Clinicians often sit in their offices or surgeries and wonder why the home blood-glucose monitoring record prepared by the patient is at odds with the objective measurement of control given by hemoglobin A1c (HbA1c). In this issue of the Journal, Skeie et al. (1) point to one possible facet of this discrepancy. They suggest that the performance of instruments for blood-glucose monitoring is worse in the hands of the patients than in the hands of trained laboratory personnel. Furthermore, few if any of the instruments, when used by the patients, gave performances that would meet established guidelines for quality of results (2, 3).

The final decade of the last century was crucial for diabetes management. Evidence from the Diabetes Control and Complications Trial (4) in the US, which involved type 1 diabetic patients, and from the United Kingdom Prospective Diabetes Study in the United Kingdom, which involved type 2 diabetic patients (5, 6), confirmed the long-held, but previously somewhat unsubstantiated, view that control of blood glucose was important in delaying the onset or preventing the development of complications. Obtaining and maintaining euglycemia in diabetic patients, however, remains an elusive goal for many, but importantly, the evidence suggests that improving outcome is a continuum, i.e., benefit accrues for any decrease in HbA1c.

Current treatments of both type 1 and type 2 diabetic patients are limited by several problems. In type 1 diabetes, the insulin that is given is wrong in the wrong place at the wrong time and in the wrong dose. Subcutaneous administration of insulin inevitably leads to loss of the normal portal:peripheral ratio of circulating insulin. Exogenous insulin needs to be given 20–30 min before a meal to achieve circulating concentrations appropriate for the meal. Even then, because of dimer and hexamer formation at the injection site, absorption is sluggish and does not mimic normal physiology. Moreover, because the feedback loop of glucose on insulin secretion is lost, the amount of insulin given can never be precisely what is required, and episodes of hyper- and hypoglycemia ensue. Developments in insulin therapy, such as continuous subcutaneous insulin delivery and insulin analogs with less hexamer formation, are tools toward improving control, but until closed-loop feedback systems for glucose concentration-regulating insulin delivery become available for routine clinical use, the majority of patients with type 1 diabetes will rely on the less precise feedback of blood-glucose monitoring as a guide to the amount of insulin needed.

In patients with type 2 diabetes, the issue is somewhat different. Oral agents and diet may control glucose concentrations in some people for some time, but there is little evidence that they alter the natural history of the disease and slow the loss of β cells with time (7). Nevertheless, controlling blood glucose plays an integral part in well-being and long-term health. To achieve this, patients needing insulin may use blood-glucose monitoring to adjust their doses in a way similar to that used by type 1 patients. For the majority using diet or oral hypoglycemic agents, the effect is more of monitoring control rather than day-to-day therapy adjustment. Of course, all patients can see the impact of dietary indiscretion on glucose concentrations, which may lead to greater dietary adherence, but in the main, home blood-glucose monitoring by type 2 diabetic patients being treated with diet alone or with tablets functions mainly as a means of monitoring. Since its introduction (8, 9) into clinical practice, self-monitoring of blood glucose has been a useful tool of support for patients attempting to improve their diabetic control. That it is by no means perfect is alluded to above and is apparent to both patients and clinicians alike. Attempts, therefore, to define areas in which performance can be improved are to be welcomed.

Underpinning this use of home blood-glucose monitoring must be the performance of the meters, especially in terms of accuracy and precision. Skeie et al. (1) evaluated the analytical quality of different instruments for blood-glucose monitoring, comparing the performance of patients and qualified laboratory staff. In addition, some information was gathered on patients’ use of blood-glucose testing through a questionnaire. Patients’ blood-glucose measurements had a larger deviation (the difference between a first measurement and a laboratory method) for three of the five instruments and greater imprecision (the variation between duplicate measurements) in all five instruments than did the measurements by laboratory personnel. The methodology applied is in line with previous studies, but the use of different batches of strips by the patients and the technician does not allow a conclusion on the contribution to the differences observed from the patient rather than from the inherent variation in the strips. Even in trained hands the latter may cause confusion, as is exemplified by the results for the One Touch meter. The exclusion of outliers may be scientifically justifiable, but these results are of real clinical importance because they may prompt inappropriate action.

More than this, however, is the paramount place of education in the patient’s care. It seems self-evident that the patient will need education in the technique of using the meter, some information on when to measure blood glucose, and how to respond to the results. Indeed, a lack of such educational input may, in certain circumstances, be construed as a standard of care falling below what might be expected by professionals (10) and the courts. It is the results from the questionnaire (1) on the use of...
self-monitoring by diabetic patients that raises most concern with respect to interpreting these results and applying them to the diabetic population at large. Only 50% of the patients studied based their choice of meter on advice from healthcare professionals, thus suggesting a shortage of professional input at initiation of blood-glucose monitoring; in addition, 51% were described as self-educated. Without input by a healthcare professional on the how, when, and what to do with the results of home blood-glucose monitoring, it seems small wonder that results are less than exemplary.

Thus, although the contribution by Skeie et al. (1) is to be welcomed as identifying an area for improvement in home blood-glucose monitoring, it must be seen in the wider context of patient education. The importance of education in achieving accuracy and precision of home blood-glucose monitoring results by patients cannot be ignored, and proper educational programs must be developed and available to gain the best from current and future technologies.

References

Malcolm Nattrass
Diabetes Resource Centre
Selly Oak Hospital
University Hospital Birmingham NHS Trust
Birmingham B29 6JD, United Kingdom