM and T2DM in 11 countries were asked to generate a BG profile once a month for three consecutive months using a paper-based BG analysis tool (Accu-Chek® 360° View® BG analysis system, Roche Diagnostics, Mannheim, Germany).[28] Measurements were performed before and 2 h after main meals and before bedtime on three consecutive days. This intervention resulted in improvements in diabetes management, with significant improvements in HbA1c, BG and lipid parameters, and blood pressure; acceptance of the structured SMBG tool among patients and physicians was high. In another analysis from the STeP study,[29] the addition of an automated decision support tool and/or an educational DVD to structured SMBG data improved the ability of clinicians to identify significant glycemic patterns correctly and to make appropriate therapeutic decisions to address those patterns. This study also highlights the importance of educational approaches in optimizing the use of structured SMBG data.

Information from three other studies has added to the STeP study data or have highlighted the lack of routine SMBG among diabetes patients. In the study by Cox and coauthors,[30] routine SMBG readings were retrieved from memory meters and combined with information about episodes of severe hypoglycemia; this information was used to estimate the relative risk for such events. The relative risk of severe hypoglycemia was found to increase significantly in the 24 h before the episodes. A sliding algorithm predicted 58–60% of episodes of severe hypoglycemia when three SMBG readings were available, which increased to 63–75% if five SMBG readings were available, demonstrating the utility of pattern management in predicting severe hypoglycemia. Kempf and coauthors[31] evaluated a 12-week lifestyle intervention in the Retrospective Study Self-Monitoring of Blood Glucose and Outcome in Patients with Type-2-Diabetes study. Non-insulin-treated patients with diabetes generated an SMBG profile (seven-point BG diurnal profile) every 4 weeks, in addition to weight, waist circumference, and physical activity (steps/day). Patients who completed the program showed significant reduction in weight, body mass index, waist circumference, BG, blood pressure, low-density lipoprotein cholesterol, and HbA1c, accompanied by increased physical and mental health and reduced depression measurements. The study by Hansen and coauthors[32] assessed the frequency of and motives for SMBG using data from a cross-sectional survey of individuals with T1DM and demonstrated just how few SMBG data might be available for pattern management. Patient compliance with SMBG was limited; almost two-thirds of patients did not perform daily SMBG, and one-third did not perform routine tests. Lower HbA1c was associated with more frequent testing.

While these studies have provided valuable information on the value of a structured approach to SMBG and pattern management in diabetes management, specific information on how SMBG might be structured to detect BG patterns, however, remains limited; it is likely that information on pattern management protocols is buried within educational curricula.

While there is no clinical trial data suggesting the appropriate amount of data that should be collected, the American Association of Clinical Endocrinologists recommend that intensive episodic SMBG could be done in patients who (a) have been having recurrent hypoglycemia; (b) are undergoing changes in medication, i.e., steroids; and (c) have worsening HbA1c values.

Addressing Barriers to Pattern Management

Even after receiving training, patients may not perform recommended therapeutic tasks such as measuring BG or dose-adjusting insulin in response to BG patterns for a variety of emotional/psychological reasons[23–25] (**Figure 1**). These reasons may be complex and include lack of motivation (they do not wish to do it), lack of appropriate beliefs (they believe that they cannot do it, that it is unnecessary, that the hassle of adherence outweighs the potential advantage of the reduced risk of long-term complications), or fear of negative consequences. Fear of negative consequences, for example, may lead patients to enter incorrect data in their log books; studies have shown that a large proportion of patients with T1DM (65%) recorded entries in a way that obscured hyperglycemia or hypoglycemia, and one-third of patients with T2DM keep inaccurate diaries.[33]

Awareness of decision-making theories may help us understand the psychology underlying the "lack of appropriate beliefs" obstacle to dose adjustment and pattern management.[34] First, immediacy as well as concreteness of reward may influence decision making.[35] A key principle of diabetes management is that patients are indeed asked to engage in difficult diet and lifestyle changes and to adhere to therapy that may have short-term unpleasant side effects. In return, they may gain a reduced risk of serious—but theoretical and seemingly distant—consequences. The immediate, certain, positive outcome of avoiding the inconvenience of BG measurement, pattern assessment, and dose adjustment is assigned more weight than the long-term, uncertain, possible positive outcomes of reduced diabetes complications. In short, "people often prefer smaller rewards sooner to larger rewards later."[36] This discrepancy may represent a barrier to the efficiency of patient education. Kahneman and Tversky's prospect theory points out that aversion to losses is greater than attraction to gains[37], and this phenomenon may also affect patient behaviors concerning insulin dose adjustment.[25]

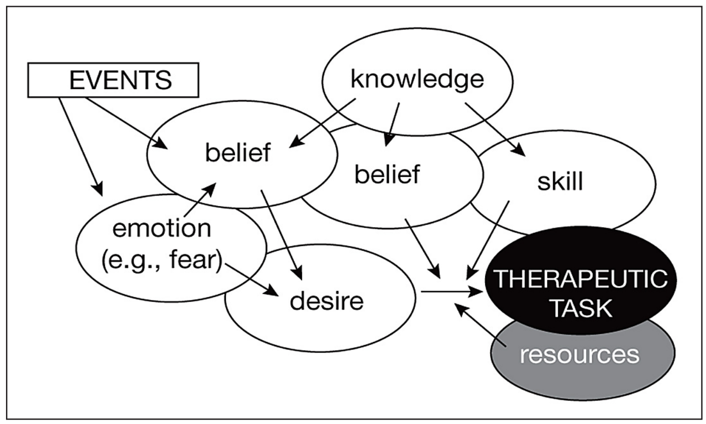

Figure 1. A mental-states-based model of adherence. Desire, associated with appropriate beliefs, is the driving force, while knowledge and skills have an indirect role. Emotions can lead to a revision of beliefs and desires. An example is the fear triggered by a severe hypoglycemic episode. Resources have a permissive role. Adapted with permission from *Diabetes and Metabolism*.[24]

Secondly, according to Kahneman and Tversky,[38] when having to make a decision under uncertainty, people rely on heuristics—rapid thinking processes that are usually efficient but can lead to bias. For instance, the availability heuristic is used when individuals are asked to predict the likelihood of an event: they base their answer on how easily an example of such an event happening previously comes to mind. In the case of SMBG, it will tend to overestimate the risk for hypoglycemia because patients remember hypoglycemic events more readily than normal BG values; this is due to the greater power of bad events over good ones in learning processes.[39] People use heuristics when they have a difficult question to answer, and one can understand how, in the case of diabetes management, glycemic variability represents an incentive to use them.

We suggest that a structured approach to SMBG and automated pattern recognition may address obstacles to effective diabetes management (**Table 2**). First, SMBG provides immediate, positive, and concrete feedback. Also, SMBG and the accompanying education about interpreting the data may potentially enable the patient to see the impact of adjustment to diet, activity, or insulin dose on BG in the short term and to feel rewarded for his or her action; studies are needed to test this hypothesis. Second, when patients are confronted with glycemic variability (both intraday and interday), an obstacle to pattern management may be the time and tedium involved with BG measurement and analysis, followed by calculation of appropriate dose adjustment. This leads patients to use Kahneman and Tversky's[38] heuristics with their source of bias, including the overestimation of the risk of hypoglycemia. Automating as many of these functions as possible may help support patients and increase use of pattern analysis in diabetes management. This is discussed in the next section of this article.

Table 2.
Creating Order From Disorder: How SMBG and Automated Pattern Recognition Can Address Barriers to Self-Adjustment of Insulin Doses

Obstacle	Solution
• The reward of adjusting insulin dose is abstract and remote	• SMBG provides a concrete and immediate result of action
• Shortage of time hindering appropriate evaluation of insulin titration	• Rapid assessment by automated pattern recognition
• Uncertainty on the BG situation	• Pattern recognition alleviates this uncertainty
• Data overload: cannot see the forest for the trees	• No need for detailed evaluation

Tools for Pattern Detection and Management

Incorporating pattern management into practice requires detection of patterns. A first step in this is establishing target and baseline values for preprandial and postprandial BG. Patients must document carbohydrate intake, medication use (including rotation of the insulin injection site),[40] physical activity, and psychological factors (such as stress) that may affect BG levels.

Pattern management further involves uncovering how a pattern originates, followed by conducting a retrospective review to connect meals, medication, or other causes to an excursion. Patterns may identify issues with the basic structure of the regime, i.e., inadequate overnight insulin or inadequate prandial insulin or may identify specific behaviors such as inadequate or overzealous correction of high or low readings or hypoglycemia caused due to exercise or alcohol. Looking at "modal day" data can provide some information toward structural issues, and looking at outlier data, especially episodes of hypoglycemia or very high glucose, can provide information on some behavioral aspects. Knowing about common patterns can help identify them through what can be quite a daunting maze of numbers. Information on exercise, alcohol, and food intake are essential in making sense of the data.

Tools to Aid Pattern Recognition

Paper Log Book

The traditional paper log book offers the advantages of simplicity and a minimal learning curve. Filling in the log book may also help the patient to appreciate the real frequency of high, normal, or low BG, though this has not been proven empirically. It has the disadvantage of being labor intensive for both the patient and health care provider (HCP). An exploratory study determined that 78% of primary care physicians were able to identify the primary glucose abnormality in sample cases using a validated paper log (Accu-Chek 360° View BG analysis system).[27] Augmenting this paper log book with an automated decision support tool improved the ability of primary care physicians to identify the primary glycemic abnormalities correctly compared with the paper tool alone. The automated decision support tool algorithm analyzes SMBG data recorded in the paper log book, generates a report identifying the primary glycemic abnormality, and recommends therapeutic options.[41]

Meters with Add-On Devices or Applications

There are a number of meters and smartphone applications available that can use data such as insulin-to-carbohydrate ratio, BG targets, and insulin sensitivity to calculate appropriate short-acting insulin such as FreeStyle InsuLinx®, Abbot Diabetes Care, Alameda, CA; Roche Expert, Roche; and iBGStar® (Sanofi-Aventis, Frankfurt, Germany). These devices to provide a "calculator" function but do not actively monitor patterns or offer advice on changing those settings in response to patterns.

On-Meter Software

The OneTouch® Verio®Pro and VerioIQ BG meters (LifeScan Inc., Milpitas, CA) have pattern detection on the actual meter via the high and low pattern tool. The high and low pattern tool can be set to alert users automatically in real time to the possible development of high or low BG patterns, with high and low limits customized for each patient.[42] These are currently the only systems on the market that have this on-meter pattern alert.

Off-Meter Software

Most manufacturers of home BG meters offer SMBG analysis software solutions. The off-meter OneTouch Diabetes Management Software and the OneTouch ZoomPro software (both from LifeScan Inc.) offer periodical assessment of seven-point testing. OneTouch Diabetes Management Software highlights before- and after-meal patterns, while OneTouch ZoomPro includes an optional pattern recognition feature. One limitation is that the software examines absolute values, whereas relative changes are of more importance for pattern recognition.

Online Tools

Several online tools enable patients to upload data from BG meters for viewing and analysis by HCPs. Clinicians may then obtain a variety of reports. Examples of these platforms include CareLink Pro (*http://www.medtronic.com/for-healthcare-professionals/products-therapies/diabetes/diabetes-management-software/careLink-pro-diabetes-therapy-management-software/index.htm*), Diasend (*http://diasend.com/site/index.php?lang=en*), and DIABASS (*http://www.mediaspects.com/index.php?lang=en&key=diabass5*). These tools aim to facilitate communication between HCPs and patients. The CareLink Pro software does offer some pattern recognition facilities, identifying issues that may predispose to high or low readings, However, this requires at least five days of CGM over the past week.[43]

Technological support offers the advantages of improved accuracy and convenience over paper logs, the capacity to display data in a variety of forms that may be impactful for patients and HCPs, and the ability to store and share findings electronically. Standardizing pattern analysis algorithms in software would ensure consistent application of the desired protocols. Addressing issues of electronic information privacy and virus contamination may facilitate the use of this technology.

We would like to include a caveat here: by knowing that the data are stored in the meter's memory, there is the possibility that the patient does not fill their log book, does not use the technology, or does not adjust the insulin doses and gets emotionally disconnected from the data and the appropriate actions. An important task of HCPs is to prevent this potential disconnect. Indeed, it is important to point out that when we speak about the "memory" of a glucometer, it is only a metaphor: human memory not only stores data, but in addition is governed by emotions and thus has a teaching effect aimed at optimizing future actions.[39] This emotional effect may be missing in the passive filling of the meter's "memory," disconnecting emotions from memory.

Optimizing the Patient–Health Care Provider Relationship

Self-monitoring of BG and pattern management require significant commitment from both the patient and the HCP. Guidelines stress the importance (in both patients and HCPs) of sufficient understanding, training, skills, and willingness to undertake SMBG, as well as desire to use this information to adjust therapy to agreed treatment goals.[44,45] One of the key principles underlying successful pattern management is that HCPs must ensure that patients are appropriately trained in SMBG use and interpretation (**Table 3**). Another key principle is that HCPs must review SMBG results consistently, use the BG data to guide changes in therapy, and communicate to patients how BG data influence their care so that pattern management has motivational value.

It is important to optimize the patient–HCP relationship. Some patients report frustration that HCPs show no interest in their BG records or BG fluctuations, making therapeutic adjustments based on HbA1c values only.[47] A similar complaint may be around the difficulty in obtaining data from devices from different companies, the clinician's computer often resembling an octopus with numerous cords for each manufacturer. This also leads to problems in

Table 3.
Requirements for Successful Pattern Management[18,45,46]

Patient requirements	HCP requirements
• Have the skills to perform SMBG	• Accept the relationship between glucose variability and long-term risks
• Understand why and how to record food intake, physical activity, use of insulin, oral antidiabetic medication (or any other therapies, including times of use) that may influence BG	• Know how to set end points for determining diabetes control
• Understand why and how to record stress or other psychological factors that may influence BG	• Understand how to interpret SMBG results
• Be trained to interpret their BG test results, identify acute and chronic issues with glycemic control based on those results, and make appropriate adjustments	• Have the skills to adjust therapy appropriately to achieve established end points
• Accept the importance of relying on SMBG readings rather than a subjective sense of wellbeing for taking action	• Communicate to patients how the BG data influences their care so that pattern management has motivational value

identifying data from different software programs. This problem can be mitigated to some degree through some commercial software solutions such as Diasend, which can import data into a common platform, making it easier for the clinician to access relevant information. Commending patients for taking the time to collect BG data, along with assisting them in creating a simple action plan with instructions for responding to high or low BG readings can improve BG patterns, may encourage patients to persist with SMBG, and may improve the patient–HCP relationship. Health care professionals should also ensure that they react to patient SMBG data in a nonjudgmental manner to avoid discouraging individuals who obtain insufficient readings or respond inappropriately to a BG finding.[45]

Conclusions

Interpretation of BG data patterns can shed light on the reasons for poor glycemic control and suggest possible management strategies. Diabetes management based on BG patterns with appropriate education has been associated with reduced HbA1c levels, lower incidence of hypoglycemia, and prediction of severe hypoglycemia, but more clinical trials are warranted to confirm the clinical relevance of these associations.

Self-monitoring of BG is the most accessible way to assess glycemic patterns in real time. Patterns are not always easy to detect or interpret, but on-meter and web-based tools can support both patients and clinicians. Successful pattern management requires education and mutual commitment from the HCP and patient. The two must establish an ongoing collaboration to obtain, review, and interpret SMBG values and to make changes based on the patterns in those values.

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