

# Use and Abuse of Glucose Reflectance Meters

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All diabetic patients who had been using home glucose monitoring devices during the last 2 yr in the area served by the specialist Diabetes Unit in Christchurch, New Zealand were invited to complete a questionnaire designed to provide information on glycemic control, treatment regimen, and patterns of glucose recording. Questionnaires were completed by 111 of 152 patients, of whom 99% were using insulin. The period of use of reflectance meters was between 1 and 18 mo. Forty-three percent used their meters in a manner considered unsatisfactory and 15% failed to write down results. Those patients recording for the longest periods showed a significant trend to more inefficient use of devices. Forty-four percent still relied on their medical supervisor for treatment changes, but most attended infrequently (mode 12 wk; range 1–52 wk). Most frequently, treatment changes were to insulin dose and only one-third had adopted more “physiologic” regimens incorporating rapid-acting insulin. Blood glucose control was not significantly changed from that found in a group of diabetic subjects during the first weeks of monitoring. These results suggest that (1) many patients do not use home glucose monitoring devices in a manner likely to allow rational modification to therapy, (2) neither patients nor family physicians have reacted appropriately to high recorded values, and (3) chronic use of home monitoring has not resulted in good glycemic control for many patients. *DIABETES CARE* 5: 542–544, SEPTEMBER–OCTOBER 1982.

Many diabetes units now encourage patients to use home glucose monitoring devices in the expectation that better control will result.<sup>1–7</sup> However, most of these earlier studies reported results from small numbers of patients who had received intensive education with regular follow-up, and it is not surprising that this commitment of time and resources resulted in better glycemic control. Over the next few years, greater numbers of patients, both insulin-dependent and non-insulin-dependent, will wish to use some form of blood glucose testing, and this will inevitably reduce the effectiveness of those programs committed to individual instruction and frequent review.

Recognition of this trend has encouraged this diabetes unit to adopt the approach in which the family physician and practice nurse assume the major management role. The unit provides comprehensive educational courses covering all aspects of diabetes for patients, but it sees its long-term effectiveness through active participation of other health professionals in the treatment programs. To assess the outcome of this policy as practiced over the last 2 yr, a survey has been

made of all diabetic patients in the area serviced by this diabetes unit who have obtained a reflectance meter.

## METHODS

This specialist diabetes unit serves 900 insulin-dependent and approximately 5000 non-insulin-dependent diabetic patients. By December 1980, 152 of these patients had been supplied with a reflectance meter. Written request from their doctor was required, and although the diabetes unit arranged for initial instruction in the effective use of the meters, all patients subsequently visited their family physician for treatment review. Both patients and doctors were given guidelines indicating how the device could be put to best use. Devices used by patients were the Eytone and Glucometer (Ames, Elkhart, Indiana) and the Hypocount (Hypoguard, United Kingdom).

Questionnaires were mailed to all patients and followed by a telephone call. Returned questionnaires were coded and analyzed by computer. One hundred eleven questionnaires (73%) were returned in time for analysis. Late returns gave a

final yield of 87%, but their inclusion did not influence results. Written records of home monitoring results were supplied by 88 patients and were used to derive mean blood glucose values (MBG) and percentage of recordings  $\leq 10$  mmol/L. All glucose values recorded by the patient over a 2-wk period before the questionnaire was sent out were used to derive these indices.<sup>8</sup>

RESULTS

Ninety-two of the patients were using more than one daily injection at the time of the questionnaire. The mean duration of diabetes from diagnosis was 12 yr (range 1–58 yr) and mean daily insulin dose 37 U (range 4–110 U). The treatment regimens had been changed in 82 cases since monitoring had begun. The most common change was a change in dose (53 instances) followed by mixing of different insulin types (38 instances) and increased frequency of injection (17 instances). Only seven had changed the type of insulin used. Forty-nine percent of the respondents were happy to change treatments without consultation with a medical adviser, while 44% still relied on their doctor's advice. Most subjects (87 of 111) did show records to their family practitioner, but the mean interval of discussion was 8 wk with a mode of 12 wk (range 1–52 wk). Only four subjects were receiving supportive advice from a medical source on a regular basis, in spite of the fact that 12% had acquired the meter with written assent of their doctor within the previous 4 wk (Table 1).

Forty-seven of the 111 respondents (43%) were using their meters inappropriately, i.e., insufficient data upon which to

base a treatment change that would give better blood sugar control (Table 1). Of these, 2 subjects were not now using their devices; 20 recorded blood sugar levels twice a day immediately before injection and did not sample periprandially or in between injections; and 25 measured a single blood sugar value and recorded with variable frequency from occasionally to daily. Patients who had owned their reflectance meters for longer periods had less efficient patterns of use than those who had used them for a shorter duration (Table 1).

Blood glucose control as assessed by calculation of MBG and percent of values  $\leq 10$  mmol/L was not significantly different from that found in a group of 38 patients at the start of self-monitoring ( $9.4 \pm 3.1$  mmol/L for long-term users versus  $10.4 \pm 4.0$  mmol/L at the start of monitoring). In contrast to this semiquantitative assessment of glycemic control, 63% of the 111 patients did claim that control had improved during the period of monitoring, while 32% reported that control had remained the same; forty-eight percent reported fewer episodes of hypoglycemia.

No association was found between the degree of control attained and other variables such as recording frequency, patterns of insulin use, or frequency of visits to a doctor. Furthermore, respondents who had taken the opportunity to attend a comprehensive educational course at the Diabetes Center did not show better glycemic control than those who had not attended.

DISCUSSION

As home glucose monitoring finds favor with more diabetic patients, it is conceivable that a substantial proportion of the diabetic population in the area serviced by this unit (6000–8000 individuals) could be measuring their blood glucose levels within a few years. There is no way that a single diabetic unit manned by a small number of specialists can ever provide adequate medical surveillance of these patients to the same degree reported in the earlier studies.<sup>1–7</sup> For these reasons it was felt that family doctors would be the only effective means by which adequate surveillance could be provided. However, these data show less satisfactory outcome than has been reported by other units; therefore, this article attempts to highlight the reasons behind this apparent failure of reflectance meters to promote better patient self-sufficiency and improved glycemic control. The results may be useful to other units that are encouraging the widespread use of home monitoring devices with the expectation that better glycemic control will result.

Many diabetic patients (43%) were not using their meters in a pattern that would provide them with adequate information on which to base therapeutic decisions. Furthermore, 15% failed to record results despite being provided with compact recording booklets. Such individuals were not in a position to make rational decisions for themselves, and their medical advisers were provided with insufficient data to make changes in treatment.

Most patients in this study were seeing their medical ad-

TABLE 1  
Use of reflectance meters

Pattern of usage	Number of patients	(%)			
Not used during last month	4	(3.6)			
Used regularly	87	(79.0)			
Never used between 2400 and 0600 h	68	(60.2)			
Maintained written records	94	(85.5)			
Duration of meter ownership (mo)					
1	13	(11.7)			
2–5	32	(28.8)			
6–11	57	(51.4)			
12–18	9	(8.1)			
	Duration of use (mo)				
Pattern of usage	1	2–5	6–11	12–18	Total
Suboptimal*	3	13	24	7	47
Recommended†	10	18	32	2	62
Total	13	41	56	9	109‡
Proportion suboptimal	(0.23)	(0.42)	(0.43)	(0.18)	

\* Suboptimal: two or fewer recordings on testing days.

† Recommended: three or more recordings per 24 h several days per week.

‡ Two patients gave no response to question.

X<sup>2</sup> for linear trend = 4.35; 1 DF, P < 0.05.

visers to discuss glucose results once every 12 wk, which suggested that the reason for attendance was not to discuss results but to pick up their next prescription for insulin or testing equipment (in New Zealand prescriptions may be obtained for a maximum of 3 mo). It is unlikely that this infrequent contact will ever allow improvement of control. Some patients have even acquired new prescriptions without seeing their family doctor in consultation within 12 mo.

Improved control is not an automatic event associated with recording of blood sugars since experimentation with the insulin regimen and adjustment of the diet and exercise program is necessary. Twenty-two percent of the insulin-dependent diabetic subjects in our group have had no changes made to their insulin therapy since monitoring began, and only a third of the group have added rapid-acting insulin to their regimens. This implies poor understanding by both patient and medical adviser toward effective insulin replacement. Most patients have simply been subjected to change in dosage, an event not likely in itself to result in better glycaemic control.

In the long-term, it was hoped that with continued support by the medical adviser, patients would become more self-sufficient and be prepared to undertake treatment changes themselves.<sup>9</sup> However, 44% of the patients were still relying on a doctor to make changes in their insulin therapy and were not participating in the decision-making to any degree. Ideally the doctor should become an adviser and educate the patient to achieve a level of self-sufficiency resulting in less reliance on community health resources.

The results in which control did not appear to improve during long-term use of reflectance meters are very disappointing. There seems little doubt that substantially better control than has been achieved in this long-term study can result. Local experience with pregnant diabetic patients, who are subjected to close specialist scrutiny and follow-up, suggests that good control is dependent on comprehensive education and regular review.

These conclusions have prompted the unit to introduce some changes to the program. More rigid patient instruction is given and expectations of control are now clearly defined.

Algorithms on self-adjustment are given to patients. Results are now reviewed by the specialist unit and advice on management transmitted to the family physician. The unit realizes the need for a major educational investment if the patient and attending doctor are to use these valuable therapeutic aids to their full potential.

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