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Physiological Outcomes of an Internet Disease Management Program vs. In-person Counselling: A Randomized, Controlled Trial

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ABSTRACT

OBJECTIVE

To compare physiological outcomes and satisfaction for follow-up care between an interactive diabetes internet program and Diabetes Education Centres.

METHOD

A randomized, controlled trial with outcomes of glycosylated hemoglobin (A1C), fasting blood glucose, total cholesterol, triglycerides (TG), high-density lipoprotein cholesterol, low-density lipoprotein cholesterol and patient satisfaction. Enrollment was staggered, with individuals assessed at baseline, 3, 6 and 12 months.

RESULTS

Fifty-seven participants completed the study (20 control, 37 internet). Physiological outcomes were not statistically different between the 2 groups. However, within-group comparisons demonstrated a significant improvement in the internet group's A1C, TG and satisfaction levels from

RÉSUMÉ

OBJECTIF

Comparer un programme interactif en ligne et des centres de formation diabétique pour ce qui est des issues physiologiques des soins et de la satisfaction des patients à l'égard des soins.

MÉTHODE

Essai contrôlé avec répartition aléatoire au cours duquel on a évalué l'hémoglobine glycosylée (HbA_{1c}), la glycémie à jeun, le cholestérol total, les triglycérides, le cholestérol des lipoprotéines de haute densité, le cholestérol des lipoprotéines de basse densité et la satisfaction des patients. L'inscription à l'étude était décalée et les patients étaient évalués au départ et après 3, 6 et 12 mois.

RÉSULTATS

Cinquante-sept participants ont terminé l'étude (20 témoins, 37 Internet). Il n'y a pas eu de différence statistique entre les groupes pour ce qui est des issues physiologiques. Toutefois, des comparaisons au sein de chaque groupe ont révélé que dans le groupe Internet, il y avait une amélioration significative de l'HbA_{1c}, des triglycérides et du degré de satisfaction par rapport au départ après 3 et 6 mois ($p < 0,0452$, $p < 0,0428$ et $p < 0,0138$, respectivement).

CONCLUSIONS

Même si le nombre de sujets était limité, l'étude a permis de faire des constatations significatives au sein de chaque groupe sur la prise en charge du diabète. Il faudra effectuer d'autres études sur d'autres applications du programme en ligne pour la prise en charge du diabète.

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baseline to 3 and 6 months ($p<0.0452$, $p<0.0428$ and $p<0.0138$, respectively).

CONCLUSION

Although the trial was limited in sample size, it yielded significant findings for diabetes management, within group. Further research in using the internet program in other applications for diabetes management is needed.

INTRODUCTION

Type 2 diabetes mellitus is a chronic and progressive disease that has become a public health issue worldwide (1). It is estimated that more than 2 million Canadians have diabetes, although many will go undiagnosed until a related health crisis occurs (2). Diabetes is also one of the most costly chronic diseases. In Canada, at least $9 billion is spent annually managing diabetes and its complications (2), and individuals with diabetes incur 2.4 times as many healthcare costs as those without the disease (1), including direct medical costs and other indirect costs (i.e., time lost from work) (3).

Despite the rising prevalence of diabetes, there remains a significant gap between the number of people with the disease and those receiving proper care (3). It is estimated that fewer than 1 in 5 people with diabetes in Ontario, Canada, have had contact with a diabetes specialist, and this ratio is increasing (4). The high rates of diabetes in more geographically remote areas of the province raise concerns about access to appropriate specialty services for those living in those regions (4), but access to care in more populated areas is an issue as well; the Diabetes Complications Prevention Cooperative's (DCPC) analysis has determined that only about 25% of those with diabetes in Southwestern Ontario are being served in various Diabetes Education Centres (DECs) (3). The DCPC recommends that by 2006, 50% of those with diabetes be seen at a DEC; as well, it recommends a clinician-to-patient ratio of no less than 1 team per 1000 patients (3).

There are many barriers to meeting these recommended standards of care. The optimal care and management of diabetes require intensive physiological monitoring and behavioural change (5). As well, interventions to ensure optimal diabetes management—such as glycemic monitoring, nutrition counselling, psychosocial support and screening for complications—are all resource-intensive and require the involvement of both healthcare providers and patients (6). Because of limited specialized resources and increasing prevalence rates, the gap between the need for service and its timely provision is widening. The DCPC estimates that the average waiting list for an initial visit at a DEC is about 35 days (3), and other barriers may also exist, such as transportation, parking, loss of income and anxieties related to the hospital/DEC setting (1).

How will the healthcare system be able to achieve the recommended standards of care, given the limited resources available? An innovative model for delivery of care is needed to address the challenge of managing diabetes in a readily accessible and continuous manner (6).

A number of computer-based diabetes management systems have been evaluated and reportedly improve patient care (7-9). These studies used the computer mainly as an electronic data display, as a decision support tool for clinicians or for information exchange between healthcare providers and patients (7-9). Some internet solutions did not provide a comprehensive management program, using the internet only as a chat room or focusing on only a portion of diabetes management (10,11). Methodological deficiencies were also noted in the literature, as most studies were nonrandomized or had a short time frame for follow-up (12,13). Measurement of such systems' efficacy in improving glycemic control were also lacking; results were focused primarily on improving the number of clinic visits, the number of tests and patient satisfaction (8,11). As clinicians continue to integrate new interventions or methods of improving diabetes management into their practice, new initiatives must meet evidence-based quality of care standards, and their benefits must be substantiated with respect to improvements in diabetes outcomes (14). This study examined a comprehensive interactive internet program as an adjunct to the current DEC program in the follow-up of patients with diabetes and as a potential solution to ongoing chronic disease management.

METHODS

Study design and study population

This study was a randomized, controlled trial comparing the efficacy of an interactive internet program (intervention group) with that of a DEC program (control group) with respect to follow-up service for ongoing diabetes management. The objectives of the study were to improve glycemic control, disease management behaviours, health status and patient satisfaction.

Participants were recruited from the DECs at Cambridge Memorial Hospital and Grand River Hospital in the Waterloo region of Ontario. Informed consent was obtained from eligible individuals. Included were adults with type 1 or 2 diabetes who were internet-proficient and had regular access to the internet. Exclusion criteria were blindness, little or no dexterity, reading level below grade 5, end-stage diseases and gestational diabetes mellitus. The study received ethics

approval from the Tri-Hospital Research Ethics Board.

Participants were assessed at the DEC and received education prior to randomization, regardless of the group they were assigned to. The intervention group used the internet program instead of in-clinic follow-up for disease management. The control group received traditional face-to-face clinic management, with visit frequency determined by the patient or the diabetes educator. Blinding of DEC staff was not possible, since it would have been obvious that those who returned to the DEC for follow-up were in the control group and those who did not were in the intervention group.

Measures

Landmark diabetes outcomes studies have noted that using physiological measures alone to define health outcomes misses the complex nature of diabetes care (15-17). Therefore, this study included measurements of patient demographics, social and environmental factors, patient health, functional and psychosocial characteristics, process and mediating variables, diabetes self-management behaviours, patient satisfaction and physiological measures (16-21). Standardized instruments used were as follows: the Diabetes Empowerment Scale (16), the Problem Areas in Diabetes Questionnaire (17), the Diabetes Care Profile (18), the Diabetes History Form (19) and the Minimum Data Set for Home Care (20,21). This paper reports results for only physiological and patient satisfaction measures. Physiological measures included laboratory testing of glycosylated hemoglobin (A1C) and fasting blood glucose (FBG), as well as fasting lipid profiles, including total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C). Patient satisfaction was measured using the Diabetes History Form (19) satisfaction subscale, which included 6 items measuring the following: being satisfied with care received, being informed about care, healthcare providers being up to date with treatment, testing, communication and knowing who to ask questions.

Data collection

Data were collected from July 2002 to February 2004. Participants were followed for 1 year and assessed at baseline, 3 months, 6 months and 1 year from the time of enrolment. Education was conducted between the baseline and 3 month assessments. Because recruitment was staggered, the number of participants assessed at each follow-up naturally decreased, and only participants who started at the beginning of the study completed the full 1 year follow-up period.

Diabetes Education Centres

The DECs at Cambridge Memorial Hospital and Grand River Hospital offer diabetes education and ongoing management to children and adults with type 1 and type 2 diabetes. A physician referral is needed for a patient to attend the centre. Services offered at both DECs include the following: one-on-one assessment with a nurse and dietitian (1 visit); diabetes education in an individual or group setting (1 to 4 visits); and follow-up management based upon identified needs (number of visits negotiated between the patient and clinical staff). Medical directives are in place that enable certified nurses and dietitians to adjust medications and insulin to improve diabetes management. Topics covered at the DEC include understanding the diagnosis of diabetes; self-monitoring of BG; meal planning; diabetes medications and insulin management; multiple daily insulin injections and adjustments; sick-day management; travel and stress management; and prevention and delay of diabetes complications.

The internet program

The internet program consisted of a central data repository that the patient or healthcare provider could access via a confidential password. Patients had their own unique profile, where they were able to enter data on BG measurements, diet, exercise, insulin and oral medications. A certified diabetes nurse, working under medical directives, had access to all patient profiles. The nurse was able to monitor data, give feedback and make recommendations about adjusting medications or other aspects of treatment. The nurse also provided individual education based on participants' needs. The patients understood that this program offered timely feedback but was not a substitute for any required emergency treatment. The program also offered a chatting/communication module, which enabled patient-to-patient discussions. A bulletin board section was also used, enabling patients to post moderated messages, including recipes, information about diabetes supply items and other general information. Glucose meters and connection cables were provided for all participants to facilitate the downloading of BG test results to their internet patient profile.

Statistical analysis

Statistical analysis was performed using SAS Version 9.1 (SAS Institute, Carrie, North Carolina, United States [US], 1989). Descriptive statistics for laboratory measures were expressed as mean $\pm$ SD. The satisfaction measure was an ordinal scale ranging from 1 to 5. For the laboratory measures, between-group comparisons were conducted using the independent Student t-test to assess for significant changes. Within-group comparisons of the same cohort from baseline to the different follow-up times were done using the paired sample Student t-test. A p-value of <0.05 was considered to be statistically significant.

RESULTS

Seventy individuals (33 male, 37 female) initially consented to participate in this project; however, 13 dropped out after the education portion and before the 3 month assessment. A total of 57 participants completed the 1 year study or came to their natural censored endpoint at 3 or 6 months because of stag-

gered entry times. Twenty were randomized to the control group and 37 to the intervention group. Patient demographic characteristics and social and environmental factors (i.e. gender, age, marital status, education, living arrangements, employment status, diabetes care provider source, having an endocrinologist, drinking, smoking, self-perceived poor health, trade-offs and informal support services) are shown by treatment group in Table 1. Information on type and duration of diabetes was not collected. Based on clinical experience, we know that most patients referred to the DEC are newly diagnosed. Also, it was felt that since patients were randomized to their respective treatment groups, each group was likely to include patients with comparable durations of illness.

It is worth noting that the majority of the patients in both the control and intervention groups were cared for by generalists such as family physicians, internists or nurses. Only 31.2% of patients in the control group and 9.1% in the intervention group were cared for by specialists, including endocrinologists and nurses/nurse practitioners who work with an endocrinologist. A very small number of patients (2 in control and 1 in intervention) were actually followed by an endocrinologist for their diabetes. Smokers comprised 18.9% of patients in the intervention group and 15.8% in the control group; 10.8% of patients in the intervention group perceived themselves as having poor health vs. 5.3% in the control group. There were also patients who had to make a trade-off between daily living expenses and spending money on medical care (11.1% in the control group and 10.8% in the intervention group). Most patients (95% in control and 97.3% in intervention) had informal support services. There were, however, no statistical differences in any of the patient characteristics and factors between the control and intervention groups.

The baseline laboratory data given in Table 2 showed no significant difference between the 2 groups with respect to A1C, FBG, TC, TG, HDL-C and LDL-C. Mean glycemic control at baseline was similar for both groups: 6.8% for the control group and 6.7% for the intervention group. However, the range of A1C levels was widespread in both groups (approximately 4.0 to 10.0%). The mean FBG for the control group was 8.14 mmol/L and for the intervention group was 8.07 mmol/L. The range for both groups was similar, from euglycemia (5.30 mmol/L) to hyperglycemia (16.20 mmol/L). Lipid profiles for both groups demonstrated suboptimal values and were higher than the clinical guidelines. Mean TC levels for the control and intervention groups were 5.09 mmol/L and 5.00 mmol/L, respectively; the range was similar between the 2 groups. Mean TG levels were slightly different between the 2 groups: the control group had a mean TG level of 2.03 mmol/L (range: 0.97 to 3.59 mmol/L), while the intervention group had a higher mean TG level of 2.29 mmol/L (range: 0.78 to 5.03 mmol/L). HDL-C was similar between the control and intervention groups: the control group had a mean HDL-C level of 0.98 mmol/L (range: 0.09 to 1.50 mmol/L), while the intervention group had a mean HDL-C level of 1.02 mmol/L (range: 0.07 to 1.67 mmol/L). Mean LDL-C was slightly better for the intervention group (2.87 mmol/L; range: 1.43 to 4.75 mmol/L) than the control (3.19 mmol/L; range: 1.29 to 5.36 mmol/L).

There were no significant differences when comparing physiological measures between the control and intervention groups at any of the follow-up time points. Patients in these 2 groups seemed to have progressed in the same direction and at a similar rate. When progress was examined within each group, however, there were positive changes in most of the lab measures between baseline and different time points (Table 3). The intervention group's TG level improved significantly from baseline to 6 month follow-up, with a drop from 2.30 to 1.90 mmol/L; the control group, on the other hand, did not show any significant improvement at any time point. A significant improvement was also observed in the intervention group for A1C: mean A1C dropped from 6.7 to 6.5% from baseline to 3 months. However, this significant change was not extended to 6 months or 1 year. There were no significant changes in the control group for this measure. The control group did significantly better with respect to LDL-C level at 1 year (2.47 mmol/L) over baseline (3.19 mmol/L).

Figures 1 and 2 illustrate how mean TG and A1C levels changed from baseline to 1 year follow-up. Figure 1 shows that the intervention group's TG level was slightly higher than that of the control group at baseline. There was no significant drop in TG level from baseline to 6 months in the control group. At 1 year, the mean TG level actually showed an increase in the control group. On the other hand, the mean TG level in the intervention group was maintained at 3 months and then dropped significantly at 6 months. This lower level was maintained to 1 year. The comparison demonstrates that the intervention group achieved a better management of TG levels than the control group.

Figure 2 shows that the control and the intervention groups had comparable A1C levels at baseline. There was no change in A1C from baseline to 6 months in the control group. At 1 year, A1C actually increased in the control group. A1C in the intervention group, however, dropped significantly at 3 months and then was maintained from 6 months to 1 year. This comparison demonstrates that the intervention group achieved a better management and control of A1C than the control group.

Table 3 also shows that patients in the intervention group were also more satisfied at the 3 and 6 month follow-up compared to their own baseline, but the control group did not show a significant improvement compared to its own baseline. It was noted that the absolute satisfaction level at baseline for the control group was higher than that in the intervention group; however, the difference was not statistically significant. The intervention group made a bigger relative gain in this measure than the control group.

Table 1. Frequency and distribution of patient demographics at baseline

Variable	*Control n (%)*	*Intervention n (%)*	*p value*
Treatment group*	**20 (28.6)**	**37 (52.9)**	**0.1909**
Gender			0.9277
Male	9 (45.0)	18 (48.6)	
Female	11 (55.0)	19 (51.4)	
Age (years)			0.1909
<40	4 (20.0)	9 (24.3)	
41–65	10 (50.0)	24 (64.9)	
>65	6 (30.0)	4 (10.8)	
Marital status			0.2880
Married	14 (70.0)	30 (81.1)	
Not married	6 (30.0)	7 (18.9)	
Education			0.4100
High school	8 (40.0)	8 (21.6)	
Technical or trade school	3 (15.0)	5 (13.5)	
University or higher	9 (45.0)	24 (64.9)	
Living arrangement			0.6249
Live with spouse or other	19 (95.0)	36 (97.3)	
Live alone	1 (5.0)	1 (2.7)	
Employment status			0.1170
Working full- or part-time	8 (40.0)	24 (64.9)	
Not working outside of home	9 (45.0)	9 (24.3)	
Did not respond	3 (15.0)	4 (10.8)	
Diabetes care provider source			0.0950
Generalist	8 (40.0)	24 (72.7)	
Specialist	5 (25.0)	3 (9.1)	
Other	3 (15.0)	3 (9.1)	
No one	0 (0)	3 (9.1)	
Did not respond	4 (20.0)	0 (0)	
Have an endocrinologist			0.1489
Yes	2 (15.0)	1 (2.7)	
No	13 (65.0)	32 (86.5)	
Did not respond	5 (20.0)	4 (10.8)	
Drinking problem			0.3021
Yes	1 (5.0)	2 (5.4)	
No	19 (95)	35 (94.6)	
Smoking			0.7722
Yes	3 (15.0)	7 (18.9)	
No	16 (80.0)	30 (81.1)	
Did not respond	1 (5.0)		
Self-perceived poor health			0.4906
Yes	1 (5.3)	4 (10.8)	
No	18 (94.7)	33 (89.2)	
Trade-offs (daily living vs. medical care)			0.9740
Yes	2 (11.1)	4 (10.8)	
No	18 (88.9)	33 (89.2)	
Informal support services (lives with patient)			0.6249
Yes	19 (95)	36 (97.3)	
No	1 (5.0)	1 (2.7)	

*N=70; dropouts=13 (18.6%)

Table 2. Univariate distribution for physiological measures at baseline

Physiological measure	*Control*		*Intervention*	
	Mean (SD)	**Range**	**Mean (SD)**	**Range**
A1C (%)	6.8 (0.01)	4.2–9.6	6.7 (0.01)	4.3–9.8
FBG (mmol/L)	8.14 (2.89)	5.30–16.20	8.07 (1.94)	5.70–14.40
TC (mmol/L)	5.09 (0.98)	2.85–7.04	5.00 (0.97)	3.32–7.30
TG (mmol/L)	2.03 (0.75)	0.97–3.59	2.29 (1.01)	0.78–5.03
HDL-C (mmol/L)	0.98 (0.31)	0.09–1.50	1.02 (0.35)	0.07–1.67
LDL-C (mmol/L)	3.19 (0.85)	1.29–5.36	2.87 (0.83)	1.43–4.75

A1C = glycosylated hemoglobin
FBG = fasting blood glucose
HDL-C = high-density lipoprotein cholesterol
LDL-C = low-density lipoprotein cholesterol
SD = standard deviation
TC = total cholesterol
TG = triglycerides

DISCUSSION

Although the study was designed to be a randomized, controlled trial and the randomization procedure was followed strictly, an unequal distribution of patients in the control and intervention groups was observed. This was attributed to differential attrition in the control group. Many patients left the study because they were assigned to the control group, and the study design did not allow crossover to the intervention group. This phenomenon showed that the internet was a preferred method of diabetes management among this group of individuals. For future studies, it will be very valuable to collect baseline information on all consenting subjects, including dropouts. This will allow analysis of any potential group biases with respect to dropouts or crossover.

Although the number of patients was not equally distributed between the control and intervention groups, there were no significant differences between these 2 groups in patient characteristics or social and environmental factors, making these 2 groups comparable. This lack of significance could be due to the small sample size.

There were 2 remarkable events during the recruitment phase of the study that led to a smaller-than-expected sample size: outbreaks of severe acute respiratory syndrome (SARS) and the Norwalk virus. These 2 illnesses caused major disruption to outpatient services at both study hospitals, hindering study recruitment. Further, patients in the study may have withdrawn from the control group, which required them to visit the DEC at the hospital, because of fear of nosocomial infections at the time of the study.

The sample comprised a relatively young group, with a majority of the patients under age 65. This was probably a result of the inclusion/exclusion criteria. In order to ensure that internet access and computer literacy were not barriers to the use of the diabetes internet program, only people who were proficient in computer use and had regular access to the internet were included in this study. This decision was partly financially based (there was no funding to supply computers or internet access to project patients), but primarily a result of "lessons learned" from previous experiences (22). A US study recommended strongly that patients have their own computer and be internet proficient to avoid significant dropouts owing to frustration with hardware, software and/or internet use (22). Because the study focused on current internet users, external validity and generalization is applicable to the diabetes population that currently uses internet/computer technology.

When comparing physiological measures, no statistical significance was found between the 2 groups. This could be explained by the small sample size or by the fact that both groups progressed in the same direction and at a similar rate. Since the DEC offers a gold standard, benchmarking service in diabetes care, and since patients were followed up by a team of professionals including physicians, dietitians and nurses who have certified diabetes education qualifications, the ability to provide an ongoing management service that resulted in no significant difference from the gold standard speaks positively about the internet program. However, it is important to examine whether both the DEC and internet programs led to improvement in patient outcomes within each group from baseline to 1 year follow-up.

The within-group analysis comparing baseline to various follow-ups demonstrates significant statistical differences in

Table 3. Test of difference for physiological measures and satisfaction scale compared at time n (n=3 month, 6 month, or 1 year follow-up) to baseline within the same group*

	Control				*Intervention*			
Values	**n**	**Mean (SD)**	**Mean difference (SE)**	**p value**	**n**	**Mean (SD)**	**Mean difference (SE)**	**p value**
A1C (%)								
3-month follow-up	19	6.8 (1.0)	0.0 (0.07)	0.8836	34	6.5 (1.0)	–0.2 (0.09)	0.0452†
vs. baseline		6.8 (1.0)				6.7 (1.0)		
FBG (mmol/L)								
1-year follow-up	8	7.713 (2.14)	–0.275 (0.84)	0.7534	17	8.029 (2.17)	–0.483 (0.67)	0.4821
vs. baseline		7.988 (2.07)				8.512 (2.46)		
TC (mmol/L)								
1-year follow-up	9	4.600 (0.90)	–0.782 (0.35)	0.0537	16	5.151 (1.42)	0.165 (0.26)	0.5318
vs. baseline		5.382 (1.13)				4.986 (1.11)		
TG (mmol/L)								
6-month follow-up	14	2.04	2.132 (0.76)	0.4539	24	1.900 (1.10)	–0.402 (0.19)	0.0428†
vs. baseline		2 (0.75)	–0.090 (0.12)			2.302 (1.01)		
HDL-C (mmol/L)								
1-year follow-up	9	0.963 (0.26)	–0.095 (0.04)	0.0527	16	1.098 (0.28)	0.069 (0.04)	0.1257
vs. baseline		1.058 (0.24)				1.029 (0.21)		
LDL-C (mmol/L)								
1-year follow-up	8	2.468 (0.74)	–0.750 (0.29)	0.0372†	13	2.968 (0.90)	0.089 (0.24)	0.7196
vs. baseline		3.218 (0.98)				2.879 (0.99)		
Satisfaction scale								
3-month follow-up	10	3.650 (1.34)	0.133 (0.13)	0.3434	27	3.574 (1.03)	0.383 (0.15)	0.0150†
vs. baseline		3.517 (1.37)				3.191 (0.94)		
6-month follow-up	13	3.731 (0.79)	0.308 (0.28)	0.2867	22	3.682 (1.07)	0.508 (0.19)	0.0138†
vs. baseline		3.423 (1.32)				3.174 (0.96)		

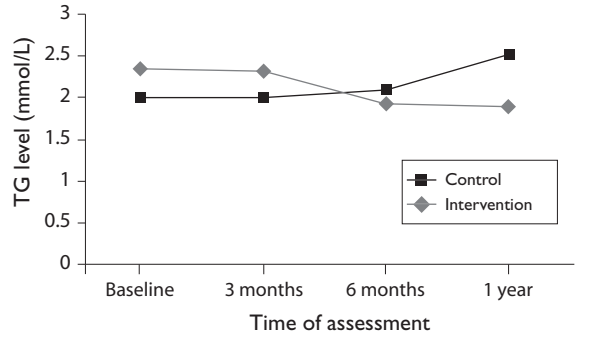
*Includes only subjects who were in both comparison times
†Statistical significance at $p<0.05$

A1C = glycosylated hemoglobin
HDL-C = high-density lipoprotein cholesterol
LDL-C = low-density lipoprotein cholesterol
SD = standard deviation
SE = standard error
TC = total cholesterol
TG = triglycerides

TG and A1C at 6 and 3 months, respectively. Both A1C and TG have important clinical relevance in the management of diabetes, as they are both markers of metabolic control and are used to assess risk for macrovascular complications, such as coronary artery disease, cardiovascular disease and peripheral vascular disease. The clinical significance of lowering TG levels is seen in the decreased risk of vascular damage or disease progression. Many healthcare providers believe that a 0.3 mmol/L reduction in TG indicates a marked improvement in a patient's vascular health (23). A decrease in A1C reflects an improvement in overall glycemic control for the preceding 3 months. A reduction in A1C of 0.2% may not be the ideal 0.5 to 1% reduction that is often cited in the literature as decreasing the risks of complications associated with diabetes (24), but any decrease in A1C is still clinically relevant. When progress in these 2 measurements was charted (Figures 1 and 2), it was apparent that the intervention group was not only able to improve significantly with respect to these laboratory values, they were also able to maintain the improvement better than the control group. Even though a drop in A1C and TG is crucial in the management of diabetes, a more contributing clinical finding was a trend in the maintenance of metabolic control (A1C and TG) by those in the intervention group for the duration of 1 year.

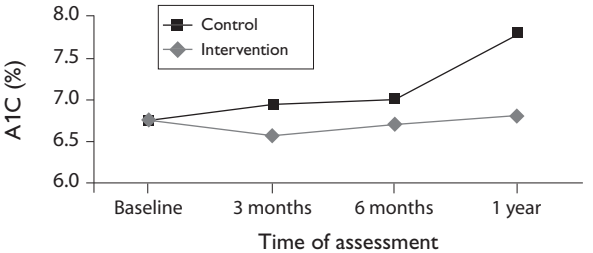
It is also worth noting that most significant positive effects were present at the 3 month and 6 month follow-up, but not

Figure 1: TG levels between control and intervention groups



TG = triglycerides

Figure 2: A1C levels between control and intervention groups at 4 time points



A1C = glycosylated hemoglobin

at 1 year (no significant changes may indicate maintenance). A potential explanation may be that, because many patients were enrolled late into the study, they were followed for only 3 months. This resulted in a reduced sample size for the 6 month follow-up, and even further reduction for the 1 year follow-up (Table 3), resulting in a lack of power to detect difference due to small sample size.

Currently, the gold standard in diabetes care is for a DEC to provide education and management with a team of healthcare professionals, despite being a costly and labour-intensive approach. For there to be no significant difference between the intervention and control groups with respect to management could indicate that the patients in the intervention group were doing just as well as those in the control group.

We are aware that results from this sample may not be generalizable to the overall diabetes population (i.e. internet-proficient and non-internet-proficient populations). Also, considering the range of A1C levels at the beginning of the study (4.0 to 10.0%), it is fair to conclude that most of the patients were either newly diagnosed with type 2 diabetes or well managed. Further evaluation of the diabetes internet program needs to be done to determine the benefit in a variety of diabetes populations, such as non-internet users, those with gestational diabetes, children with type 1 diabetes and intensive insulin therapy users. Further research may also explore other chronic disease processes that require intense, ongoing monitoring and management, such as congestive heart failure or cardiac rehabilitation. It is, however, important that, as one of the pioneering research projects in diabetes internet disease management, this project focused on evaluating those who are current internet users and understanding how they respond to this new tool before including the general population.

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AUTHOR DISCLOSURES

No duality of interest declared.

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