Review of the Effect of Internet Therapeutic Intervention in Patients With Type 1 and Type 2 Diabetes

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The use of the Internet has changed the way health care professionals manage diabetes, with platforms now available allowing patients to upload self-monitoring of blood glucose data and share with their health care provider (1). Previous studies have established the efficacy of Internet blood glucose monitoring systems (1–3).

It is now our standard of care to offer an Internet blood glucose monitoring system to patients. We currently have 1,100 patients enrolled and have outcome data on the first 409 patients. Of the 409 patients, 388 had HbA_{1c} at baseline and at least one subsequent HbA_{1c} determination within 9 months. HbA_{1c} values from 3–9 months were averaged to generate follow-up data. The relationship of reporting frequency and HbA_{1c} change was determined by dividing patients into frequent reporters, who reported more than once per month, and infrequent reporters.

Patients were instructed to upload self-monitoring of blood glucose readings every 2 weeks through their choice of platform including CareLink (Medtronic), meters equipped with report-generating software (Contour USB, Bayer; FreeStyle InsuLinx, Abbott; iBGStar, Sanofi), and a customized spreadsheet (Excel, Microsoft). All platforms generated reports presenting the mean, SD, and range of glucose values according to time of day. The patient's endocrinologist reviewed the readings and sent feedback to the patient via e-mail. Recommendations included changes in therapy, testing frequency, and lifestyle or encouragement to continue with no changes.

Key results are summarized in Table 1.

HbA_{1c} in all type 2 diabetic patients declined from 8.36 $\pm$ 1.35% to 7.91 $\pm$ 0.98% ($P < 0.001$). For type 2 diabetic patients treated with insulin, HbA_{1c} declined from 8.53 $\pm$ 0.82 to 8.12 $\pm$ 0.91% ($P < 0.001$). Type 2 diabetic patients exclusively on oral hypoglycemic agents (OHAs) declined from 8.15 $\pm$ 0.98 to 7.67 $\pm$ 1.29% ($P < 0.001$).

At baseline for type 2 diabetic patients, there was no statistically significant difference in HbA_{1c} values for the groups whether they were frequent or infrequent reporters. At follow-up, it was found that HbA_{1c} in frequent reporters were significantly lower than in infrequent reporters, regardless of treatment ($P < 0.05$).

It was found that type 1 diabetic patients who had "ideal" HbA_{1c} showed little decrement in HbA_{1c} values. When excluding patients with HbA_{1c} <6.9 ($n = 17$), type 1 diabetic patients showed a decline of 8.12 $\pm$ 1.38% to 7.93 $\pm$ 1.17% ($P < 0.01$).

We observed a trend of less frequent reporting among type 1 diabetic patients with lower HbA_{1c} values. When we excluded patients with HbA_{1c} <7.4 ($n = 26$), we found frequent reporters had lower follow-up HbA_{1c} than infrequent reporters ($P < 0.05$).

Regardless of type of diabetes or treatment, all patients improved significantly. Additionally, when separated into frequent versus infrequent reporters, we found no differences at baseline. At follow-up, frequent reporters had consistently lower HbA_{1c} values.

Previously, there has been a lack of data to fully demonstrate the efficacy of Internet interventions on type 1 diabetic patients, with most available studies conducted on much smaller sample sizes (4,5). We found Internet intervention to be effective across all groups, including type 1 diabetic patients. The lowering of HbA_{1c}

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Table 1—Baseline and follow-up HbA_{1c} in frequent and infrequent reporting patients

		Baseline HbA_{1c} (SD)*		Follow-up HbA_{1c} (SD)†		
Type of diabetes	*n*	NGSP, %	IFCC, mmol/mol	NGSP, %	IFCC, mmol/mol	*P* value
Type 1‡	115	8.12 (1.38)	65 (15.1)	7.93 (1.17)	63 (12.8)	<0.01
Frequent reporters§	44	8.07 (0.84)	65 (9.2)	7.85 (1.02)	62 (11.1)	
Infrequent reporters§	71	8.14 (1.15)	65 (12.6)	7.98 (1.00)	64 (10.9)	
Type 2 OHA	116	8.15 (0.98)	66 (10.7)	7.67 (1.29)	60 (14.1)	<0.001
Frequent reporters	35	8.03 (1.25)	64 (13.7)	7.48 (0.85)	58 (9.3)	
Infrequent reporters	81	8.21 (1.42)	66 (15.5)	7.75 (1.27)	61 (13.9)	
Type 2 insulin+/− OHA	140	8.53 (0.82)	68 (9.0)	8.12 (0.91)	65 (9.9)	<0.001
Frequent reporters	41	8.42 (1.40)	69 (15.3)	7.86 (1.39)	62 (15.2)	
Infrequent reporters	99	8.57 (1.42)	70 (15.5)	8.22 (1.08)	66 (11.8)	
Type 2	256	8.36 (1.35)	68 (14.8)	7.91 (0.98)	63 (10.7)	<0.001

Baseline HbA_{1c} values were compared with follow-up averages using paired samples *t* tests. Frequent and infrequent reporters were compared at baseline across all defined groups using independent *t* tests and again at follow-up. IFCC, International Federation of Clinical Chemistry and Laboratory Medicine. *P = NS for frequent reporters compared with infrequent reporters for each type of diabetes. †$P = 0.05$ for frequent reporters compared with infrequent reporters for each type of diabetes. ‡Excluding patient HbA_{1C} <6.9 ($n = 17$). §Excluding patient HbA_{1C} <7.4 ($n = 26$).

improves long-term diabetes outcome and lowers costs. The efficacy of this intervention warrants consideration of coverage for this service by insurance plans.

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