A Comparison of Diabetes Education Administered Through Telemedicine Versus in Person

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OBJECTIVE — To determine whether diabetes education can be provided as effectively through telemedicine technology as through in-person encounters with diabetes nurse and nutrition educators.

RESEARCH DESIGN AND METHODS — A total of 56 adults with diabetes were randomized to receive diabetes education in person (control group) or via telemedicine (telemedicine group) and were followed prospectively. The education consisted of three consultative visits with diabetes nurse and nutrition educators. The in-person and telemedicine groups were compared using measures of glycemic control (HbA_{1c}) and questionnaires to assess patient satisfaction and psychosocial functioning as related to diabetes. Outcome measures were obtained at baseline, immediately after the completion of diabetes education, and 3 months after the third educational visit.

RESULTS — Patient satisfaction was high in the telemedicine group. Problem Areas in Diabetes scale scores improved significantly with diabetes education (adjusted $P < 0.05$, before vs. immediately after education and 3 months after education), and the attainment of behavior-change goals did not differ between groups. With diabetes education, HbA_{1c} improved from 8.6 ± 1.8% at baseline to 7.8 ± 1.5% immediately after education and 7.8 ± 1.8% 3 months after the third educational visit (unadjusted $P < 0.001$, $P = 0.089$ adjusted for BMI and age), with similar changes observed in the telemedicine and in-person groups.

CONCLUSIONS — Diabetes education via telemedicine and in person was equally effective in improving glycemic control, and both methods were well accepted by patients. Reduced diabetes-related stress was observed in both groups. These data suggest that telemedicine can be successfully used to provide diabetes education to patients.

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Diabetes self-management education (DSME) is essential in the care of the person with diabetes. DSME can help improve glycemic control, self-care, and emotional well-being and decrease the cost of care (1–9).

In spite of the known benefits of comprehensive DSME programs, they are not available to a large number of individuals with diabetes. In many areas, people with diabetes live too far away from or do not have the transportation to be able to attend comprehensive education programs. In addition, low-income patients with diabetes who are often treated in public health care systems frequently experience access problems (10).

Several investigators (11,12) have demonstrated the effectiveness of the telephone in diabetes management, which would provide a means to reach patients with diabetes who have access problems. Hayes et al. (12) demonstrated that certified diabetes educators using telephone counseling provided brief and effective interventions that supported lifestyle behavioral changes. In a large study, Piette et al. (11) were able to show that automated telephone disease management calls to and from low-income patients provided medical information that was reliable and significantly altered their diabetes management.

Telemedicine uses new technologies to bring subspecialty consultations to distant sites. Although previously untested, telemedicine has the potential to deliver high-quality DSME programs to patients with barriers to access. Areas that are medically underserved may particularly benefit from the use of this new technology. We used a prospective randomized study to investigate the hypothesis that diabetes education can be provided as effectively through telemedicine technology as through in-person encounters with diabetes educators.

RESEARCH DESIGN AND METHODS

Patients with diabetes, ages 18–75 years, who presented to the Joslin Diabetes Center at SUNY Upstate Medical University in Syracuse, New York, and to satellite offices in Oswego, New York, and Oneida, New York, were asked to participate in this study. To be eligible, subjects must not have had diabetes education for at least 1 year and be able to read, understand, and sign the consent document. Patients were excluded who had a history of not keeping doctor's appointments, had profound visual or hearing impairment, had psychiatric illness not controlled with medications, had a history of illicit drug use or heavy alcohol consumption (more than four alcoholic drinks per day), and were not willing to travel to Syracuse if randomized to receive diabetes education in

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Abbreviations: ADS, Appraisal of Diabetes Scale; DQOL, Diabetes Quality of Life; DSME, diabetes self-management education; DTSQ, Diabetes Treatment Satisfaction Questionnaire; PAID, Problem Areas In Diabetes.
A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

Table 1—*Timeline of intervention visits and data collection*

	Baseline assessment	Intervention visit 1	Intervention visit 2	Intervention visit 3	First assessment visit*	Second assessment visit†
Timeline	−14 days to 0	Time 0	4–6 weeks	8–12 weeks	Immediately after visit 3	3 months after visit 3
Dietitian educator visit		60 min	30 min	30 min		
Nurse educator visit		60 min	30 min	30 min		
HbA_{1c}	X				X	X
Lipid profile	X				X	X
PAID scale	X				X	X
ADS scale	X				X	X
DTSQ	X				X	X
DQOL scale	X				X	X
Telemedicine Patient Satisfaction Survey					X	
Goal setting/assessment		X		X		

*Obtained immediately (within 2 weeks) after the third educational visit; †obtained 3 months after the third educational visit.

person. This study was approved by the SUNY Upstate Medical University Institutional Review Board for the Protection of Human Subjects.

If the patient agreed to participate in the study, he or she was randomized to meet with a diabetes nurse educator and dietitian in person at the Joslin Diabetes Center in Syracuse or to meet with them through videoconferencing at one our telemedicine sites located in Oswego, Oneida, or an off-site location in Syracuse. Each subject had three education visits. The first included 1-h consultations with the diabetes nurse educator and the dietitian. There were two 30-min follow-up appointments with the educator and dietitian at 4–6 weeks (visit 2) and 8–12 weeks (visit 3) after the initial visit (Table 1). The two nurse educators and the dietitian educator who participated in the study were certified diabetes educators and had extensive experience in providing diabetes education. The dietitian and nurse educator had been in our endocrine practice for 7 years, whereas the second nurse educator had been in our practice 5 years. Subjects in both treatment arms were presented the same information and used the same educational materials. Our diabetes education program is recognized by the American Diabetes Association and meets all national standards. The intervention sessions were interactive and included a focus on knowledge, lifestyle behaviors, and skill development, as well as skills to prevent and identify complications. The educators also addressed coping skills to improve psychosocial function, which included the use of empowerment techniques. Of subjects in the study, 88% completed the three education visits. Subjects in each group were managed in the same manner, and the treating physician was unaware to which group the subjects were randomized.

The in-person group had the information presented one-on-one in person on-site, whereas the telemedicine group had the information presented one-on-one via teleconferencing. During the telemedicine session, the patients and educators were able to see and hear one another in real time using teleconferencing hardware and software over a private ISDN (integrated services digital network) line. The ISDN line provided about 128 kilobits of data to flow between sites with improved real-time voice, video, and graphic transmission. There was slight delay in sound, which was well accepted. A document camera was provided for the educators to enlarge brochures and text, and food models were used to demonstrate portion sizes.

The equipment used at the off-site locations included a Dell Dimension Pentium Pro II 233 with MMX, MultiVideo Labs 27-inch SVGA monitor with tuner, Canon VC-C1 MKII PtX camera with remote, Cannon VC-C1 MKII wide-angle lens adapter, Alpha TeleCom NT-1 with power supply, Key Tronics wireless keyboard with trackball, and PolyCom sound station conference system attached to a Pentium II PC with a 27-inch monitor. Joslin Diabetes Center equipment included a Dell Dimension Pentium Pro II 233 with MMX, Intel ProShare business videophone kit, PolyCom SoundPoint PC, Cannon RE-350 document camera, Cannon VC-C3 PTZ camera, and Canon wide-angle lens kit. The televisits were compliant with the data security requirements of the Health Insurance Portability and Accountability Act.

Data collection points are shown in Table 1. At baseline, demographic information was obtained from each subject. At baseline, immediately after the third educational visit (visit 3), and 3 months after the third educational visit, each subject was asked to complete the Problem Areas in Diabetes (PAID) scale (13), the Diabetes Quality of Life (DQOL) scale (14), and one measure of cognitive appraisal, the Appraisal of Diabetes Scale (ADS) (15). Participants also completed the Diabetes Treatment Satisfaction Questionnaire (DTSQ), which has been specifically designed to measure satisfaction with diabetes treatment regimens in people with diabetes (16). The PAID scale is a 20-item measure of emotional adjustment to life with diabetes, which has been validated to be a measure of emotional functioning in diabetes (13). The DQOL scale, developed by Jacobson et al. (14) and used in the Diabetes Control and Complications Trial, assesses four aspects of quality of life directly related to diabetes: diabetes satisfaction, impact and worry, and social worry. It has also proven to be valid and reliable. The three subscales were scored and a total score was also obtained. The seven-item ADS scale measures the individual's appraisal of the illness in terms of his or her cognition about diabetes (15). The surveys were completed via paper and pencil at

Table 2—*Baseline characteristics*

	In person	Via telemedicine
n	22	24
Age (years)	61.37 ± 8.95 (44.8–80.2)	53.95 ± 10.08 (36.3–70.0)
Sex (M/F)	13/9	8/16
Diabetes type (type 1/type 2)	2/20	3/21
BMI (kg/m^2)	31.34 ± 6.20 (20.57–44.15)	35.95 ± 9.22 (22.41–56.80)
Duration of diabetes (years)	11.72 ± 8.2 (1.42–35.02)	15.78 ± 11.54 (1.75–49.03)
HbA_{1c} (%)	8.33 ± 1.63 (5.10–12.60)	8.68 ± 2.17 (4.7–12.50)

Data are *n* or means ± SD (range). All post-measures were not available for all subjects.

the specified times. Patient readiness to learn was assessed by the educator and dietitian during their meetings with the patients. The subjects set goals for changing self-care behavior, including nutritional behavior goals at the initial visits under the supervision of the nurse and diabetes educators. At each follow-up visit, an assessment was performed to determine if these goals were met. The goals were considered to be fully achieved or partially achieved. For example, if the goal was to check fingerstick glucoses four times daily and the subject only checked twice daily, then the goal was considered to be partially achieved. If the subject checked the fingerstick glucoses four times daily as recommended, then the goal was considered fully achieved. In addition, at baseline, immediately after visit 3, and 3 months after the third educational visit, glycemic control was determined by measuring HbA_{1c}. Fasting lipid profile, sitting resting blood pressure, weight, height, and BMI were also obtained at baseline, immediately after visit 3, and 3 months after the third educational visit. At the 3-month visit (visit 3), subjects participating in the telemedicine group also completed the Telemedicine Patient Satisfaction Survey (17), which evaluated their satisfaction with the telemedicine service.

Statistical analysis

Eligible patients ($n = 56$) were randomized into the two treatment arms using a stratified randomization procedure for random permuted blocks, as described by Pocock (18). Stratification was by type of diabetes (type 1/type 2), yielding two total strata. A block size of four was used. This process ensured an equal number of patients in the two groups and equal distribution of patients by diabetes type. There were five dropouts in the in-person group and five dropouts in the telemedicine group (17.8% of total subjects). Reasons for discontinuing participation were concurrent illness ($n = 1$), lack of time to participate ($n = 8$), and inability to keep subsequent appointments ($n = 1$).

The primary end point was HbA_{1c}. A two-factor mixed-model ANOVA statistic was used to compare HbA_{1c} values observed before and after diabetes education by subjects' condition (in person vs. via telemedicine). Analysis of secondary end points (LDL cholesterol, HDL cholesterol, triglyceride levels, weight, BMI, PAID scale, ADS scale, and DQOL scale) were performed using similar 2 × 3 ANOVA testing, crossing pre–/post–time points with in-person/telemedicine conditions. Further analysis of the data using BMI and age as covariates was undertaken because these baseline differences were significant. The ANOVA 2 × 3 statistical design used eliminated any subject for whom all three measures (baseline, immediately after education, and 3 months after education) were not present. We do not have all post-measures for all subjects. The results reported on each measure (i.e., HbA_{1c}) are for those subjects for which we have data for all three measurement points (baseline, immediately after education, and 3 months after the third educational visit). SPSS statistical software was used to analyze the data.

RESULTS

Demographic characteristics

A total of 22 subjects received diabetes education in person, and 24 subjects received diabetes education via teleconferencing (Table 2). Their mean age, BMI, sex, duration of diabetes, and baseline HbA_{1c} are shown in Table 2. Most participants in the study had type 2 diabetes and were obese. The in-person group was significantly older than the telemedicine group, with ages of 61.37 ± 9.85 years (mean ± SD) and 53.96 ± 10.08 years, respectively. The in-person group also had fewer women and had a lower mean BMI than the telemedicine group, but neither of these differences was significant. Although 67% of the subjects in the telemedicine group were female, versus 41% in the in-person group, χ^2 analysis of the sex distribution by group was not significant. Most of the subjects were Caucasian (95%), and 5% were African American. Of the participants, 41% completed high school, 47% were college graduates, and 6% graduated from high school and attended college but did not graduate.

Metabolic control

Our primary end point was glycemic control, as indicated by HbA_{1c} levels. Table 3 shows HbA_{1c} results at baseline, immediately after education, and 3 months after the third educational visit. The HbA_{1c} level improved from 8.6 ± 1.6% at baseline to 7.8 ± 1.5% immediately after the diabetes education intervention and 7.8 ± 1.8% 3 months after the third educational visit. This improvement with time was significant overall ($P < 0.001$), immediately after ($P < 0.001$), and 3 months after the third educational visit ($P < 0.001$). However, when BMI and age were included as covariates in our ANOVA, there was a trend in improvement in glycemic control, which did not reach statistical significance ($P = 0.089$). No significant effects involving condition emerged, indicating that the improvement in HbA_{1c} occurred regardless of the method of delivery of diabetes education (via telemedicine or in person).

Analysis of the lipid profile results showed an improvement LDL cholesterol. LDL cholesterol decreased from 2.89 mmol/l at baseline to 2.65 mmol/l immediately after the third educational visit ($P < 0.05$) and to 2.62 mmol/l 3 months after the third educational visit ($P = 0.055$). However, when our outcome analysis was adjusted for BMI and age, the improvement in LDL cholesterol was no longer significant. Neither treatment arm effect (in person vs. via telemedicine) nor the arm × time (pre/post) interaction effect was significant, indicating that the improvement in LDL cholesterol was independent of the group to which the subjects were randomized. We

Table 3—*Results of measures of glycemic control, psychosocial functioning, and satisfaction*

In person vs. via telemedicine	n	Baseline	Immediately after education*	3 months after education†
HbA_{1c}†, #, ††, ‡‡ (%)				
In person	18	8.6 ± 1.6	7.8 ± 1.3	7.6 ± 1.3
Via telemedicine	19	8.7 ± 2.1	7.8 ± 1.6	7.8 ± 2.2
Total	37	8.6 ± 1.8	7.8 ± 1.5	7.8 ± 1.8
LDL cholesterol§, **, ††, ‡‡ (mmol/l)				
In person	19	2.93 ± 0.74	2.79 ± 0.68	2.67 ± 0.97
Via telemedicine	15	2.84 ± 0.98	2.47 ± 0.86	2.55 ± 0.97
Total	34	2.89 ± 0.84	2.65 ± 0.77	2.62 ± 0.96
PAID scale§, ‖, **, ††, ‡‡				
In person	17	35.8 ± 23.4	33.6 ± 17.0	29.4 ± 17.8
Via telemedicine	14	37.4 ± 25.8	28.1 ± 22.0	27.4 ± 17.9
Total	31	36.6 ± 24.1	31.1 ± 19.2	28.6 ± 17.6
ADS scale§,**, ††, ‡‡				
In person	19	20.1 ± 4.7	19.3 ± 2.7	18.6 ± 4.2
Via telemedicine	15	20.1 ± 4.1	17.1 ± 3.7	18.6 ± 3.5
Total	34	20.1 ± 4.4	18.3 ± 3.3	18.6 ± 3.9
Treatment satisfaction‡,**, ††, ‡‡				
In person	16	23.8 ± 7.9	30.7 ± 3.8	29.1 ± 5.3
Via telemedicine	12	22.8 ± 8.6	30.9 ± 4.2	31.3 ± 4.2
Total	28	23.4 ± 8.1	30.8 ± 3.9	30.0 ± 5.1
DQOL scale‡, **, ††, ‡‡				
In person	19	61.2 ± 15.0	69.6 ± 11.8	68.4 ± 13.5
Via telemedicine	16	63.4 ± 13.0	71.4 ± 12.2	69.1 ± 11.0
Total	35	62.2 ± 13.9	70.4 ± 11.8	68.7 ± 12.3

Data are means ± SD. All post-measures for all subjects were not available. *Obtained immediately after visit; †obtained 3 months after third educational visit. Baseline vs. post-education unadjusted for age and BMI: ‡$P < 0.01$, §$P < 0.05$, ‖NS. Baseline vs. post-education adjusted for age and BMI: ¶$P < 0.05$, #$P < 0.1$, **NS. In person vs. via telemedicine: ††NS. Time × condition: ‡‡NS.

found no significant effects for triglycerides, HDL cholesterol, and total cholesterol, nor did we observe any significant changes in BMI or systolic and diastolic blood pressures with diabetes education delivered via tele-education or in person.

Emotional measures and quality of life

The PAID survey was administered to all subjects at baseline, immediately after the third educational visit, and 3 months after the third educational visit. The PAID instrument was scored on a scale of 0–100. Higher scores indicated higher emotional distress associated with diabetes. Table 3 demonstrates the results obtained at baseline and immediately and 3 months after education in the in-person and telemedicine groups. With diabetes education, the PAID score improved significantly from baseline immediately and 3 months after the third educational visit ($P < 0.007$) in both the telemedicine and in-person groups. This effect was significant when we adjusted our outcome analyses for BMI and age ($P = 0.026$, baseline vs. 3 months after education). ANOVA did not revealed any significant differences between the in-person and telemedicine groups.

Subjects also completed the ADS scale at baseline and immediately and 3 months after education (Table 3). A lower ADS score indicated that the individual had a more positive view or appraisal of his or her diabetes. After three consultative visits with the diabetes nurse educator and dietitian, the participants had a more positive appraisal of their diabetes ($P < 0.05$) regardless of whether diabetes education was administered in person or via telemedicine. Again, the ANOVA revealed no significant effects involving condition. However, this change was no longer significant when adjusted for age and BMI.

Table 4—*Telemedicine Patient Satisfaction Survey*

Question	Score
How comfortable did you feel? (0, very uncomfortable; 5, very comfortable)	4.2 ± 1.2 (19)
How convenient was the encounter? (0, not at all convenient; 5, very convenient)	4.4 ± 1.0 (19)
Was the lack of physical contact acceptable? (0, not acceptable; 5, very acceptable)	4.3 ± 1.3 (19)
Concerns about privacy (0, no concerns; 5, very concerned)	1.1 ± 1.7 (19)
Overall satisfaction (0, not all satisfied; 5, very satisfied)	4.3 ± 1.3 (19)
Would you do it again? (yes/no)	16/3

Data are means ± SD (n).

Table 5—*Nutritional and educational goal attainment success of patients*

	Nutritional goal attainment		Educational goal attainment	
	Met goal	Not met	Met goal	Not met
In-person group	10 (47.4)	11 (52.4)	12 (60)	8 (40.0)
Telemedicine group	12 (52.6)	9 (47.4)	9 (50)	9 (50.0)
Total	20 (50.0)	20 (50.0)	21 (55.3)	17 (44.7)

Data are count (%). In person vs. via telemedicine: NS.

Patient satisfaction

Participants in the study who received diabetes tele-education completed the Telemedicine Patient Satisfaction Survey at visit 3 (Table 4). Most patients felt comfortable with teleconferencing and found it very convenient. The lack of physical contact was generally acceptable and concerns about privacy were low. Almost all indicated that they would do it again (16 of 19, 84.2% of telemedicine participants who responded). Overall satisfaction was high (score 4.3 of 5).

All subjects were asked to complete the DTSQ before and after the education intervention. Participants' satisfaction with the treatment increased significantly ($P < 0.001$), be it diabetes education via telemedicine or in person immediately ($P < 0.001$) and 3 months after the third educational visit ($P < 0.001$) (Table 3). There was no difference in satisfaction scores between groups and no interaction of group by time. The improvement in the DTSQ as well as the DQOL scale was not statistically significant when our outcome analysis was adjusted for age and BMI as covariates.

Nutrition and diabetes education behavioral goals

Each study participant formulated individualized attainable nutritional and diabetes management goals during his or her visit with the educators. These goals were reviewed at visit 3 to determine if the participant partially or completely met these goals. A χ^2 analysis of the proportion of the participants who fully achieved the diabetes education general and nutritional goals showed no differences between the in-person versus telemedicine groups (Table 5). Of the study participants, 50% fully met their nutritional goals and 55% met their diabetes educational goals after educational intervention.

Costs of telemedicine intervention

The cost of the necessary equipment at our diabetes center was $5,078 and at one of our distant sites, $6,340. The line charges amounted to a monthly maintenance ISDN line charge of $37 and a charge of $14 per hour for line use.

CONCLUSIONS

— Our study is the first to suggest that telemedicine is an effective means of providing diabetes education to patients. We have also shown that comprehensive diabetes education delivered via telemedicine is as well accepted as in-person education. Glycemic control, as measured by HbA_{1c}, improved comparably with diabetes education in both the in-person group and the telemedicine group, but did not reach statistical significance when adjusted for age and BMI. We also assessed emotional well-being and quality of life because others have shown that improved emotional well-being leads to better diabetes self-care (9,10). We used the PAID scale, ADS questionnaire, and the DQOL survey, which have been well validated and have proven reliable in people with diabetes (13–15). Diabetes education via telemedicine and in person significantly reduced diabetes-related distress, as shown by the results of the PAID. This may lead to higher morale and better psychological adjustment to diabetes and, as a result, can contribute to better long-term glycemic control. Improvements observed using other survey instruments did not obtain statistical significance. We should highlight that the group who received diabetes education via telemedicine was highly satisfied, as shown by their responses in the Telemedicine Patient Satisfaction Survey. This group found the service comfortable and very convenient.

Diabetes education was successful and effective in both the in-person and telemedicine groups in promoting behavior change. Most of the patients partially or completely achieved their diabetes education self-care and nutritional goals. Our diabetes nurse educator was even successful in teaching insulin administration via telemedicine to a patient who had very high blood glucose levels on oral hypoglycemic agents and needed to initiate insulin therapy.

A few previous studies have investigated the use of telemedicine for medical management of diabetes, but none of these studies examined the use of this technology for diabetes education (19, 20). Communication with health care providers and health care facilities using telemedicine can improve diabetes care (21). Our findings of similar effects in the in-person and telemedicine groups support the necessity for larger studies to confirm this preliminary finding to enable Medicare, Medicaid, and third-party payers to determine policy for reimbursement for diabetes education services provided via telemedicine technology (22).

The present report is the first to examine the use of telemedicine technology for conducting diabetes education programs in a small controlled prospective randomized study. Our group has found diabetes education using telemedicine technology feasible, acceptable, and effective in the management of patients with diabetes. With the proper equipment in place, access to distant sites was easily achieved. All that was required was the assistance of a person to turn on the monitor and computer and dial-up the number of our center or wait for our tele-call. The cost of the equipment was not prohibitive.

There are several limitations to our study. Our sample size was limited and our power calculations before commencing the study were aimed at detecting large group differences. We cannot exclude small differences between the groups. Given our SD data and sample size, the HbA_{1c} difference between groups would have had to be 1.65% to have 80% power to detect significance. Our observed difference at the 6-month assessment visit was 0.21, with a 95% CI of −1.01 to 1.42. Assuming 80% power and an SD of 1.5%, to detect a group difference of 0.21 as in this study, we would have needed 761 subjects in each treatment arm, which was cost-prohibitive. Thus, we were not powered to detect small differences.

A second limitation was the baseline differences in BMI and age present in the participants. These differences could potentially have moderated treatment effects, and when we controlled for them, the improvement in our main outcome variable (HbA_{1c}) was no longer significant, although a trend in improvement of glycemic control ($P = 0.089$) was still present. A small sample size also limited the ability to detect differences when there were added covariates. Controlling for BMI and age, however, did not affect the improvement in PAID scores, which suggests that diabetes education improved emotional well-being regardless of the method of delivery (tele-education vs. in person).

A third limitation of our trial was the lack of a control group. A nonintervention usual care group was not included because we were interested in comparing diabetes education through telemedicine technology versus in person and did not want to deny any subject education because of ethical concerns. The value of DSME in improving glycemic control has been shown by others and was not the primary objective of this study (1). However, because a control group was not included, alternative explanations for improved glycemic control in both groups include self-selection issues, regression to the mean, or the added assistance in organizing visits associated with obtaining outcome data.

A fourth study limitation is that the goal assessment was obtained by the clinicians and that these data are limited given the motivation for positive responses on both the patients' and providers' part. Our nurse educators did change during the study period, but the dietitian educator remained the same. Having the same educators in both arms of the study could be a limitation if one of the educators were biased in favor of one of the methods, thereby affecting, even unconsciously, their interaction with patients in each of the arms of the study. On the other hand, having different educators in each arm of the study could have introduced an equal, if not more significant, problem, i.e., any impact noted could be a function of the personality and skills of the educator rather than of the educational methodology.

The use of new telemedicine technologies provides an opportunity for people with diabetes who live in rural and medically underserved areas to have access to high-quality diabetes education programs. It is hoped that the use of this approach will help motivate and empower underserved patients to take better care of themselves and to avoid the complications of diabetes. Although our study indicates that diabetes education is effectively administered via telemedicine, further studies are needed with larger numbers of patients to conclusively determine that diabetes education delivered via telemedicine technology is equally as effective as diabetes education administered in person.

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