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

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Read the related research by Brendan McIntosh and colleagues on pages e102–13.

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There have been considerable advances in the technology of assessing real-time glucose levels in patients with diabetes. The first self-testing kit for measuring glucose in urine was developed in the 1940s. The advent of the capillary blood test strip followed in 1956, and glucose meters in the 1970s and early 1980s.[1] The introduction of these latter devices meant that patients taking insulin had an option other than urine testing for monitoring their glucose levels. Since then, glucose meters have become smaller and lighter, and the amount of blood required and time to get a result have decreased.

These advances have facilitated the adoption of self-monitoring of blood glucose levels as part of the routine care of diabetes managed with insulin. People with diabetes can obtain a quick and accurate reading of their blood glucose level and use this information to adjust their insulin to reach evidence-based therapeutic targets. In contrast, those whose type 2 diabetes is managed with oral hypoglycemic therapy typically cannot adjust their treatment in response to a specific blood glucose reading. Although blood glucose readings inform care providers on the effectiveness of prescribed treatment regimens, the direct benefit of self-monitoring to the patient not taking insulin is unclear.

In this issue of *Open Medicine*, McIntosh and colleagues examine the efficacy of self-monitoring of blood glucose levels in patients with type 2 diabetes managed without insulin.[2] Their rigorously conducted systematic review and meta-analysis of 21 studies showed that self-monitoring resulted in a modest, significant reduction in hemoglobin A_{1c} (HbA_{1c}) concentration (weighted mean difference −0.25%, 95% confidence interval [CI] −0.36% to −0.15%) compared with no self-monitoring. Subgroup analysis showed no significant difference between the results from randomized controlled trials (RCTs) that provided patients with education on how to interpret and apply self-monitoring test results (weighted mean difference −0.28%, 95% CI −0.47% to −0.08%) compared with RCTs that did not (weighted mean difference −0.22%, 95% CI −0.34% to −0.10%). The results did not change when the authors included only studies of higher quality (3 RCTs, weighted mean difference −0.21%, 95% CI −0.34% to −0.08%) or in the subgroup analysis that looked at frequency of self-monitoring per day, duration of self-monitoring, time since diabetes diagnosis, glycemic control or type of oral hypoglycemic therapy used. McIntosh and colleagues sought to determine the optimal frequency of self-monitoring; however, there were insufficient data available to assess this.

Similar to another recently published review,[3] the review by McIntosh and colleagues demonstrates that self-monitoring of blood glucose levels results in a reduction in HbA_{1c} concentration of 0.25%. Although a statistically significant result, it is unclear what it means clinically. A wealth of epidemiologic evidence has shown significant reductions in micro- and macrovascular complication rates with decreasing HbA_{1c} levels, with some showing a relative risk reduction of up to 18% in cardiovascular events with every 1% decrease in HbA_{1C} level.[4] However, interventional trials designed to test whether intensive glucose-lowering strategies benefit patients with type 2 diabetes have shown mixed and somewhat modest benefits. The ACCORD, ADVANCE and VADT studies and the 10-year follow-up data from the UKPDS trial have shown that the degree of benefit related to lowering HbA_{1c} with respect to macrovascular outcomes likely depends on

several factors, including the duration of diabetes, the degree of dysglycemia and perhaps the choice of oral therapy used.[5–8] In absolute terms, the number of events prevented by lowering the HbA_{1c} concentration by 0.25% would appear to be quite small given the cost of self-monitoring of blood glucose. In fact, a recent economic analysis conducted by Cameron and colleagues showed that the absolute risk reduction in micro- and macrovascular disease associated with 40 years of self-monitoring of blood glucose among people with diabetes managed without insulin was rather small.[3] The number needed to treat to prevent 1 diabetes-related complication ranged from 228 (for heart failure) to 1299 (for end-stage renal disease). Although the direct benefits to the person performing the self-monitoring may be underwhelming, the downside is clear: self-monitoring is uncomfortable, inconvenient and costly.[9]

Further trials comparing self-monitoring and no self-monitoring are not needed (although there are several published protocols for proposed studies). What is needed is clear evidence on the optimal clinical application of self-monitoring. Patients with type 2 diabetes are a clinically heterogeneous population. Although the benefit of self-monitoring to the entire population is small, there are likely subgroups who do benefit from testing. We must also consider that self-monitoring of blood glucose is not cheap and has been found to be cost-inefficient.[3] Despite the paucity of strong evidence for clinical or cost effectiveness, a recent study by Gomes and colleagues showed that overall use of self-monitoring *increased* by almost 250% from 1997 to 2008 in Ontario.[10] The study also showed that 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.[10] Recognizing the tremendous cost of self-monitoring, Gomes and colleagues used decision analysis modelling to propose several blood glucose self-monitoring strategies based on the type of therapy patients were receiving (e.g., lifestyle modification, oral hypoglycemic therapy, insulin), presuming that patients taking insulin and those at risk for hypoglycemia may receive the most benefit from self-monitoring. They concluded that unlimited coverage of self-monitoring for those taking insulin and limited, strategic testing among those not taking insulin would significantly reduce the costs associated with self-monitoring and may not alter clinical outcomes.[10] This conclusion is based on simulation modelling, which has inherent limitations. However, tailored strategies for self-monitoring of blood glucose need to be studied prospectively to determine their impact on both clinical outcome and cost.

So where does that leave us? Self-monitoring of blood glucose appears to improve glycemic control in patients with type 2 diabetes managed without insulin. But does this translate into better patient outcomes, especially when we factor in the pain, inconvenience and cost of self-monitoring to patients? Do all patients with type 2 diabetes managed without insulin need to engage in self-monitoring? Probably not, but we still lack important information on how to use this technology effectively and efficiently and who will benefit the most. Ultimately we require prospective trials that examine under what conditions to make best use of this tool so that a broad, indiscriminate approach can be avoided.

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