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Impact of Telehealth Education Versus Standard Care on Increasing Self-Efficacy Scores and Diabetes Knowledge in Adult Diabetics

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Impact of Telehealth Education Versus Standard Care on Increasing Self-Efficacy Scores and Diabetes Knowledge in Adult Diabetics

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Abstract

Background: Evidence supports the use of telehealth as an effective method to support the increase in self-efficacy and knowledge among patients with Diabetes Mellitus.

Objectives: This study was to determine whether using telehealth education in conjunction with standard care compared to standard care only, could increase self-efficacy scores and knowledge for adults with diabetes.

Methodology: A randomized, pre-posttest design is used. A convenient sample of 58 adults with self-reported type 2 diabetes were recruited from a faith-based environment. The control group received two 45-minutes standard education sessions about diabetes and diabetes care. The intervention group received weekly smart-phone messaging for three weeks in addition to the two 45-minute standard education sessions. Diabetes self-efficacy and knowledge were measured before and after the interventions.

Results: There were 28 participants in the control group and 30 in the intervention group. We found a significant difference on self-efficacy from baseline to post-education (6.32 versus 7.77, $p<0.001$), and from baseline to the two-week follow up (6.32 vs. 8.88, $p<0.001$). Diabetes knowledge were also significantly higher after the two education sessions. However, we did not find a significant difference between the two group on diabetes self-efficacy or knowledge.

Conclusion: The results of this study suggest that education sessions in faith-based settings can significantly increase adult's diabetes knowledge and self-efficacy. Telehealth along with

standard education did not significantly increase self-efficacy scores and knowledge than educations sessions alone. This could be due to the short follow up time.

Impact of Telehealth Education Versus Standard Care on Increasing Self-Efficacy Scores and Diabetes Knowledge in Adult Diabetics

Background

Diabetes Mellitus (DM) is one of the most common chronic diseases worldwide (Faruque et al., 2016; Baron, Hirani, & Newman, 2017). Diabetes in 2015 was noted by the American Diabetes Association (ADA) to be the seventh leading cause of death in the United States (ADA, 2017). The Centers for Disease Control (CDC) estimated in the National Diabetes Statistics Report of 2017 that 30.2 million adults had diabetes in 2015 and 1.5 million of those were newly diagnosed cases (CDC, 2017). In the last 20 years, the number of adult cases with diabetes has tripled due to an increasing population age and increased patient rates of obesity (CDC, 2017). The ADA reports, there are 7.2 million Americans who are undiagnosed and 84.1 million who are categorized as pre-diabetic in the US alone (ADA, 2017). This number is being discussed and noted to be significant because it is suggested that without intervention, many of the pre-diabetics could develop type 2 DM within 5 years (ADA, 2017).

Type 2 DM is caused by the body's ineffective use of insulin, according to Powers et al., (2015), and requires patients diagnosed with the disease to make daily self-management decisions that greatly impact their overall success in managing day to day. The World Health Organization (WHO) has found through observational studies a link between type 2 DM and an

increased risk of cardiovascular diseases and all-cause mortality (Moreno-Iribas et al., 2017). The increasing prevalence of diabetes is currently a major public health concern with substantial risk of increased morbidity and mortality (Lee et al., 2016).

Telehealth, a way of delivering healthcare remotely via tele-communications technology such as the use of smart phones, holds promise for improving health outcomes in chronic disease management, per the Report of Congress (2017) submitted by the U.S. Department of Health and Human Services. Hanlon, Caines, Campbell, McKinstry, Weller, & Pinnock (2017) suggest telehealth is a means of delivering care to a growing prevalence of long-term conditions such as diabetes. Telehealth has been noted to be useful when educational strategies are incorporated as an essential part of DM care (Moreira et al., 2017). Telehealth has attracted and continues to attract attention as a viable option for delivering care to patients with chronic conditions (Hanlon et al., 2017). The use of telehealth technology has shown improvement in glycemic control through Hgb A1c levels as noted by Grock, Ku, Kim & Morin (2017). Mobile phones have been used successfully in the management of diabetes and have shown positive impacts on self-efficacy, self-management behaviors and increased knowledge (Dobson et al., 2016).

This study intended to improve self-efficacy and diabetes knowledge in patients with diabetes using telehealth as a means of delivering education and spiritual motivation in a faith-based setting. The technological advancements of telehealth were used to augment usual patient education to achieve optimal patient outcomes that could make more sustainable educational impacts in the treatment of diabetes.

Problem statement

The current standards set by the 2017 National Standards for Diabetes Self-Management Education and Support identifies the need for services that embrace "ever-increasing" platforms and systems that provide personal centered services. Usual care alone delivers positive results to improve patient outcomes in the treatment of the chronic diabetes management of DM and self-efficacy scores however, telehealth holds promise as a means to further improve health outcomes in chronic disease management as a supportive therapy, per the Report to Congress (2017), submitted by the U. S. Department of Health and Human Services. The incidence and prevalence of DM is increasing drastically (Baron, Hirani, & Newman, 2017). The number of people with diabetes worldwide is estimated to be 642 million by the year 2040 (Armstrong & Moore, 2018). Due to the increasing numbers of cases of DM each year and the extraordinary rate at which the disease rate is intended to grow, greater strides should be made to increase self-efficacy scores, and diabetes knowledge for these patients. The CDC releases national DM statistics every 2 years to bring greater public awareness to this treatable disease (Rowley, Bezold, Arikan, Byrne, & Krohe, 2017).

Purpose

The purposes of this study included 1) whether education sessions delivered a faith-based setting increased diabetes knowledge and self-efficacy, and 2) whether using telehealth education in conjunction with standard care as compared to standard care alone, would increase diabetes knowledge and self-efficacy scores for adult patients with diabetes. We

aimed to deliver spiritual motivation via telehealth to assess if this had a positive impact on diabetes knowledge and self-efficacy in a faith-based setting.

Specific Aims

This study's specific aims included:

1. To evaluate if education sessions about diabetes and diabetes care delivered in a faith-based setting to participants with type 2 diabetes could improve diabetes knowledge and self-efficacy;
2. Evaluate the impact of telehealth enhanced teaching and spiritual motivation in conjunction with standard care education compared to standard care education alone on increasing knowledge and self-efficacy scores for diabetes in a faith-based setting.

Significance

Diabetes is one of the most serious health concerns and policy agendas today (Tol, Alhani, Shojaeazadeh, Sharifirad, & Moazam, 2015), due to the substantial number of diabetes cases in the U.S. and worldwide in the past 20 years and the prediction of even larger numbers of cases by 2040. Ensuring diabetes is adequately treated and patients are given every opportunity to gain a greater knowledge of self-management skills is a top priority in health care. Chronic disease management is a major topic of conversation in the healthcare arena today. The Centers for Medicare & Medicaid Services (CMS) utilizes quality strategy guidelines to guide agency activities and ensure all facility components are working together toward a transformation for all healthcare (CMS, 2016). The CMS (2016) outline the importance of the six

goals of success they devised as strategy of prioritization, including, 1) make care safer by reducing harm caused in delivery of care, 2) strengthen persons and their families as partners in their care, 3) promote effective communication and coordination of care, 4), promote effective prevention and treatment of chronic disease, 5), work with communities to promote best practices of healthy living, and 6), make care affordable. This study aligned with the CMS goals of success by promoting effective communication and coordination of care by allowing providers and patients to share power, responsibility, goal setting, decision making and care management while promoting effective prevention and treatment of chronic disease. This study also meets the goal of working with communities to promote best practices of healthy living in a faith-based setting.

Literature Review

Diabetes is one of the most common chronic diseases with high prevalence worldwide causing this literature search to be one that initially resulted in large yields. The search began using the CINAHL database. Using search terms of diabetes mellitus, type 2 and telehealth or telemedicine or telemonitoring or tele practice or telenursing or telecare and A1c or glycosylated hemoglobin, with years of 2012-2018, yielded 73 results. The search was further focused to include English language, human randomized controlled trials, USA, and all adult, which yielded 11 viable articles. The 4 duplicates were discarded due to them being in Medline, SCOPUS and PubMed listings for a total of 7 articles for this review.

The SCOPUS search yielded 73 documents using the search headings of Diabetes Mellitus and telehealth and A1c. By adding subject areas of medicine, Nursing and Health

Professions with keywords: Human(s), Telehealth, Hemoglobin A1c, Telemedicine, Adult and major Clinical Study, country-USA and language-English, the yield was reduced to 23 documents. Those 23 documents were further reduced by 2, due to not meeting inclusion criteria of having patients in their home environment for telemonitoring. Two additional trials that were pharmacist led were also discarded which reduced the total yield to 19 and all were utilized for systematic review. The inclusion and exclusion criteria remained the same as with initial search.

The subject headings of Diabetes Mellitus AND telehealth AND A1c were utilized within the Medline/Ovid search. This search yielded 35 results. The search was further narrowed by adding publication years of 2012-2018, English as the language and randomized controlled trial, which yielded 9 results. Two of these results were duplicated on this list, which brought the total yield amount to 7 articles. All 7 articles were included in the review.

The PubMed data search was also utilized for this review. PubMed suggested three thousand two articles using the keywords Diabetes Mellitus type 2. Once the additional keyword telehealth was added the result yield was decreased to forty-eight and further adding A1c, yield was 24 articles. There were 7 duplicate articles noted in SCOPUS, Medline and CINAHL databases which were deducted to bring the total yield to 17 articles and all were used for this review.

Five randomized clinical trials were reviewed to evaluate the evidence of telehealth on clinical outcomes in adults with diabetes, including Baron, Hirani, & Newman (2017); Davis, Hitch, Salaam, Herman, Zimmer-Galler, & Mayer-Davis (2010); Greenwood, Blozis, Young,

Nesbitt, & Quinn (2015); Moattari, Hashemi & Dabbaghmanesh (2013) & Tildesley et al., (2013). In 2017, Baron, Hirani and Newman compared standard care to standard care supplemented with mobile phone-based home telehealth on A1c and quality of life among 91 insulin-requiring people with diabetes. They did not find a significant difference on A1c, but noted that mobile phone-based home telehealth had a positive effect on quality of life at 9 months. In Davis and associates' study (2010), they compared telecare versus usual care on glycated hemoglobin among a rural population. They found that telecare significantly reduced glycated hemoglobin at 6 and 12 months. Greenwood et al., (2015) compared telehealth remote monitoring intervention with usual care and evaluated A1c, Summary of Diabetes Self-Care Activities (SDSCA), Diabetes Empowerment Scale, and Diabetes Knowledge Test. They found that both the intervention and control groups lowered A1c levels, but the telehealth intervention group had significantly greater reduction in A1c than the control group (Intervention group: 1.11 reduction, usual care: 0.70 reduction, $t=2.87$, $p<0.01$). The telehealth group also significantly improved on several subscales of the SDSCA.

Moattari, Hashemi & Dabbaghmanesh (2013) conducted a randomized clinical trial comparing tele-education versus usual care on A1c among 48 insulin-dependent patients in Iran, 24 participants in the experimental group received an electronic education program for twelve weeks including consultation service, quick answers to patients' questions, contact with the healthcare team and education materials. They found significant reduction in the A1c levels at the end of the study. Tildesley et al., (2013) studied the effects of an Internet blood glucose monitoring system (IBGMS) on glycated hemoglobin levels in patients with type 2 diabetes mellitus treated with insulin. Their comparison group received real-time continuous glucose

monitoring (RT-CGM). They found both methods achieved significant A1c reductions within the 6 months study period, however, the two groups were not statistically significant.

The five studies varied on treatment modality, control condition, and sample characteristics. Overall, the evidence supports the usefulness of telehealth on improving Hgb A1c levels and other outcomes. There were no associated risks noted with either standard care or telehealth augmented care in any of the articles. Each article did however, note issues with the sample size. Greenwood et al. (2015) reported a saturation of their participant pool as one of the sample size issues they faced in their study where as Moattari, Hashemi & Dabbaghmanesh (2013) and Tildesley et al. (2013) reported attrition issues which resulted in less reliable data results. Overall, all studies had limited sample size.

In addition to the five randomized clinical trials, the authors also reviewed other studies regarding telehealth. Wayne et al., (2015) described health coaching in primary care as one of the significant benefits of patients. In a systematic review regarding the effectiveness of telehealth on diabetes care. McLean, Sheikh, Cresswell, Mukherjee, Hemmi and Paglari (2013), found that many studies showed no differences in outcomes between telehealth care and usual care. Clinical effectiveness of telehealth care interventions seemed to be greatest in patients with greatest risk of hospitalization and death and that there was even stronger evidence that telehealth care can also reduce the frequency of hospitalization.

Theoretical Foundation

Chronic disease continues to reduce quality of life in patients such as those with DM (Borji, Otaghi & Kazembiegi, (2017). Dorthea Orem's Self Care Deficit Theory was utilized as one

of the theoretical foundations of this project (Appendix 1). The other theoretical foundation being utilized for this project was the Stetler Model (Appendix 2).

Dorthea Orem's Self Care Deficit Theory is a self-care model which focuses on the patient's ability to perform self-care to maintain life, health and well-being with the nurse assisting that process through performing, leading, supporting, teaching and manipulation of an environment to enhance individual development (Shah, 2015). Orem believed, people have a natural ability for self-care and defines self-care deficit as those individuals whose self-care needs outweigh their ability to provide the needed self-care levels (Simmons, 2009). Orem's theoretical framework is rooted in Maslow's Hierarchy of Needs which will prove to be an asset here in that DM is believed to be a self-care management disease in which patients should be sufficiently responsible to take care of themselves. The main goal of self-care is to regulate the effective factors on growth and the patient's performance in relation to life, health and well being (Shah, 2015). Orem incorporates the nurse as an agent of change who teaches the patient how to solve problems and make decisions through support and nursing care that impact quality of life within chronic disease (Borji, Otaghi, & Kazembeigi, 2017). According to Borji et al., (2017), Orem's Self Care Model is noted to be one of the most complete self-care theories that provide clinical guidelines for change in self-care as a major factor in healthcare changes and is crucial for the control of DM. The fundamentals of this principle are designed to address individuals taking responsibility for their health and the health of others (Borji, Otaghi, & Kazembeigi, 2017).

The Stetler model is a process model that specifies six phases or steps in the process of translating research into practice. Since the aim of process models is used to guide the process

of instituting research into practice (Nilsen, 2015), the Stetler model is used as the evidence-based practice (EBP) guideline for this project as each phase has key components that ensure each phase contributes to all overall EBP success. The Stetler model formulates a series of critical thinking and decision-making phases which are designed to facilitate safe, effective use of research findings (Stetler, 2001). The National Collaborating Centre for Methods and Tools (2011) states, the Stetler model assists practitioners in assessing how research findings can be applied in practice through the use of critical thinking and reflective practice. This model of EBP outlines criteria to determine the desirability and feasibility of apply and study to address issues using four criteria. These criteria include substantiating evidence, current practice related to the need for change, fit of substantiating evidence for the user group and setting, feasibility of implementing the research findings with regards to risk and benefit assessment, availability of resources and stakeholder readiness. In this study, we gathered and evaluated evidence, determined that education sessions for adults with diabetes were needed in a faith-based setting, received stakeholders support, and successfully implemented the interventions.

Identifying and Defining Variables

The dependent variables in this study include diabetes self-efficacy and diabetes knowledge. Independent variables included 1) pre-post education and 2) intervention method (standard education, standard education plus tele-enhancement). Clinical variables include diagnosis of diabetes, years of diagnosis, diabetes management (insulin, pills and diet controlled) and whether or not participants recall their A1c levels. In addition, we collected demographic variables, including age, gender, and race/ethnicity. The theoretical and operational definitions are summarized in appendix C.

Method

Design

We used a pre-posttest experimental design and randomly assigned participants to a control group or intervention group to compare the effects of telehealth education in conjunction with standard education on the self-efficacy scores and diabetes knowledge for people with diabetes in a faith-based setting. This design allowed us to compare the two teaching methods. Outcomes were collected at three intervals, pre-intervention, immediately post education (2 weeks after pretest) and 3 weeks post the second education session.

Standard care education covered basic diabetes care. The care covered minimal terminology, a basic description of what causes high and low blood sugars and how to treat low blood sugars that constitute emergent situations. This education shared tips on constitutes fast acting and slow acting treatment as well as general procedures for how to self-monitor blood sugars as well as basic dietary principles, common serving sizes, sick day treatment, basic benefits of increasing exercise and how to get started with activity regimen. The diabetes education class topics were broken into two sessions and each session was about 45 minutes.

- The first class covered general diabetes information, how to check blood sugar, how often should the patient visit the care providers, dietary considerations that are important for lowering A1c levels in diabetes. This class also covered diabetic meal planning, reading food labels, low carbohydrate snacks, low-calorie vegetables, appropriate drinks for diabetes, sugar substitutes, eating on the go, carbohydrate counting and diabetes complications.

- The second class covered physical activity, exercise and foot care. This class also covered the tips for aerobic/cardio exercise, how exercise lowers blood sugars, exercise (time, frequency and intensity). It encompassed how to protect the feet, toenail care, appropriate foot ware and appropriate way to clean and inspect the feet.

The intervention group received two 45-minute standard care diabetes education classes and additional spiritual encouragement utilizing text messages or emails via the use of a telehealth modality. Text messages were sent weekly for three weeks to the cell phone numbers provided and emails were sent to the email addresses provided by the participants at the initial intake process.

After signing written consent, each participant was randomly assigned to either control group or the intervention group using a random number table by the student investigator (Appendix D). The random numbers assigned to each participant were used to identify the participants from the 1st class meeting throughout the duration of the study. All other identifiers were removed from the study records.

Interventions were delivered by the student investigator; educational classes were delivered in a classroom setting as a group class and the telehealth interventions were delivered via text messages or emails.

Sample

The target population for this project included all adults with a diagnosis of diabetes. The inclusion criteria included people who had been diagnosed with type 2 diabetes, were able to speak and understand English, and had an existing telehealth

modality to accept text messages or emails. Exclusion criteria included people with severe cognitive conditions preventing them from being able to self-report outcomes.

We used a convenience sample recruited from the eligible church members as it serves as the most common and most convenient way to select participants who meet the necessary sampling requirements for the study.

Sample size

Assuming a moderate effect size of d=0.5, with 80 % power, alpha of 0.05, for aim 1, we need 34 participants; and for aim 2, we need 64 in each group (128 total). However, due to the limitations in time scope, this pilot study aimed to have 30 participants in each group. Considering that this study lasts for 3 weeks and some of the participants dropped out before completing the data collection and assuming a 10 % drop out rate (90 % of the participants would complete the study), we attempted to recruit 30 in each group to ensure that we had 27 participants in each group who completed data collection.

Recruitment

The church leaders announced the study in their weekly services. There was an initial information session, at which time participants were given study instructions, signed the study consent, self-reported eligibility criteria and had the opportunity to ask and have all study related questions answered by the student investigator who spoke with the eligible participant in a face to face interaction. The entire recruitment process was completed by the student investigator. Once they had completed the intake process which consisted of completing the pre survey, completed the two education classes, participants were randomly assigned to one

of two groups. The intervention group received weekly text messages for three weeks and the control group without the messages. Which group the participants were assigned to was determined by chance, like flipping a coin. Both groups received the same two education classes, each 45 minutes long, covering general information, complications, diet and exercise, and treatment compliance. The two educational classes were held one week apart. Participants in the intervention group also received one text message per week for 3 weeks. Data was collected at the beginning of the first education session (baseline), immediately following the end of the second education session, and at the end of the telehealth intervention session. All participants completed the same survey three times. Each survey took approximately 10-15 minutes to complete.

Setting

The study was performed in a faith-based setting. The setting spanned over 3 church campuses with greater than 5000 members, on the east coast of the United States of America. The standard education care project setting was held in the church's classroom and the telehealth augmented spiritual encouragement was delivered via text messaging on their mobile phone or via email at the email addresses provided at the initial information session. It took approximately 2 weeks to determine project participation and to obtain the required sample size. There were two standard education sessions which were provided in a classroom setting, each 45-minutes long. The intervention participants received additional diabetes knowledge and spiritual encouragement via text messages or email.

Instrumentation/Measurements

This project utilized the following tools to record and measure study outcomes. Demographic data was collected from the participants using a questionnaire created by the student investigator. Data included the participant's age, race/ethnicity, gender, marital status and whether he/she has health care coverage. Clinical data included self-reported diagnosis of type 2 diabetes, length of diagnosis, current treatment (insulin, pills, or diet controlled), and A1c from previous health visits (if known).

The Self Efficacy for diabetes (Schmitt et al., 2013, Duprez et al., 2016) measures the participant's confidence level in being able to complete the listed tasks regularly. There are 8 items and each item was scored from 1 to 10. The score for each item was the number the participant had circled. If the participant circled two consecutive numbers the lower number was used however, if the numbers circled were not consecutive that item was not scored at all. The score for the scale was the mean of the eight items. If more than two items were not scored, data is treated as missing. Higher numbers indicate high self-efficacy. The self-efficacy tool that has been tested to be reliable and valid is useful both in practice and research (Schmitt et al., 2013 and Duprez et al., 2016).

The Michigan Diabetes Research Center has developed several instruments to measure diabetes knowledge (Duprez et al. 2016). In this study, diabetes knowledge was measured by the Patient's Diabetes Knowledge (PDK) Questionnaire (Garcia & et al. 2001). There were 24 knowledge questions, and each is scored as yes, no or don't know. The correct answer was coded as 1 and incorrect answer was coded as 0. The summary score was used in analysis. Diabetes knowledge was also measured using the Revised Michigan Diabetes Knowledge Test (MDK) (Fitzgerald et al. 2016). There are 20 items in this scale, and it contains 16 general

knowledge items for all diabetic patients and four insulin related questions designed to be answered by insulin dependent patients. For each item, the correct answer was coded as 1 and the incorrect answer was coded as 0. The summary score was used in analysis.

Data Collection Procedures

Data collection for this study took place in a faith-based church setting. All collected data was held in a password protected database. Pre-study self-efficacy scores along with pre-study diabetes knowledge scores were collected and all results were then recorded on the designated Excel collection worksheet for each study participant.

The data for this study was collected via paper and pencil surveys, and questionnaires. All survey and study paperwork were collected at the end of each class session in individual pocket folders and secured with paper clasps to decrease the opportunity for papers to be lost or mixed up. All patient identifiers were kept on the inside of the packet to maintain patient privacy and to ensure results were collected and recorded for the appropriate participants. All data paper copies were secured. They were stored in a locked file cabinet when not in use to maintain HIPAA compliance and patient confidentiality.

Randomization was utilized to categorize participants in either the standard care control group or the intervention group. All eligible participants were identified using the last three digits of randomization numbers given at the start of the study program. The study investigator was responsible for all duties within this study to include making copies, passing out material folders and all diabetes education materials, power presentations and spiritual encouragement text messages and emails.

All intervention participants were required to sign the same consent forms. Class schedules were given out at the initial class meeting to explain program rules and expectations, at which time participants signed consents to participate. All collected data was recorded on a data collection worksheet instrument and filed in a database that only the student investigator has access to. A data collection code sheet was used for each intervention participant and that was also kept in a locked the database. Each document utilized was recorded in a back up system for access in the event the system goes down or data is lost.

Data Analysis Plan

Variables were defined one at a time. Once all variables were defined, data was manually entered into the IBM SPSS system. Statistical analysis was performed using SPSS' latest version (IBM) SPSS statistical significance in study analyses. The SPSS allowed for the management of data and to calculate wide varieties of statistics and is known for being relatively easy to use and understand.

Descriptive statistics were performed to examine the study variables. Mean, standard deviation, minimum, maximum, and skewness were performed on interval/ratio level data such as age, the self-efficacy for diabetes knowledge scores. Frequency and percentages were reported for categorical variables.

We compared the demographic and clinical variables between the two intervention groups to identify potential confounders. For aim 1, whether education sessions improve participants' knowledge and self-efficacy, we used paired t-tests. For aim 2, whether telehealth education in conjunction with usual care can increase self-efficacy scores for intervention

participants when compared with control group, we used independent t-tests. For all analyses, alpha is set at 0.05.

Results

Characteristics of the Sample

A total of 63 people responded to the survey and took the classes. Among them, five were excluded because they were not sure if they had been diagnosed with diabetes. Thus, we included 58 participants in the analyses. There were 28 participants in the control group and 30 in the intervention text message group.

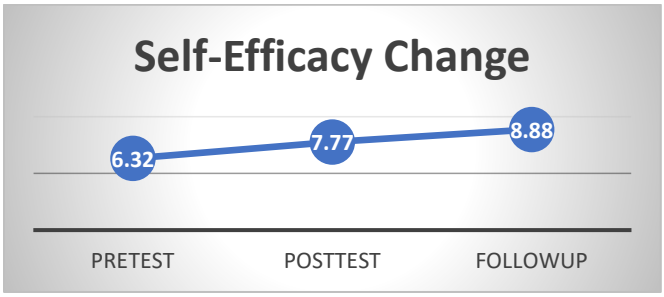
The characteristics of the sample are summarized in Appendix E, table 2. The mean age for the sample was 58.3 years, participants ranged from 31-89 years of age. Of the total participants, 19 (32.8%) were male and 50 (86.2%) were African American. There were no significant differences noted between the control and intervention group on any of the demographic and clinical variables. The results ranged from p values of 0.37 to 0.97.

Research question 1. In adults with diabetes in a faith-based setting, does education sessions improve self-efficacy and diabetes knowledge?

The mean score and change of diabetes **self-efficacy** are summarized in the following table and figure. At baseline, the mean self-efficacy score was 6.32. It improved to 7.77 immediately post the two education sessions. At the final follow up, among the 47 respondents, the score was 8.88.

Diabetes self-efficacy

	N	Mean (SD)	Min	Max
Diabetes Efficacy Pretest	58	6.32 (1.61)	2.38	9.75
Diabetes Efficacy Posttest	57	7.77 (1.68)	3.00	10.63
Diabetes Efficacy Follow-up	47	8.88 (1.59)	4.38	11.00



There was a significant difference from baseline to post-education (6.32 versus 7.77, paired t=7.68, p<0.001), and from baseline to the two-week follow up (6.32 vs. 8.88, paired t=10.09, p<0.001). The self-efficacy was also higher in the follow up than immediately post the education (7.77 vs. 8.88, t=6.58, p<0.001).

Knowledge scores were assessed before the education sessions, immediately post education, and final follow up. The following table summarized the Patient diabetes knowledge (PDK) and Michigan Diabetes Knowledge (MDK).

	n	Mean	Std. Deviation	Min.	Max.
Pretest Patient Diabetes Knowledge	58	17.45	4.79	3.00	24.00
Post Patient Diabetes Knowledge	57	21.89	2. 40	8.00	24.00
Final Patient Diabetes Knowledge	47	22.21	1.30	18.00	23.00
Pretest Michigan Diabetes Knowledge	58	12.36	3.91	3.00	18.00
Post Michigan Diabetes Knowledge	57	16.51	2.31	8.0	19.0
Final Michigan Diabetes Knowledge	48	15.75	3.19	1.00	19.00

Both knowledge scores increased from baseline to immediately after education. For PDK, paired t test showed that there were significant differences between baseline and post-education (17.45 vs. 21.89, t=6.39, p<0.001), and from baseline to follow up (17.45 vs. 22.21, t=6.38, p<0.001). The difference between post-education and follow up was not statistically significant (21.89 vs. 22.21, t=1.51, p=0.137).

For MDK, there were significant differences between baseline and post-education (12.36 vs. 16.51, t=7.38, p<0.001), and between baseline and follow up (12.36 vs. 15.75, t=5.18, p<0.001). There was no significant difference between post-education and the follow up (16.51 vs. 15.75, t=0.83, p=0.410).

Research question 2: In adults with diabetes in a faith-based setting, does telehealth education in conjunction with standard diabetic care significantly improve self-efficacy scores and diabetes knowledge compared to standard diabetic care alone?

We used independent t-test to compare the means between the two groups on the follow-up scores. The results are summarized in the follow table.

Comparison between the control and the intervention groups

	Control group	Text-message intervention group	T, p value
Diabetes self-efficacy	8.85	8.90	0.111, p=0.912
Patient diabetes knowledge	22.15	22.26	0.282, p=0.779
Michigan Diabetes Knowledge	16.05	15.52	0.567, p=0.574

For self-efficacy, the control group had a mean of 8.85 while the treatment group had a mean of 8.9. The difference was not statistically significant. For PDK, the two means were 22.15

for the control group and 22.26 for the treatment group; they were not statistically significant. For MDK, the mean for the control group was 16.05 and 15.52 for the treatment group. This was also not statistically significant.

Discussion

The current practice in many healthcare educational settings utilizes educational materials from the American Diabetes Association (ADA). Seldom does one see that education augmented with telehealth modalities that are delivered in faith-based settings. In this study, we implemented an intervention to use telehealth message to sustain participants' knowledge and self-efficacy regarding diabetes and its management. After reviewing the results of this study, there is evidence to support education being augmented by telehealth modalities however the faith-based setting did not prove to impact the learning process with any significance.

Consistent with what have been reported in the literature, we found that two education classes improved participants' knowledge and self-efficacy regarding diabetes and its managements. The self-efficacy increased from pretest (6.32), to posttest (7.77) and then to follow up in the final testing (8.88). This suggests that classes targeting patients with diabetes in church settings are highly effective. They should be adopted as a standard practice.

We found no significant differences between the telehealth augmented group versus the control group. This could be due to several reasons. First, our follow up was only 3 weeks. During that time, both groups had retained the knowledge they gained from the classes thus there was no significant differences between them. Second, it could be related to the messages

we delivered. Our messages were inspirational rather than providing further education. Should we combine the inspirational knowledge with additional education, the result could be different. Thirdly, as suggested by McLean, et al. (2013), the non-differences in outcomes between telehealth care and usual care could be due to the patient population. The benefits of telehealth care interventions were the greatest in patients with greatest risk of hospitalization and death. Where in our study, our patients were relatively healthy, and we did not measure hospitalization or emergency usage.

Limitations

The critical limitation of this study was sample size. This sample population was obtained from 2 churches of different suburban communities. A population in a more diverse setting and location would have significantly increased the generalizability of the results. There was some difficulty with buy in due to the inability to get potential participants to commit to multiple classes for the entire duration of the study. Another limitation was that the study was advertised within the church and could have resulted in stronger numbers if advertised to participants within the community that were not church members or did not attend the church regularly. It was also noted that transportation was an issue for many of the church members as they utilized the church's transportation system to attend worship but could not attend the study classes due to those same transportation issues when church transportation was not being offered. Classroom location was also a potential limitation as the classes were held in the fellowship area at the church that is usually utilized to prepare and serve food on a regular basis, utilizing that area to share healthy dishes that were prepared at the classes would have

allowed the participants the opportunity for test testing and would possibly have provided an opportunity to get more participants involved.

Another limitation was the short follow up time. Due to the timeline, we only followed patients for three weeks. A longer period of telehealth and follow up might result in more effectiveness of the telehealth intervention. Moreover, we did not measure any objective outcomes such as A1C and healthcare usage. These are critical areas that might benefits from telehealth.

Conclusion

Today healthcare utilizes many aspects to educate patients who have chronic illnesses. Telehealth is only one of those aspects, yet it is one which is in the technological forefront. As diabetes is one of the most common chronic diseases worldwide and thus impacts a great number of people, many of whom are undiagnosed, it seems one of the most promising facets of educating patients as it allows healthcare to meet them in their environment to receive care. Telehealth is an alternative modality that has in the past, proven to be a significant means of delivering care to a growing prevalence of long-term conditions. Although the results of this study showed that telehealth along with standard education did not result in an increase in self-efficacy scores and knowledge in adult patients with diabetes, that could be due to various limitations. Further research regarding the use of telehealth in faith-based settings is necessary to investigate its effectiveness in multiple outcomes including knowledge, self-efficacy, diabetes management activities, A1C and resource utilization.

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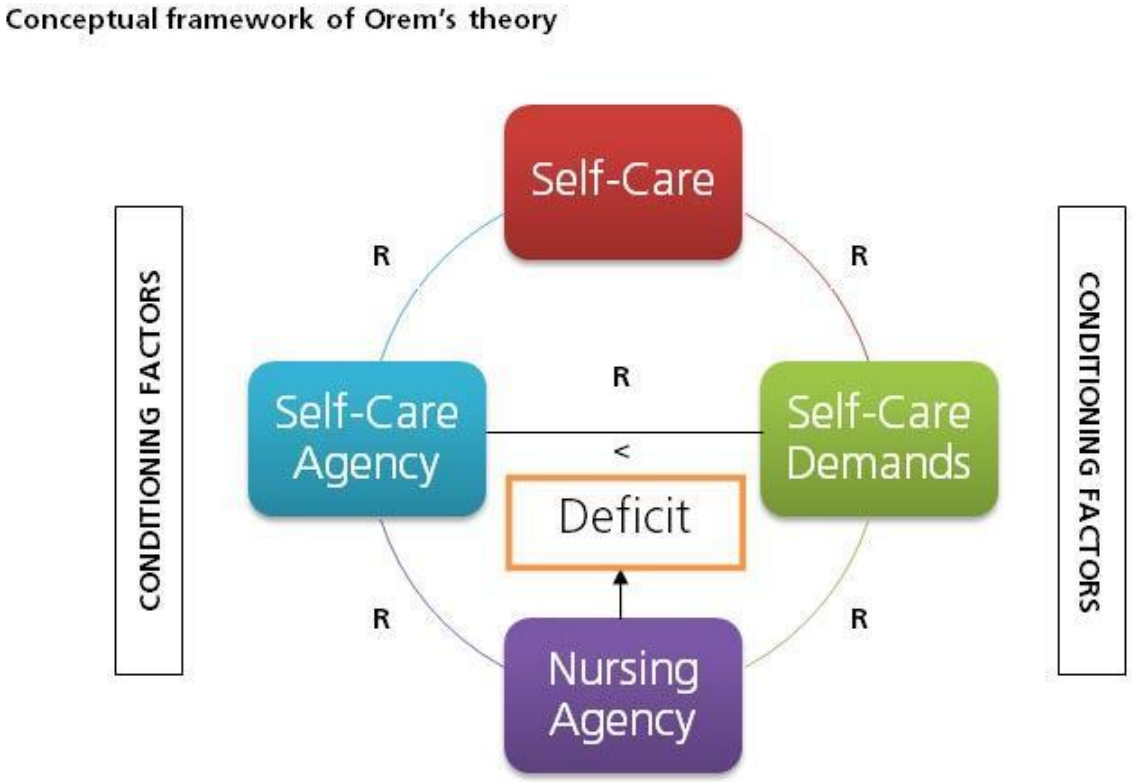
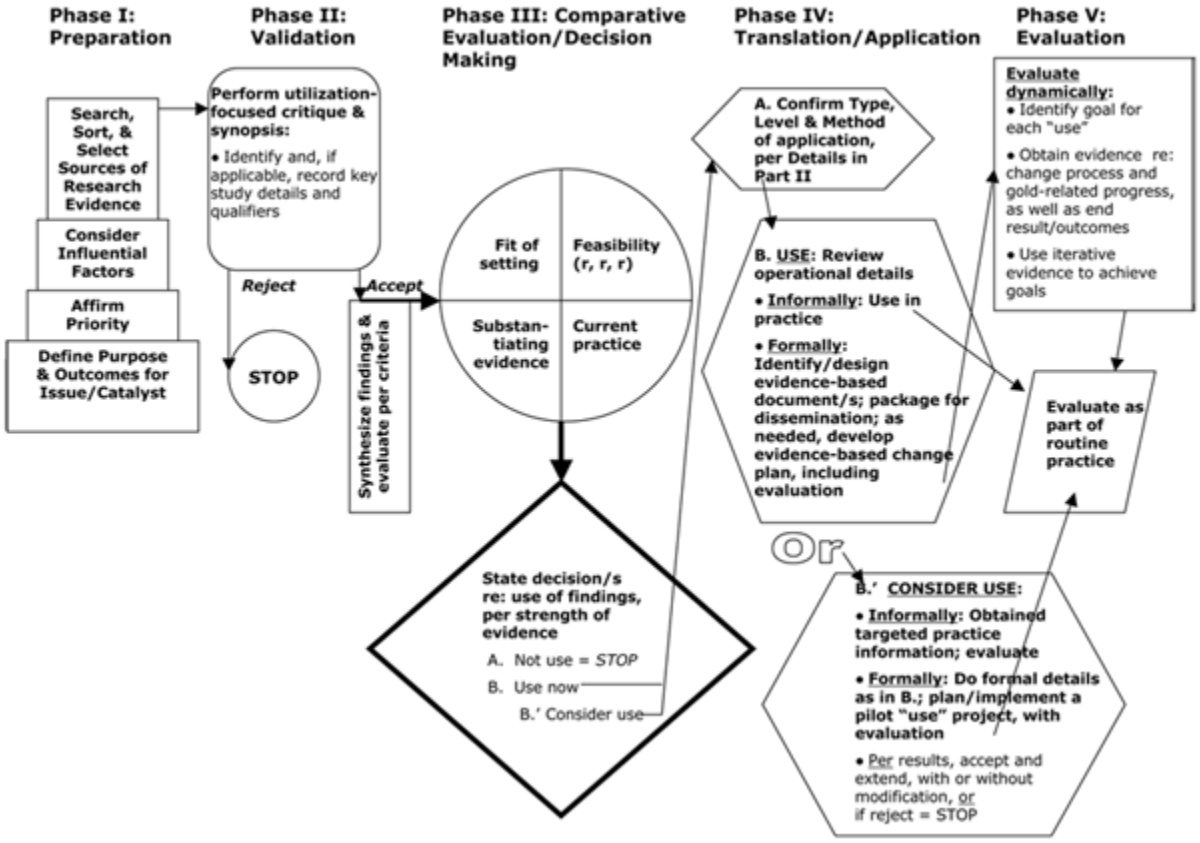
Appendix A

Figure 1. Orem's Model



Appendix B

Figure 2. Stetler's Model



Appendix C

Table 1. Definitions of Study Variables

VARIABLE	TYPE	THEORETICAL DEFINITION	OPERATIONAL DEFINITION	Need to say here if it is nominal, ordinal, etc.
Age	Demographic	Chronological age of patients enrolled in telehealth education	1 = 18 to 30.9 2 = 31 to 45.9 3 = 46 to 60.9 4 = 61 and above	Ordinal and ratio
Gender	Demographic	Patients gender identified in CPRS medical records	1 = Male 2 = Female 3 = Transgender	Nominal
Race	Demographic	Identification with population group sharing genetic or biological traits	Ethnic background 1 = African American 2 = Caucasian	Nominal
Diagnosis of Diabetes	Clinical Characteristics	Diagnosis of Diabetes listed in CPRS medical record	0 = no 1 = yes	Nominal

Whether or not knowing Hemoglobin A1c level	Dependent	Result is expressed as a number = 6.1 or greater	1 = 6.1 - 7.0 2 = 7.1 - 8.0 3 = 8.1 - 9.0 4 = greater than 9.1	Nominal (yes or no)
Education - enrollment in telehealth education program	Independent Variable	Diabetic Education delivered via telehealth	0 = no 1 = yes	Nominal
Received eduation	Independent Variable	Diabetes Education Sessions	0 = No (pretest) 1 = Yes (post test)	Nominal
Self-Efficacy	Dependent variable	The feeling of confidence in one's self-management abilities	The Self Efficacy for diabetes	Interval
Diabetes Knowledge	Dependent Variable	Knowledge about diabetes	Patient Diabetes Knowledge (PDK) Michigan Diabetes Knowledge (MDK)	Interval

Appendix D

Figure 3. Random digits Chart

Random digits

Line								
101	19223	95034	05756	28713	96409	12531	42544	82853
102	73676	47150	99400	01927	27754	42648	82425	36290
103	45467	71709	77558	00095	32863	29485	82226	90056
104	52711	38889	93074	60227	40011	85848	48767	52573
105	95592	94007	69971	91481	60779	53791	17297	59335
106	68417	35013	15529	72765	85089	57067	50211	47487
107	82739	57890	20807	47511	81676	55300	94383	14893
108	60940	72024	17868	24943	61790	90656	87964	18883
109	36009	19365	15412	39638	85453	46816	83485	41979
110	38448	48789	18338	24697	39364	42006	76688	08708
111	81486	69487	60513	09297	00412	71238	27649	39950
112	59636	88804	04634	71197	19352	73089	84898	45785
113	62568	70206	40325	03699	71080	22553	11486	11776
114	45149	32992	75730	66280	03819	56202	02938	70915
115	61041	77684	94322	24709	73698	14526	31893	32592
116	14459	26056	31424	80371	65103	62253	50490	61181
117	38167	98532	62183	70632	23417	26185	41448	75532
118	73190	32533	04470	29669	84407	90785	65956	86382
119	95857	07118	87664	92099	58806	66979	98624	84826
120	35476	55972	39421	65850	04266	35435	43742	11937
121	71487	09984	29077	14863	61683	47052	62224	51025
122	13873	81598	95052	90908	73592	75186	87136	95761
123	54580	81507	27102	56027	55892	33063	41842	81868
124	71035	09001	43367	49497	72719	96758	27611	91596
125	96746	12149	37823	71868	18442	35119	62103	39244
126	96927	19931	36089	74192	77567	88741	48409	41903
127	43909	99477	25330	64359	40085	16925	85117	36071
128	15689	14227	06565	14374	13352	49367	81982	87209
129	36759	58984	68288	22913	18638	54303	00795	08727
130	69051	64817	87174	09517	84534	06489	87201	97245
131	05007	16632	81194	14873	04197	85576	45195	96565
132	68732	55259	84292	08796	43165	93739	31685	97150
133	45740	41807	65561	33302	07051	93623	18132	09547
134	27816	78416	18329	21337	35213	37741	04312	68508
135	66925	55658	39100	78458	11206	19876	87151	31260
136	08421	44753	77377	28744	75592	08563	79140	92454
137	53645	66812	61421	47836	12609	15373	98481	14592
138	66831	68908	40772	21558	47781	33586	79177	06928
139	55588	99404	70708	41098	43563	56934	48394	51719
140	12975	13258	13048	45144	72321	81940	00360	02428
141	96767	35964	23822	96012	94591	65194	50842	53372
142	72829	50232	97892	63408	77919	44575	24870	04178
143	88565	42628	17797	49376	61762	16953	88604	12724
144	62964	88145	83083	69453	46109	59505	69680	00900
145	19687	12633	57857	95806	09931	02150	43163	58636
146	37609	59057	66967	83401	60705	02384	90597	93600
147	54973	86278	88737	74351	47500	84552	19909	67181
148	00694	05977	19664	65441	20903	62371	22725	53340
149	71546	05233	53946	68743	72460	27601	45403	88692
150	07511	88915	41267	16853	84569	79367	32337	03316

Appendix E

Table 2. Characteristics of the sample

Variable	Mean (SD) or Freq (%)	Control group	Treatment group	Statistics and p value
Age in years	58.34 (14.08), 31-89	58.32 (13.51)	58.37 (14.81)	t=0.012, p=0.99
Gender				χ^2=0.431, p=0.512
• Male	19 (32.8%)	8 (42.1%)	11 (57.9%)	
• Female	39 (67.2%)	20 (51.3%)	19 (48.7%)	
Race/Ethnicity				χ^2=0.432, p=0.511
• African American	50 (86.2%)	25 (50%)	25 (50%)	
• Other	8 (13.8%)	3 (37.5%)	5 (62.5%)	
Years of diagnosis				χ^2=2.470, p=0.481
• <1 year	18 (31.0%)	9 (50%)	9 (50%)	
• 1-5 years	22 (37.9%)	8 (36.4%)	14 (63.6%)	
• 6-10 years	10 (17.2%)	6 (60.0%)	4 (40.0%)	
• >10 years	8 (13.8%)	5 (62.5%)	3 (37.5%)	
Diabetes treatment				χ^2=1.989, p=0.370
• Insulin	18 (31.0%)	11 (61.1%)	7 (38.9%)	
• Pills	16 (27.6%)	6 (37.5%)	10 (62.5%)	
• Diet	24 (41.4%)	11 (45.8%)	13 (54.2%)	
Know A1C values				χ^2= 0.001, p=0.971
• Yes	25 (43.1%)	12 (48.0%)	13 (52.0%)	
• No	33 (56.9%)	16 (48.5%)	17 (51.5%)	
Marital status				χ^2= 0.074, p=0.786
• Not married	30 (51.75%)	15 (50%)	15 (50%)	
• Married or having a partner	28 (48.3%)	13 (46.4%)	15 (53.6%)	
Education				χ^2=0.021, p=0.885
• <= High school	15 (25.9%)	7 (46.7%)	8 (53.3%)	

• Some college or higher	43 (74.1%)	21 (48.8%)	22 (51.2%)	
Have Insurance	58 (100%)			NA*

*all participants have insurance.