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EDITORIAL

Self-Monitoring of Blood Glucose and Type 2 Diabetes: New Tricks for the Old Dog?

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"At a meeting in 1956, Priscilla White of the Joslin Clinic asked: 'Do you think patients should learn to do their own blood sugars?' This was greeted with laughter from the audience who clearly regarded it as an outrageous idea."[1,2]

Background

As part of a modern management strategy for type 2 diabetes, there is a general consensus that some form of self-monitoring of glucose levels is probably beneficial as an adjuvant in encouraging lifestyle change and medical therapy.[3,4] However, it is self-evident that any potential value of monitoring relates to the actions consequent upon taking the measurements (**Table 1**)—testing for the sake of testing without considering the context of the result appears to be of almost no value.[5]

At present, the optimum timing and frequency of self-monitoring of blood glucose (SMBG) that is acceptable to individuals living with type 2 diabetes is unclear. For insulin-treated individuals, there is general agreement that SMBG is of value, allowing them to alter insulin doses according to meals, exercise, or travel. Somewhat surprisingly, in trials of insulin initiation in type 2 diabetes, dose titration schedules are not always included in the protocol, and training of participants about carbohydrate counting is virtually absent.[6,7] The place of SMBG in the management of non-insulin-treated type 2 diabetes patients remains controversial. In general, systematic reviews of the role of SMBG in non-insulin-treated type 2 diabetes have concluded that there may be little or no benefit, with only small differences in hemoglobin A1c (0.16–0.42%).[8]

Table 1.
Potential Value of Self-Monitoring of Glucose Levels in Diabetes Care

Patient	• Assess effectiveness of prevailing lifestyle and therapies • Assess impact of changes in lifestyle factors • Guidance on changing timing and frequency of therapies • Self-titration of medication dose • Early warning system (e.g., detection of hypoglycemia)
Health care provider	• Assess the impact of diet and exercise • Assess effectiveness of lifestyle and therapies • Recommend changes to therapies • Assess impact of therapy change • Intensify therapy • Confirmation of suspected hypoglycemia

Balancing Need and Risk

It is generally accepted that, in type 2 diabetes, blood glucose monitoring is performed less frequently than desirable, that positive behavior change from SMBG testing is difficult to obtain, and that the procedure of testing is often unstructured, leading to the perception that it is therefore of limited value and should be rationed.[9]

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Abbreviations: (SMBG) self-monitoring of blood glucose

Keywords: checklist, monitoring, self-monitoring of blood glucose, type 2 diabetes

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It is also evident that the potential impact of any blood glucose monitoring system will be dependent on the clinical risk profile of the individual doing the test; the present circumstances around when the test is performed, e.g., a "routine" test versus a test taken before driving a motor vehicle; and what follows from obtaining the test result. The frequency of testing and the accuracy of the system will also be influenced by the anticipated outcome (i.e., why do a test if the result is expected to be much higher than ideal), the personal disruption caused by performing the test, and the clinical risk from any inaccuracy associated with the performance of the monitoring system. An additional factor relates to the complexity of the decision-making process after obtaining blood glucose data. It has been shown in insulin-independent patients that more structured SMBG, together with physician and patient training in interpretation of the results obtained from preclinic visit seven-day profiles, can be helpful. This approach appears to result in more timely and intensive therapy changes and modest improvements in glycemic control without requiring an increase in the overall frequency of testing.[10]

For insulin-treated individuals, it has been suggested that meaningful improvements in blood glucose control can be achieved using simple algorithms for altering the insulin dose based on premeal SMBG values.[11] However, in that study, the specific titration algorithms used were associated with a doubling of the total daily insulin dose, significant weight gain, and a relatively high frequency of severe hypoglycemic events. Ideally, an algorithm-based approach should be compared with a reference standard for mealtime insulin dose calculation, which includes qualitative assessments, e.g., burden of diabetes, flexibility, and patient empowerment in addition to the usual measures of blood glucose control and glycemic variability. As mentioned in a previous editorial in this journal, the complexity of the calculation may be beyond a significant number of people living with diabetes due to their unmet literacy and numeracy needs.[12] Furthermore, for many, the burden of having to make the calculations at every meal and every day may be too much.[13]

Fortunately, there does appear to be new opportunities for this approach to patient monitoring that has the potential to add value to diabetes care. The need is to match the optimum frequency and timing of testing to the patient and stratify according to therapeutic groups. For this to be cost-effective, consideration of its value needs to be applied in relation to the patient's understanding of the role of SMBG in their care (**Table 2**).

If all criteria within **Table 2** are met, the next step will be to define the optimum achievable approach to SMBG for a specific individual. This will vary from individual to individual and will relate to the self-perceived burden imposed by the condition of living with type 2 diabetes and the demands of the therapies used, including SMBG testing. In parallel, agreement needs to be reached for the optimum frequency and timing of SMBG balanced by the demands of the schedule for testing (**Figure 1**). This will also be influenced by the nature of the prescribed therapies, e.g., hypoglycemia risk and the needs of the individual, for example, shift work, long-distance travel, and pregnancy.

It is anticipated that new developments in diabetes-related technologies may have a major impact in reducing the burden. Potential examples include bolus calculators for multiple daily injection therapy similar to currently

Table 2.
Self-Monitoring of Blood Glucose in Type 2 Diabetes: A Checklist

Does the patient
• Understand the steps needed to perform successful SMBG?
• Understand the limitations of the technology, including the potential for interfering substances?
• Agree the appropriate timing for undertaking SMBG?
• Agree the appropriate frequency for undertaking SMBG?
• Understand the cause of the achieved result?
• Understand the consequences of the achieved result?
• Have the ability to consider making a change of lifestyle based on the achieved result?

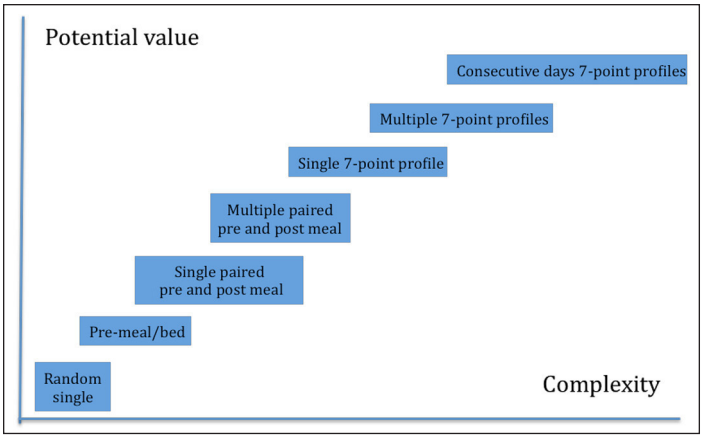

Figure 1. The potential value obtained from structured SMBG and the complexity of the required task.

available systems for insulin pump users; insulin dose titration support for basal insulin adjustment and mealtime dosing where individuals are unable or unwilling to assess meal carbohydrate content; real-time telehealth monitoring, decision and motivational support; and electronic assessment of meal content and size.

In summary, the current approach to SMBG testing for individuals living with type 2 diabetes lacks structure. Furthermore, patients often have not had the training that enables them to interpret the results and make meaningful changes consequent upon them. Advances in technology should allow more people to use information more appropriately and, at the same time, reduce the overall burden. In parallel, the optimum timing and frequency of testing must be determined for a given individual. Otherwise, the economic burden associated with unstructured testing will eventually result in rationing of a potentially valuable technology—not because of the technology per se, but because of our inability to use it in the most cost-effective way.

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