To test or not to test? Self-monitoring blood glucose in patients with type 2 diabetes managed without insulin

Sonia Butalia[1], BSc, MD, FRCPC, Doreen Rabi[1,2,3], MD, FRCPC, MSc

[1]Division of Endocrinology, Department of Medicine, University of Calgary
[2]Department of Community Health Sciences, University of Calgary
[3]Department of Cardiac Sciences, University of Calgary

There have been considerable advances in the technology of assessing real-time glucose levels in diabetes. The first glucose testing of the urine was developed in the 1940's. This was followed by the advent the first capillary blood test strip in 1956 and the first glucose meters in the 1970's and early 1980's (Bloomgarten). The introduction of such devices meant that patients on insulin now had an alternative option to urine testing for monitoring their glucose levels. Since that time meters have become smaller and lighter and the amount of blood required and time to get a result have decreased. Such advances have facilitated the adoption of self-monitoring of blood glucose (SMBG) into the routine care of diabetic persons using insulin. People with diabetes can obtain a quick and accurate blood glucose reading and use this information to adjust their insulin to reach evidence based therapeutic targets. For patients with diabetes not on insulin, type 2 diabetic patients on oral hypoglycemic therapy in particular, may not be able to adjust their treatment in response to a specific blood glucose reading. While blood glucose readings remain important information and do inform care providers on the efficacy of prescribed treatment regimens, the direct benefit of SMBG to the patient not on insulin is unclear.

In this edition of the Open Medicine, McIntosh *et al* examine the efficacy of SMBG in patients with type 2 diabetes managed without insulin. This rigorously conducted systematic review and meta-analysis of 21 studies (7 studies in the meta-analysis) showed SMBG lowered hemoglobin A1C by 0.25% (weighted mean difference, 95% confidence interval -0.36 to -0.15%) when comparing compared with no self-monitoring. Sub-group analysis showed no significant difference between randomized-controlled trials with study participants that were provided instruction on interpretation and application of the results compared to those that were not (-0.28%, 95% CI -0.47 to -0.08%; -0.22%, 95% CI -0.34 to -0.10, respectively). Also the results did not change when looking at the higher quality studies (3 studies, weighted mean difference hemoglobin AIC -0.21%, 95% CI -0.34 to -0.08) or in other subgroup analysis that looked at frequency of SMBG monitoring per day, duration of SMBG, proximity to diagnosis, glycemic control, or type of oral agents used. This review sought to determine the optimal frequency of self-monitoring however there was insufficient data available to assess this.

Similar to other recently published reviews (Cameron), this review demonstrated that SMBG lowers HbA1C by 0.25%. This is a statistically significant result, but it is unclear what it means clinically. There is a wealth of epidemiologic evidence that demonstrates significant reductions in micro- and macrovascular complication rates with decreasing HbA1C, with some demonstrating up to a 18% relative risk reduction in

cardiovascular events with every 1% decrease in hemoglobin A1C (Selvin). However, interventional trials designed to test whether intensive glucose lowering strategies benefit patients with type 2 diabetes have shown mixed and somewhat modest benefits. ADVANCE, ACCORD, VADT and the 10 year follow-up data from UKPDS have illustrated that the degree of benefit related to lowering hemoglobin A1C with respect to macrovascular outcomes likely depends on several factors including duration of diabetes, degree of dysglycemia and perhaps the choice of oral therapy used (ADVANCE, ACCORD, Duckworth, Holman). In absolute terms, the number of events prevented by lowering A1C by 0.25% would appear to be quite small given the costs of SMBG. In fact a recent economic analysis of SMBG conducted by Cameron *et al*, illustrated that the absolute risk reduction in micro- and macrovascular disease associated with 40 years of SMBG among persons with diabetes not on insulin was rather small. The number needed to treat to prevent 1 diabetes related complication ranged from 228 (for heart failure) to 1299 (for end-stage renal disease). While the direct benefits to the individual engaging in SMBG may be under-whelming, the downsides of SMBG are clear- SMBG is uncomfortable, inconvenient and costly (Peel, Cameron, Gomes).

Further trials comparing SMBG versus no SMBG are not needed (although there are several published protocols for proposed studies). What is needed is clear evidence on the optimal clinical application of SMBG. Patients with type 2 diabetes are a clinically heterogeneous population, and while the benefit of SMBG to the entire population is small, there are likely subgroups that do have more to gain from testing. A recent review of dispensing practices in Ontario in patients aged 65 and older found that overall use of SMBG increased by 250% from 1997 to 2008 (Gomes). Also 60% of patients taking diabetes medications not known to cause hypoglycemia and 30% of patients who did not use any diabetes drugs were dispensed blood glucose test strips (Gomes). Recognizing the tremendous cost of the current use of SMBG, the authors used decision analysis modeling to proposed several options from a cost-effectiveness standpoint for test strip use based on the type of therapy patients were on (lifestyle, type of oral agent, insulin, etc.,). Perhaps SMBG should be selectively used in patients on oral agents known to cause hypoglycemia rather than those on lifestyle only. It is these tailored strategies that need to be prospectively studied to find optimal ways to use SMBG in patients with type 2 diabetes not on insulin.

So where do we stand now? SMBG appears to improve glycemic control by a reduction of the hemoglobin A1C by 0.25%. But what still remains to be determined is if this translates into better patients outcomes especially when we factor in the pain, inconvenience, and cost to patients. Do all patients with type 2 diabetes not on insulin need to engage in SMBG? Probably not, but we still lack important information on how to use this technology effectively and efficiently and which patients will benefit the most. Ultimately what is required are prospective trials examining where and under what conditions to make best use of this tool in patients and a broad, indiscriminate approach should be avoided.

References:

The Action to Control Cardiovascular Risk in Diabetes Study Group. Effects of intensive glucose lowering in type 2 diabetes. *NEJM.* 2008;358: 2545-2559.

The ADVANCE Collaborative Group. Intensive blood glucose control and vascular outcomes in patients with type 2 diabetes. *NEJM*. 2008; 358: 2560-2570.

Bloomgarden ZT. Blood glucose monitoring. *Medscape*. October 13 2003 (updated October 21 2003) Available: http://www.medscape.com/viewarticle/462885 (accessed 2010 February 14).

Cameron C et al. Cost-effectiveness of self-monitoring of blood glucose in patients with type 2 diabetes mellitus managed without insulin. *CMAJ*. 2010; 182: 28-34.

Duckworth W et al. Glucose control and vascular complications in veterans with type 2 diabetes. *NEJM*. 2009; 360: 129-139.

Gomes T et al. Blood glucose test strips: options to reduce usage. *CMAJ*. 2010; 182: 35-38.

Holman RR et al. 10-year follow-up of intensive glucose control in type 2 diabetes. *NEJM*. 2008; 359: 1577-1589.

Peel E et al. Self monitoring of blood glucose in type 2 diabetes: longitudinal qualitative study of patients' perspectives. *BMJ*. 2007; 335: 493-496.

Selvin et al. Meta-analysis: glycosylated hemoglobin and cardiovascular disease in diabetes mellitus. Ann Intern Med. 2004; 141: 421-431.