AADE POSITION STATEMENT
The American Association of Diabetes Educators Position Statement:
Self-Monitoring of Blood Glucose

Introduction

Control of diabetes is contingent on numerous factors and behaviors. Among the AADE7 self-care behaviors (healthy eating, taking medications, healthy coping, being active, monitoring, reducing risk, and problem solving), self-monitoring of blood glucose (SMBG) is a key component of the treatment regimen.[1] Performance of self-care behaviors is frequently contingent on the results of SMBG, and a major component of diabetes self-management consists of maintaining control of blood glucose levels by a variety of means, depending on parameters that are individual to each person with diabetes.[2] Large clinical trials have demonstrated that glycemic control, as assessed by hemoglobin A1C levels, reduces the incidence of the pathologic changes in small blood vessels that lead to severe diabetes-related complications.[3-5] Individualized approaches to A1C control – essential for all persons with diabetes – is especially important for the adult with type 2 diabetes who is at high risk for macrovascular disease.[6-8] Self-monitoring of blood glucose (SMBG) provides immediate information on a person's glycemic level and thus, could be an important guide for adjusting all factors that affect glycemic control on a more timely basis than A1C (which reflects blood glucose levels over a three-month period).[9] To be useful, SMBG must be integrated into the diabetes self-management plan, which is ideally delivered by a diabetes educator.

SMBG has been evaluated by several major scientific societies – the American Diabetes Association, the American Association of Clinical Endocrinologists, the International Society for Pediatric and Adolescent Diabetes, and the International Diabetes Federation – and has generally been recommended as a potentially valuable part of the overall treatment plan.[10-13] However, at least one study found that for non-insulin-treated type 2 patients with diabetes, the performance and frequency of SMBG did not predict better metabolic control over 3 years.[14]

While the benefits of SMBG have generally been demonstrated in people with type 1 diabetes, studies assessing the effects of SMBG in people with type 2 diabetes have not always reported consistent results; for example, the International Diabetes Federation, summarizing randomized controlled trials in people with type 2 diabetes mellitus, found that while some trials associated SMBG with major and significant decreases in A1C, other studies reported no significant decreases.[13,15] These inconsistent findings may be due to a number of factors or study design elements, including the effect of rapid up-titrating of medications or of intensive care in both the SMBG and control groups. This may have obscured the effects of SMBG, as well as the fact that in several trials patients may not have been clearly instructed as to when they should monitor their blood glucose levels, nor how to respond to the readings.[13,16]

Nonetheless, a global consensus conference on SMBG has found that this method is the best way for people with diabetes, as well as healthcare professionals (including diabetes educators), to assess the ongoing efficacy of all aspects of the diabetes management regimen, including, but not limited to, medication and patient behavior.[17] SMBG can be an especially valuable component of self-management education, since SMBG provides critical feedback on the consequences of recent activity, including medication taking, meals, and physical activity.[18] However, it is short-term changes in blood glucose levels that lead to acute complications such as episodes of hypoglycemia, hyperglycemia, or diabetic ketoacidosis; SMBG can be used to help prevent and minimize such complications. The purpose of this position statement is to support SMBG as part of a self-management program, and to outline the role of the diabetes educator in this aspect of diabetes self-management education.

Background

The diabetes educator can contribute essential expertise for many aspects of diabetes self-management, particularly with regard to training people on how to interpret their SMBG results and make appropriate adjustments in medication, diet, and activity.[17] If SMBG is simply prescribed without education, people with diabetes are less likely to take advantage of the feedback that SMBG provides about their immediate response to medication and behavior, and may not reap the benefits of SMBG as a means of regulating and controlling their diabetes.[19] In contrast, when people with diabetes are effectively educated in using SMBG, self-management of diabetes improves. For example, clinical trials have demonstrated that those trained in using SMBG were more likely to adhere to instructions regarding meal planning, because they saw the immediate effects of their food intake on blood glucose levels.[20] Also, people with diabetes who were counseled on meal-related SMBG and kept food diaries had improved glycemic control, and improved adherence to self-management behaviors.[21,22]

SMBG, incorporated into the self-management regimen with an effective educational intervention, can also minimize the risk of complications. People with diabetes who are injecting insulin can be shown how to use SMBG to titrate their dosage to achieve improved glycemic control while minimizing acute episodes of hypoglycemia. Symptoms of hypoglycemia may not be recognized by young children or their parents, thus SMBG is particularly valuable in this population.[23]Another study reported that hypoglycemic episodes among people with type 2 diabetes tend to be less frequent in those who employ SMBG.[24]

The evidence regarding the benefit of SMBG in those who are treated with insulin is clear.[25-27] However, in people with type 2 diabetes who are not taking insulin, the evidence is equivocal.[24,25,28] The ability to understand SMBG results needs to be linked with the capacity to carry over the results into action; in one study, 24% of patients using SMBG did not improve their metabolic control because of inability to act on their SMBG results, even though they had the capacity to understand the results.[21]

A person with diabetes who regularly carries out a program of SMBG – and who has learned how to interpret the results and use the information that SMBG provides to make changes – can expect to see improvement in overall glycemic control as well as a reduction in the incidence of complications.[24,25] People with both type 1 and type 2 diabetes trained in the use of SMBG experience fewer acute or long-term complications and are able to use SMBG to predict future episodes of mild, moderate, or severe hypoglycemia.[24,29,30] Evidence suggests that employing

SMBG may be able to reduce the risk of neuropathy and retinopathy. People with type 2 diabetes using SMBG experienced a lower incidence of cardiac events in the first years following diagnosis.[28,30,31] The Diabetes Control and Complications Trial (DCCT), the Epidemiology of Diabetes Interventions and Complications trial (EDIC), and the UK Prospective Diabetes Study (UKPDS) suggested that in fact, intensive management─ including SMBG at least 4 times daily – decreased the incidence and progression of diabetes-related micro- and macrovascular complications.[3-5,33]

Beyond improving clinical outcomes, educating about SMBG can result in improvements in quality of life.[34,36] Most people with diabetes believe that using SMBG can have beneficial health outcomes, and those who received training in the interpretation of SMBG results experienced fewer negative feelings about SMBG compared to those who relied on providers to interpret their results.[36,37] Many factors (e.g., pain, socioeconomic and social support), may serve as barriers to self-monitoring behavior.[36]

Role of the Diabetes Educator

The diabetes educator plays multiple roles, has many responsibilities, and is involved in the continuum of SMBG, self-care and behaviors. The educator's role ranges from teaching the simple skills of performing a test, to educating how to interpret results and problem solve to adjust behaviors and therapy based on the information. The diabetes educator also helps patients choose appropriate and accurate blood glucose monitoring systems. SMBG is most effective when it is a continual, integral part of the diabetes management process. Numerous studies support the value of education in the use of SMBG; for example, education focusing on SMBG to improve metabolic control resulting in reductions in A1C levels in people with both type 1 and type 2 diabetes.[21,38] When people with diabetes were taught to use test results to adjust insulin doses, A1C levels improved significantly whether or not they received reminders from their healthcare team.[41]

The value of specific educational interventions has been specifically studied: non-insulin-treated people with type 2 diabetes who were trained in the interpretation of SMBG had fewer negative feelings about the procedure and an increased understanding of the value of SMBG.[37] Adolescents with type 1 diabetes transitioning to self-management increased their monitoring frequency and lowered their A1C levels when they were taught SMBG-related problem-solving skills.[40,41]

Not all people with diabetes benefit equally from SMBG, and it is an important responsibility of diabetes educators to identify which patients have the ability and the resolve to learn how to use SMBG optimally to improve their glycemic control. The effectiveness of diabetes self-management education also varies with age, with children having less capacity to implement SMBG.[42] Thus, diabetes educators engage in a process of individualized, continuing education regarding self-management and SMBG to maintain optimal metabolic control through the years.[43,44]

Among the barriers that have been identified are: cost, pain and inconvenience, psychosocial factors such as family support or low self-esteem, and physical or cognitive issues. SMBG is cost-effective and the diabetes educator can find ways to address the various barriers so that people with diabetes can benefit from SMBG.[7,17,38] For example, reducing the cost of blood testing supplies, or making them available at no charge, increases the frequency of SMBG

testing.[27,45] Patients whose SMBG supplies are covered by insurance were found to have lower A1C levels than those without insurance coverage.[47] The issue around pain and inconvenience may be larger in perception than in reality.[47]

Facilitators of SMBG behaviors include a support system. Diabetes educators can evaluate an individual's primary support network and, if needed, provide additional support and encouragement.[48] Individuals with diabetes whose support persons were depressed, had low self-esteem, or low levels of optimism, were less likely to perform SMBG.[24,49] Cognitive factors also affect the capacity to understand and implement SMBG; persons with low cognitive function are more likely to require assistance in performing all diabetes self-care tasks.[50] People with diabetes and poor vision may require special counseling or specific meter selection.[51]

It is evident that the value of SMBG is contingent on the accuracy of the blood glucose meters. These instruments may be affected by individual and environmental variables, including hematocrit, hypotension, hypoxia, hypertriglyceridemia, concomitant drugs, as well as temperature and humidity.[52,53] The diabetes educator assists in selecting meters that will be accurate in the conditions under which they will be used. One clinical trial reported that 84% of patients obtained SMBG values that were within 20% of the reference value. Diabetes educators can help to ensure that accurate results are obtained and reported.[54,55] Educators and other providers may need to access the stored data as part of the effort to ensure that clinical decisions are based on accurate blood glucose readings.

AADE Maintains the Following Positions

- The diabetes educator incorporates education in the regular performance of SMBG as a means of facilitating diabetes self-management for optimal results.
- SMBG provides the person with diabetes with immediate feedback on the consequences of recent activity, including medication taking, meals, and physical activity and should be included in DSME/T. Diabetes educators help people with diabetes take advantage of this feedback to control their diabetes, and address barriers that may affect their ability and willingness to implement SMBG.
- Accurate SMBG readings are important to clinical decision-making and healthcare outcomes. Diabetes educators help people with diabetes to obtain, report, and use accurate data safely and effectively.
- Diabetes educators understand and address the barriers that may affect ability and willingness to implement SMBG. Community resources can help overcome barriers such as cost and limited access to diabetes education.
- The diabetes educator teaches people with diabetes how to recognize when blood glucose levels are out of range, how to adjust their therapy and behaviors based on the SMBG results, and how to then verify the effects of these adjustments by performing subsequent SMBG tests.

Summary

The optimum treatment program for a person with diabetes requires ongoing self-management on a daily basis, which in turn is contingent on ongoing, effective education. The educational process will involve an interdisciplinary team of clinical care providers which includes the diabetes educator.[56,57] The diabetes educator has multiple functions directed at incorporating SMBG in the total self-management program, ranging from the specifics of SMBG meter training to empowering the person with diabetes to understand and act on the blood glucose

values, to addressing any barriers that may arise. As the health-care system evolves towards improved outcomes and greater efficiency, the responsibilities of the diabetes educator will continue to grow and become increasingly central to the goal of effective self-care.

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The evidence has been graded according to a rigorous scale as described in The Guidelines for the Practice of Diabetes Education, 2009. Evidence grades appear in parentheses at the end of each citation.

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