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Journal

Telemedicine Journal and e-Health, 20(9)

ISSN

1530-5627

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Publication Date

2014-09-01

DOI

10.1089/tmj.2013.0326

Peer reviewed

Sustained Effects of a Nurse Coaching Intervention via Telehealth to Improve Health Behavior Change in Diabetes

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Abstract

Background: *Diabetes educators and self-management programs are scarce in rural communities, where diabetes is the third highest-ranking health concern. The goal of this study was to evaluate the benefits of nurse telehealth coaching for persons with diabetes living in rural communities through a person-centered approach using motivational interviewing (MI) techniques.* ***Materials and Methods:*** *A randomized experimental study design was used to assign participants to receive either nurse telehealth coaching for five sessions (intervention group) or usual care (control group). Outcomes were measured in both groups using the Diabetes Empowerment Scale (DES), SF-12, and satisfaction surveys. Mean scores for each outcome were compared at baseline and at the 9-month follow-up for both groups using a Student's* t *test. We also evaluated the change from baseline by estimating the difference in differences (pre- and postintervention) using regression methods.* ***Results:*** *Among the 101 participants included in the analysis, 51 received nurse telehealth coaching, and 50 received usual care. We found significantly higher self-efficacy scores in the intervention group compared with the control group based on the DES at 9 months (4.03 versus 3.64, respectively;* $p < 0.05$*) and the difference in difference estimation (0.42;* $p < 0.05$*).* ***Conclusions:*** *The nurse MI/telehealth coaching model used in this study shows promise as an effective intervention for diabetes self-management in rural communities. The sustained effect on outcomes observed in the intervention group suggests that this model could be a feasible intervention for long-term behavioral change among persons living with chronic disease in rural communities.*

Key words: *behavioral health, telehealth, telenursing, telemedicine, technology, diabetes*

Introduction

Diabetes causes 10–15% of deaths in the United States,[1] where over 26 million people are diagnosed with diabetes, and an estimated 79 million people have prediabetes.[2] The prevalence of diabetes in rural communities is approximately 17% higher than in urban areas, with diabetes being the third highest-ranking rural health concern after heart disease and stroke.[3] Type 2 diabetes accounts for 90–95% of all cases of diabetes and is the most common type of diabetes in rural communities. Like many chronic illnesses, it is associated with poor health behaviors such as high-fat/high-carbohydrate diets, a sedentary life style, use of tobacco, and alcohol abuse.[4,5]

Successful approaches to improve chronic illnesses often focus on patient-centered models of care. This is particularly true in diabetes, where self-management education and support form critical components of treatment plans. Empowering individuals to take control of their health and make behavioral decisions can directly prevent or mitigate the impact of chronic illnesses.[6,7] Motivational interviewing (MI) is a counseling tool to elicit and support behavioral changes and improve self-efficacy.[8] MI enhances readiness to change by helping individuals explore and resolve ambivalence.[9,10] Miller and Rose[9] proposed that MI has two active components: a relational component, based on traditional client-centered counseling, and a technical component, involving the evocation and reinforcement of the individual change talk. MI has been successfully used in treatment of addictions[11,12] and chronic conditions, including pain self-management, weight loss, and glycemic control.[13–15] Furthermore, a MI intervention in diabetes resulted in positive effects in self-management, psychological, and glycemic outcomes in type 2 diabetes compared with a control group receiving traditional care.[16]

Traditional interventions for diabetes education have been primarily delivered through face-to-face counseling in clinics and individual visits with a nurse and/or certified diabetes educator. However, these types of interventions are difficult to implement in rural areas because of less availability of health expertise and education, longer travel times, and lack of transportation to access services.[17] Thus, new strategies to improve diabetes management in rural communities have been implemented through telehealth, Web-based models, telephone help lines, and community health advisors.[5] Several studies using telehealth in rural areas have reported improved knowledge of diabetes, self-efficacy, dietary adherence, glucose monitoring, and glycemic control.[18–21]

 DOI: 10.1089/tmj.2013.0326

A large body of evidence supports a short-term effect of diabetes self-management education.[22–25] In a systematic review of randomized controlled trials, Norris et al.[26] reported that, in general, the effectiveness of diabetes interventions was short-lived; improvements in glycemic control, knowledge of diabetes, and diet were observed in the short term, with no significant differences observed between the intervention versus control group long term (>6 months postintervention). More recent studies using different intervention modalities have shown lasting outcomes and benefits in individuals with diabetes.[27–30] Interventions using individual education,[27] the chronic care coordination model,[29] or empowerment-based diabetes self-management support[28] have demonstrated significant and sustained improvements in diabetes self-efficacy and reduced diabetes distress. This study examines the long-term effect of a telehealth coaching model using a person-centered approach that included (a) emphasis on self-management, (b) nurse health coaching using MI counseling techniques, and (c) telehealth technology. Our goals were (1) to compare the outcomes of individuals with diabetes participating in the telehealth health behavior coaching model with those receiving usual care, (2) to enhance self-efficacy among persons with diabetes so they can make optimal use of available information, resources, and skills to improve their health, and (3) to evaluate long-term health behavior outcomes of an intervention model using MI and telehealth technology.

Research Design and Methods

STUDY DESIGN AND ELIGIBILITY

This randomized, controlled study evaluated the telehealth coaching model for individuals with diabetes compared with a control group receiving usual care. Participants were recruited from six rural federally qualified health centers community clinics from Northern and Central California. Eligibility criteria were as follows: registered for care at one of the sites, over 18 years of age, a diagnosis of either type 1 or type 2 diabetes, able to speak English or Spanish, and have a telephone. There were no requirements for office visits or other clinical care during the study. Participants were excluded from the study if they had self-identified vision or literacy challenges preventing them from completing surveys or hearing problems that would interfere with the conversational coaching intervention. Potential participants were sent letters from their rural clinic to solicit their interest in a research study. Following an expression of interest, each person was contacted by the project manager who provided additional information about the study by phone. If he or she remained interested at the end of the call, a consent form was mailed with a prepaid return envelope. Once the form was returned, they were randomly assigned to either intervention or control group. Recruitment has been described in detail in a previous publication.[31]

Human Subjects approval was granted by the Institutional Review Board at the Office of Research of the University of California Davis.

INTERVENTION PROCEDURE

Three nurse coaches formed the intervention team. They were experienced Registered Nurses who had received 6 h of additional training in MI from a certified diabetes educator and had practiced MI skills with an expert trainer prior to the initiation of the intervention. Participants were randomized to the telehealth coaching (intervention) group or the control group (usual care). Usual care consisted of the services and care available at the rural clinic where the participant received healthcare. The intervention group attended a 2-h in-person session with a nurse coach where information was given about the MI[32] counseling approach used during the intervention and an overview of typical health behavior goals they may choose to work on with their coach. Participants were offered two modes to meet with their nurse coach: (1) by telephone or (2) face-to-face videoconference. Videoconferencing was available if the participant had high-speed Internet access, a Web camera, and a computer compatible with the secure, Web-based product (Polycom® [San Jose, CA] CMA, which was licensed by the University and provided at no cost). At the time this intervention was delivered, there were still significant technological barriers within the rural communities. Despite widespread interest, only three participants were able to meet with their coach through videoconferencing mode.

Each participant was assigned a nurse coach for the duration of the intervention. Spanish-speaking participants were assigned to a Spanish-speaking nurse coach. Calls were scheduled once every 2 weeks for five sessions at times chosen by the participant. Calls averaged 30 min in duration. The coaches used MI to elicit a specific target health behavior area prioritized by the participant. Participants were encouraged to select one behavior change area and create goals within that area for the duration of the study. Examples of goals were improving eating habits, losing weight, exercising, reducing stress, adhering to medication, and quitting smoking; 80% chose either nutrition or physical activity as a target. The principles of MI were used to encourage participants to set reasonable goals, to reflect on barriers to achieving goals, and to provide guidance toward generating a reasonable solution to overcome barriers and be successful.[33]

To ensure fidelity of the intervention, all conversations were recorded. An experienced certified diabetes educator and a PhD researcher in nutrition audited a sampling of each of the coaches' sessions for quality and provided feedback to the coaches at two time points during the intervention. Sessions in Spanish were transcribed in English to facilitate audit and review.

DATA COLLECTION

Surveys were mailed to participants with self-addressed return envelopes at three time points: baseline, at 16 weeks (to coincide with the end of the intervention), and at 9 months. All survey materials were either available from the original measurement source or were translated from English by the University's certified translation services.

There was low response to the second survey, coinciding with the end of the intervention (16 weeks), with only 71% returned. Several strategies increased participation in the final survey, resulting in 84% of participants completing the 9-month survey. The study coordinator, fluent in English and Spanish, placed calls to encourage survey completion at each time point and offered to assist in the completion

of the survey over the phone for both the groups. Finally, a $40 gift card was offered to all participants when they completed their final survey.

OUTCOME MEASURES

Several health behavior outcomes were measured to determine the impact of the telehealth coaching model. A survey was developed utilizing selected items previously published by the Michigan Diabetes Research and Training Center. Ten questions were used from the Diabetes History survey and five questions from the Diabetes Care Profile survey.[34]

Self-efficacy. Self-efficacy was measured using a previously validated self-efficacy measure, the Diabetes Empowerment Scale (DES)—Short Form (DES-SF),[35] which assessed the psychosocial self-efficacy of individuals living with diabetes. The DES-SF scale was further categorized into subscales: managing the psychosocial aspects of diabetes, assessing dissatisfaction and readiness to change, and setting and achieving diabetes goals. The overall score for the DES was calculated by adding all of the item scores and dividing by the number of items. The score range for the DES is 1–5.

Physical and mental health. Physical and mental health composite scores were assessed by a previously validated SF-12,v2® (QualityMetric, Lincoln, RI) health survey, a 12-item short form that measures eight domains of health using a 5-point Likert scale. SF-12,v2 scoring software calculated a scored assessment of the domains of physical and mental well-being at each measurement time point.

Satisfaction with diabetes care. This measure assessed satisfaction with current diabetes care, using a previously published satisfaction survey from the Michigan Diabetes Research and Training Center.[36] The four-item diabetes healthcare satisfaction survey was scored on a 5-point Likert scale. A summary satisfaction score was calculated by summing the item-specific scores.

STATISTICAL ANALYSIS

Baseline characteristics were compared between the individuals in the telehealth health behavior coaching model and those who received usual care. A comorbidity score was calculated for each participant to assess the burden of coexisting disease. Each coexisting condition was assigned a score of 1. We collected information on congestive heart failure, coronary heart disease, stroke, high blood pressure, high cholesterol, arthritis, chronic lung disease, chronic pain, acid reflux, depression, cancer, thyroid, prostate, glaucoma, migraines, and allergies.

Continuous variables were compared using a Student's *t* test or the Wilcoxon Signed-Rank test, and categorical variables were compared using the chi-squared test and Fisher's exact test, as appropriate. Study outcome measures from both the intervention and control groups were assessed at baseline and 9 months. Self-efficacy scores, physical and mental health composite Scores, and satisfaction with diabetes care scores were analyzed using a Student's *t* test. Missing values for the SF-12 were imputed using a previously published imputation algorithm.[37] We used the

Table 1. Characteristics of the Study Population and Loss to Follow-Up Population

CHARACTERISTIC	OVERALL (*N* = 121)	STUDY POPULATION (*N* = 101)	LOSS TO FOLLOW-UP (*N* = 20)
Gender			
Male	68 (56.2)	60 (59.4)	8 (40.0)
Female	53 (43.8)	41 (40.6)	12 (60.0)
Age (years)			
<35	4 (3.3)	2 (2.0)	2 (10.5)
36–45	9 (7.4)	7 (6.9)	2 (10.5)
46–55	30 (24.8)	24 (23.8)	6 (30.0)
56–65	41 (33.9)	37 (36.6)	4 (20.0)
66–75	29 (24.0)	25 (24.8)	4 (20.0)
76 and up	7 (5.8)	6 (5.9)	1 (5.0)
Missing	1 (0.8)	0 (0.0)	1 (5.0)
Education[a]			
≤8th grade	16 (13.2)	12 (11.9)	4 (20.0)
Some high school	12 (9.9)	7 (6.9)	5 (25.0)
High school graduate or GED	13 (10.7)	11 (10.9)	2 (10.0)
Vocational or trade school	8 (6.6)	8 (7.9)	0 (0.0)
Some college or 2-year degree	28 (23.1)	23 (22.8)	5 (25.0)
4-year college graduate	20 (16.5)	17 (16.8)	3 (15.0)
More than 4-year college degree	23 (19.0)	23 (22.8)	0 (0.0)
Missing	1 (0.8)	0 (0.0)	1 (5.0)
Income			
< $25,000	55 (45.5)	43 (42.6)	12 (60.0)
$25,000–50,000	21 (17.4)	16 (15.8)	5 (25.0)
$50,001–75,000	14 (11.6)	12 (11.9)	2 (10.0)
$75,001–100,000	10 (8.3)	10 (9.9)	0 (0.0)
> $100,000	11 (9.1)	11 (10.9)	0 (0.0)
Do not wish to answer	10 (8.3)	9 (8.9)	1 (5.0)

Data are number (%).

[a] p value < 0.05, indicates a significant difference.

difference in differences estimation to evaluate the change from baseline to the 9-month follow-up for the intervention and control group. We assessed difference in differences by calculating the difference in the mean scores at baseline (preintervention) and at 9 months (postintervention). We used regression methods to calculate the mean and standard errors for this comparison.

Results

The study included 121 participants with diabetes from six federally qualified health centers in Northern and Central California. Among the 121 participants, 61 were randomly assigned to the telehealth health behavior coaching group, while 60 continued to receive usual care; all completed baseline surveys. At 16 weeks, coinciding with completion of the intervention, 85 (70.2%) completed follow-up surveys. At 9 months, 101 (83.5%) completed final surveys. Twenty participants (16.5%), 10 each from the intervention and control groups, were not included in the analysis as they did not complete the survey at 9 months and were lost to follow-up; the remaining 101 participants were included in the analysis. Within the intervention group, 91.8% of participants completed all five coaching sessions, and 93.4% completed three or more sessions. The demographic characteristics of the study population at baseline and in the lost-to-follow-up population were similar except for their educational status (*Table 1*).

Among the 101 participants, 51 received the telehealth intervention, and 50 received usual care. Participants were predominately male (59.4%), with a majority in the 55–65-year-old age group (36.6%). Most had at least some college education (62.4%) and earned less than $25,000 (46.2%) (*Table 2*). Demographic characteristics of the participants in the intervention and control groups were similar.

There was a significant difference in self-efficacy scores at 9 months, with the intervention group having a higher score relative to the control group (4.03 versus 3.64, respectively; $p<0.05$) (*Table 3*). Furthermore, when the eight items in the DES-SF were analyzed within the subscales, significantly higher scores for "assessing dissatisfaction and readiness to change" and "setting and achieving diabetes goals" were observed in the intervention group compared with the control group (3.85 versus 3.38 and 4.12 versus 3.71, respectively; $p<0.05$). A trend toward a higher score for managing the psychosocial aspects of diabetes was seen in the intervention group relative to the control group at 9 months (4.08 versus 3.80, respectively; $p=0.09$). When comparing the difference in differences for the intervention and control group, we found significantly higher scores for the self-efficacy scores (0.42; $p<0.05$) and higher scores for the subscale assessing dissatisfaction and readiness to change (0.83; $p<0.05$). *Figure 1* illustrates the change in the self-efficacy score over time,

Table 2. Demographic Characteristics of the Study Population

CHARACTERISTIC	OVERALL (*N*=101)	INTERVENTION (*N*=51)	CONTROL (*N*=50)
Gender [*n* (%)]			
Male	60 (59.4)	29 (56.9)	31 (62.0)
Female	41 (40.6)	22 (43.1)	19 (38.0)
Age (years) [*n* (%)]			
<35	2 (2.0)	1 (2.0)	1 (2.0)
36–45	7 (6.9)	4 (7.8)	3 (6.0)
46–55	24 (23.8)	12 (23.5)	12 (24.0)
56–65	37 (36.6)	19 (37.3)	18 (36.0)
66–75	25 (24.8)	12 (23.5)	13 (26.0)
76 and up	6 (5.9)	3 (5.9)	3 (6.0)
Ethnicity [*n* (%)]			
Hispanic	34 (33.6)	17 (33.3)	17 (34.0)
Non-Hispanic	67 (66.3)	34 (66.7)	33 (66.0)
Education [*n* (%)]			
≤8th grade	12 (11.9)	6 (11.8)	6 (12.0)
Some high school	7 (6.9)	5 (9.8)	2 (4.0)
High school graduate or GED	11 (10.9)	4 (7.8)	7 (14.0)
Vocational or trade school	8 (7.9)	3 (5.9)	5 (10.0)
Some college or 2-year degree	23 (22.8)	11 (21.6)	12 (24.0)
4-year college graduate	17 (16.8)	9 (17.7)	8 (16.0)
>4-year college degree	23 (22.8)	13 (25.5)	10 (20.0)
Income [*n* (%)]			
<$25,000	43 (42.6)	22 (43.1)	21 (42.0)
$25,000–50,000	16 (15.8)	8 (15.7)	8 (16.0)
$50,001–75,000	12 (11.9)	8 (15.7)	4 (8.0)
$75001–100000	10 (9.9)	5 (9.8)	5 (10.0)
>$100,000	11 (10.9)	5 (9.8)	6 (12.0)
Do not wish to answer	9 (8.9)	3 (5.9)	6 (12.0)
Comorbidity score [mean (SD)]	3.55 (2.48)	3.22 (1.86)	3.90 (2.97)
Body mass index (kg/m^2) [mean (SD)]	31.3 (7.9)	30.5 (9.0)	32.1 (6.7)

Data are number (%) or mean (standard deviation [SD]) values as indicated.

Table 3. Comparison of Self-Efficacy Scores for Study Population at Baseline and 9 Months

	INTERVENTION ($N=51$)	CONTROL ($N=50$)	P VALUE
Diabetes Empowerment Scale			
Baseline	3.77 (0.62)	3.80 (0.61)	0.79
9 months	4.03 (0.60)	3.64 (0.84)	0.01[a]
Change from baseline	0.42		0.04[a]
Subscale: Managing the Psychosocial Aspects of Diabetes			
Baseline	3.75 (0.78)	3.71 (0.71)	0.83
9 months	4.08 (0.61)	3.80 (0.91)	0.09
Change from baseline	0.24		0.27
Subscale: Assessing Dissatisfaction and Readiness to Change			
Baseline	3.44 (1.15)	3.80 (0.86)	0.08
9 months	3.85 (1.13)	3.38 (1.29)	0.05[a]
Change from baseline	0.83		<0.01[a]
Subscale: Setting and Achieving Diabetes Goals			
Baseline	3.96 (0.73)	3.93 (0.79)	0.83
9 months	4.12 (0.68)	3.71 (0.90)	0.01[a]
Change from baseline	0.37		0.09

Data are mean (standard deviation) values.

[a]Significant difference.

showing increasing scores for the intervention group compared with the control group at 9 months.

There was a trend toward significance for the physical health composite score at 9 months, with higher scores among the intervention group than among the control group (42.11 versus 37.99, respectively; $p<0.08$). Also, the mental health composite score showed a difference between the intervention group and the control group but also failed to reach statistical significance at 9 months (49.12 versus 47.25, respectively; $p=0.44$) (*Table 4*).

Regarding satisfaction with diabetes care, the control group had higher scores compared with the intervention group (14.48 versus 13.80, p = 0.17); however, by 9 months, the intervention group had a trend toward higher satisfaction with care received than the control group (15.32 versus 15.06; $p=0.71$). *Figure 2* illustrates the change in satisfaction with care over time, showing increasing scores for the intervention group compared with the control group at 9 months.

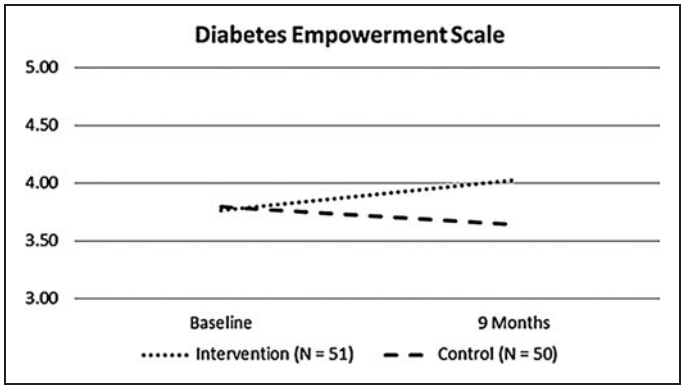

Fig. 1. Change in self-efficacy scores for study population.

Discussion

This study examined the impact of a telehealth delivered person-centered health behavior coaching model for individuals with diabetes living in rural, underserved communities. In this study we recruited 121 participants using a rapid, multisite approach and were able to achieve a low attrition rate, with 84% retention throughout the study period. The intervention group reported significantly higher self-efficacy scores following telehealth-enabled health behavior coaching compared with the control group who continued to receive usual care for diabetes.

Sustained improvements in self-efficacy scores in the intervention group at 9 months suggest a lasting benefit of the MI/telehealth intervention model. Reports on the effectiveness of diabetes self-management interventions on long-term outcomes have been mixed. In a study evaluating short-term (approximately 6 months) and long-term (approximately 8 months) outcomes of diabetes education, those receiving individual diabetes education sustained higher measures of self-efficacy and reduced diabetes distress compared with the group receiving usual care; however, no sustained improvement in glucose level, physical activity, and nutrition was observed.[27]

What determines if a diabetes intervention will result in long-term benefits is not clear, but specific types of interventions seem to be more effective in sustaining diabetes self-care. Interventions that

Table 4. Comparison of Physical and Mental Health Composite Scores for Study Population as Assessed by the SF-12 Health Survey at Baseline and 9 Months

SF-12 HEALTH SURVEY	INTERVENTION ($N=51$)	CONTROL ($N=50$)	P VALUE
Physical health composite scores			
Baseline	42.14 (11.95)	38.75 (10.82)	0.16
9 months	42.11 (10.64)	37.99 (10.32)	0.08
Change from baseline	0.73		0.83
Mental health composite scores			
Baseline	45.78 (11.12)	47.78 (11.85)	0.41
9 months	49.12 (10.01)	47.25 (11.67)	0.44
Change from baseline	−0.13		0.26

Data are mean (standard deviation) values.

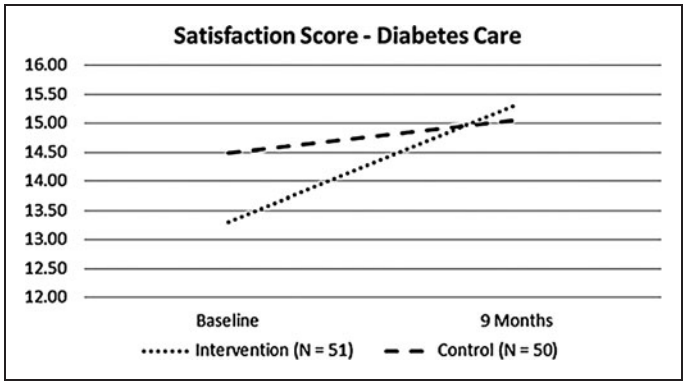

Fig. 2. Change in satisfaction scores for study population.

involve active participation and collaboration are likely to have longer and more positive clinical and psychosocial outcomes than didactic interventions in which there is limited participant input.[26] This study used MI to encourage participants to select a particular behavior change area and create goals to achieve change. Thus, the intervention group actively decided which areas to address regarding their diabetes and identified problems/behaviors that were obstacles to improvement. The active role of participants in self-managing their diabetes may have contributed to the sustained benefits postintervention observed in our study, as they were actively involved in making decisions about specific aspects of diabetes care when the intervention ended.

The coaching intervention focused on enhancing goal-setting skills by focusing on manageable steps to improve health, establishing reasonable goals, and managing barriers to goal attainment. This approach builds capacity to problem-solve and has the potential for wider applicability to other health goals. Because chronic illness management involves multiple lifestyle and behavior choices across many domains (nutrition, physical activity, medication adherence, stress management, etc.), incremental improvements in capacity to set and attain reasonable goals could advance overall self-care.

Consistent with our results, others have reported short-term improvements in diabetes self-efficacy from a MI intervention.[16,38,39] Our study extends these findings to longer-term results and suggests the potential of motivational interviewing in achieving lasting diabetes health benefits. This promising approach warrants further research using telehealth coaching alone or in combination with routine reinforcement as an effective long-term intervention.

To our knowledge, this is the first report using MI and telehealth technology in a diabetes intervention targeting rural/underserved communities who are strained to provide basic primary care and often lack specialty expertise, particularly for complex conditions. Centralized telehealth coaching could augment usual care in a cost-effective and efficient way by providing greater access for rural dwellers in an "on demand" model of care delivery. An important next step in this approach is integrating the efforts of the telehealth coach and participant with primary care through communication with the healthcare provider and data sharing within the electronic health record.

Our study has some limitations. The first is the low response rate at the 16-week follow-up. This issue was overcome at the 9-month follow-up, when improved response rates were achieved. However, the large amount of missing data at 16 weeks precluded analyses involving all three time points. The second possible limitation relates to the self-reporting bias where participants may report outcomes that match the goals set during the intervention rather than actual behavioral changes. However, others using MI have reported benefits in self-efficacy and clinical outcomes similar to those found in our study.[16,20,38,40,41] The third limitation is the lack of measurement of clinical outcomes such as weight loss, hemoglobin A1c levels, blood pressure, lipid profiles, etc. A primary goal of the study was to determine the feasibility of offering specialized care within rural communities remotely. In partnering with different clinics, we were unable to mandate regular office visits or biometric testing at specified intervals to elicit information about the impact of the study on these measures.

In conclusion, this study demonstrates the effectiveness of an innovative diabetes intervention model using a combination of MI and telehealth technology in rural communities. Our results showed sustained improvements in diabetes self-efficacy in the intervention group, suggesting the potential benefit of this intervention for individuals in underserved communities with limited access to diabetes care.

Acknowledgments

This project was funded by the National Institutes of Health American Recovery and Reinvestment Act of 2009 grant 3UL1RR024146-04S2. The project described was supported by the National Center for Advancing Translational Sciences, National Institutes of Health, through grant UL1 TR000002. This work utilized the Measurement Core of the Michigan Diabetes Research and Training Center funded by grant P60DK020572 from the National Institute of Diabetes and Digestive and Kidney Diseases. The authors acknowledge the valuable contributions of the participants in the study, the site champions and site coordinators, and our team, including Sergio Aguilar-Gaxiola, Danise Gonzalez, Deborah Greenwood, Erin Griffin, Stuart Henderson, Colleen Hogan, Samira Jones, Bridget Levich, Roxann Moritz, James Nuovo, Ayan Patel, Frances Patmon, Julie Rainwater, Vanessa Santillan, and Glee Van Loon. We also acknowledge the tremendous support from the University of California Davis Clinical and Translational Science Center whose resources lent expertise in informatics, grant writing support, research nursing staff from the Clinical and Translational Science Center Clinical Research Center, and program evaluation.

Disclosure Statement

No competing financial interests exist.

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Received: October 4, 2013
Revised: December 10, 2013
Accepted: December 12, 2013