Summer 2014

Utilizing the Technology Acceptance Model to Predict System Use of an Interactive Behavior Change Technology to Deliver Virtual Diabetes Health Education

Koren Sher'Keyer Goodman
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UTILIZING THE TECHNOLOGY ACCEPTANCE MODEL TO PREDICT
SYSTEM USE OF AN INTERACTIVE BEHAVIOR CHANGE TECHNOLOGY
TO DELIVER VIRTUAL DIABETES HEALTH EDUCATION

by

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A Dissertation Submitted to the Faculty of
Old Dominion University in Partial Fulfillment of the
Requirements for the Degree of

DOCTOR OF PHILOSOPHY

HEALTH SERVICES RESEARCH

OLD DOMINION UNIVERSITY
August 2014

Approved by:

Holly Gaff (Director)

Elizabeth Locke (Member)

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ABSTRACT

UTILIZING THE TECHNOLOGY ACCEPTANCE MODEL TO PREDICT SYSTEM USE OF AN INTERACTIVE BEHAVIOR CHANGE TECHNOLOGY TO DELIVER VIRTUAL DIABETES HEALTH EDUCATION

Koren Sher'Keyer Goodman
Old Dominion University, 2014
Director: Dr. Holly Gaff

Diabetes is expected to affect more than 21% of the U.S. adult population by the year 2050 (Boyle, Thompson, Gregg, Barker, & Williamson, 2010). What is important to understand about diabetes is that there are safe, effective non-pharmaceutical lifestyle modifications and pharmaceutical treatment options that can prevent and delay the onset of complications. Telehealth efforts are practical solutions increasingly used in the health services delivery model to improve self-care management practices among patients with multiple chronic conditions (Davis, Hitch, Salaam, Herman, Zimmer-Galler, & Mayer-Davis, 2010; Eng, Gustafson, Henderson, Jimison, & Patrick, 1999; Fitzner & Moss, 2013; Gruman, 2011; Lin, 1999; Noell & Glasgow, 1999).

The purpose of this study was to examine the effectiveness of the Technology Acceptance Model (TAM) as a theoretical framework to identify predictors of system use of telehealth messages among diabetes patients, aged 18-65, in a primary care setting. This study employed mixed methods methodologies; a randomized, pretest-posttest research design was used with a quantitative survey. The qualitative component evaluated the response to the participant's likelihood of using the resources provided to enhance the self-care management of diabetes. One-hundred fifty participants, aged 18-65 diagnosed with type 2 diabetes were enrolled in the study. Participants were randomized to experience seven weeks of telehealth messages on self-care behaviors or
to receive educational handouts.

Blood pressure was statistically significantly higher at baseline compared to follow-up. Findings revealed that blood pressure readings decreased at follow-up. Experimental group participants had statistically significantly lower Behavior Score Instrument scores at baseline than at two months and follow-up. In the TAM framework, intentions predict actual system use. Multivariate statistics revealed that age was a stronger predictor of actual system use. As age increased, the number of messages participants listened to increased. Results showed a statistically significant relationship existed between behavioral intention to use and actual system use. Findings suggests that the telephone as a communication medium, coupled with traditional face-to-face self-care diabetes management education offers an opportunity to reinforce effective diabetes management practices and provide an immediate intervention to engage patients on healthier lifestyle modifications to manage diabetes and reduce its associated complications.
This dissertation is dedicated to the memory of my mother, Mrs. Rose Emma McCutchen Goodman, my maternal grandmother, Mrs. Geneva Edith Scott McCutchen, and my paternal grandmother, Mrs. Rosella Lawrence Goodman, who taught me life's lessons in love, learning and laughter.

To my sister, Dr. Jewel Goodman Shepherd, who gave me advice, but allowed me to learn at my own pace; who set limits, but gave me room to grow; and who loved me unconditionally by setting an example.

To my niece, Breionna Neva'Rose, and my nephews, Dominic Sherman and Sean Albert, thank you for your patience as we helped each other remember how special "Mommy" was to us and for your enthusiasm as I completed this dissertation.

To my dad, Mr. Sherman Lee Goodman, thank you for your love, prayers, support, and encouragement. I could not have completed this degree without you Dad. Your life's lessons are my source of strength.

To Mr. Adrian L. Wright, I am forever grateful for the faith you have in me, your patience, and everything you have done to help me through this journey. Thank you for being so accepting of the time I spent completing this academic endeavor. Thank you most of all for my perfect gift as I neared the completion of this dissertation.

To my Arie Rose, you are my perfect gift and I hope that I am able to set the example for you that "in due season we shall reap, if we faint not." You've taught me that learning never ceases. You are my forever, Baby-Friend.
Many individuals supported me and contributed to the successful completion of this dissertation. I wish to thank my dissertation committee for their structure, continued support, and persistence since the inception of this research. Dr. Holly Gaff, my dissertation director and advisor, thank you for your unwavering commitment to me. You took me under your wing as a little tick and introduced me to the world of Modeling and Simulation. You’ve provided invaluable opportunities for my academic career, and I am forever grateful. Dr. Elizabeth Locke, thank you for your contributions to my academic, professional, and personal experiences. I am most appreciative of your willingness to share your wisdom when I needed it most. Dr. Ginger Watson, thank you for your invaluable expertise, feedback, and guidance. I am most appreciative of your belief in my ability to complete this degree.

I am thankful for the support from the College of Health Sciences and the Modeling and Simulation Steering Committee for fellowships and assistantships as I completed my doctoral studies. Special thanks to Dr. Deanne Shuman, the Health Services Research PhD Program Director, for your ongoing support and your continued interest in my academic success. To Dr. Stacey Plichta Kellar, thank you for your mentorship as I bridged education and health services research. To Dr. Marcie Wright and VCU’s Center on Health Disparities, thank you for your support of my intervention protocol. To Drs. Keith Newby, John W. Richards, Jr., Fred D. Davis, Mrs. Margaret Lemaster, and Mr. B. Jaie Jones, thank you for your untiring support throughout this entire experience, especially during the final stages of my dissertation. To Dr. Anthony Copeland, thank you for your continued prayers, encouragement, and spiritual guidance.

God, I thank You. Without You, this would not be.
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CHAPTER I

INTRODUCTION

Diabetes prevalence rates and costs have tripled in the U.S. over the past two decades. In 1991, 6.9 million adults were diagnosed with diabetes, with roughly 18.8 million in 2010 (Centers for Disease Control and Prevention, 2011). Diabetes is expected to affect more than 21% of the U.S. adult population by the year 2050 (Boyle, Thompson, Gregg, Barker, & Williamson, 2010). With substantial increases in prevalence rates are the expenditures related to the cost of care for diagnosed diabetes. Direct and indirect costs associated with diabetes in the U.S. were estimated at $98 billion in 1997 (American Diabetes Association, 1998) and at $245 billion in 2012 (American Diabetes Association, 2014). Of the $98 billion U.S. dollars spent in 1997, inpatient, outpatient, and medication expenditures accounted for 80% (American Diabetes Association, 1998). A 2013 American Diabetes Association report shows that 72% of 2012 costs accounted for direct expenditures. Advances in diabetes medication therapies include newer and costly drug treatments. With this shift came refined approaches to alternative forms of delivery systems for insulin and blood glucose monitoring and the adoption of technologies for surveillance and monitoring (Alexander, Sehgal, Moloney, & Stafford, 2010).

The Centers for Disease Control and Prevention (2011) reports that diabetes impacts approximately 25.8 million people in the U.S., with 7 million of that total classified as undiagnosed. What is important to understand about diabetes is that there are safe, effective non-pharmaceutical lifestyle modifications and pharmaceutical treatment options that can prevent and delay the onset of complications of diabetes. With
improved understanding and meaningful compliance by those at risk, morbidity and mortality from diabetes can be decreased - resulting in improved quality of life and lower costs (Centers for Disease Control and Prevention, 2013; Greisinger, Balkrishnan, Shenolikar, Wehmanen, Muhammad, & Champion, 2004; World Health Organization, 2013). Complications can be delayed or prevented with on-going diabetes surveillance, primary provider continuity of care, along with a proper diet, regular exercise, and when prescribed, medications (Parchman, Pugh, Noel, & Larme, 2002). Telehealth initiatives can augment service delivery as an added component to enhance the delivery of self-care patient education (Deily, Hu, Terrizzi, Chou, & Meyerhoefer, 2013; Gustafson, Robinson, Ansley, Adler, & Brennan, 1999).

Telehealth efforts are practical solutions increasingly used in the health services delivery model to improve self-care management practices among patients with multiple chronic conditions (Davis, Hitch, Salaam, Herman, Zimmer-Galler, & Mayer-Davis, 2010; Eng, Gustafson, Henderson, Jimison, & Patrick, 1999; Fitzner & Moss, 2013; Gruman, 2011; Lin, 1999; Noell & Glasgow, 1999). These applications offer solutions to improve overall health care delivery, quality of life, and clinical diabetes outcomes (Glasgow, Bull, Pietter, & Steiner, 2004; Eng et al., 1999; Noell & Glasgow, 1999; Orleans, 2004; Patrick, 2000). The purpose of the study, the problem statement, significance of the study, diabetes surveillance, an overview of telehealth initiatives, and limitations of previous research are presented in Chapter I. The chapter concludes with the definition of terms and the main research questions.

Purpose of the Study

The purpose of this study was to examine the effectiveness of the Technology
Acceptance Model (TAM) as a theoretical framework to identify predictors of system use of telehealth messages among diabetes patients, aged 18-65, in a primary care setting. Specifically, this study examined the model constructs and their impact on the acceptance of a telehealth initiative to provide education to patients managing diabetes.

Problem Statement

Diabetes was among the top 10 leading causes of death among adults aged 18-65 years in the U.S. in 2010 (Centers for Disease Control, 2013). Type 2 diabetes is of particular concern because it accounts for roughly 90% of cases (Boyle et al., 2010; Centers for Disease Control and Prevention, 2011; Long et al., 2010).

Pathology and Epidemiology of Diabetes

Diabetes is a metabolic disorder characterized by hyperglycemia or elevated levels of blood glucose as a result of an impaired or a deficient insulin process in the body. The three types of diabetes include type 1 (insulin deficiency), type 2 (insulin insufficiency), and gestational (insulin insufficiency during pregnancy) (American Diabetes Association, 2013). First line treatment for patients diagnosed with diabetes include lifestyle modifications incorporating diet and physical activity. Additional treatment therapies may include the use of pharmacological therapies.

Risk factors for diabetes include aging adults, obesity, genetic, racial or ethnic predispositions, insulin insufficiencies during pregnancy for women, pre-diabetes, lack of physical activity, and viral, autoimmune disorders. Improperly managed diabetes leads to long-term or multiple complications not limited to retinopathy, nephropathy, cardiovascular, periodontal, peripheral arterial, amputations, skin complications, and hearing loss (American Diabetes Association, 2013). Diabetes is most prevalent among
Blacks, Latinos, Native Americans, Asian Americans, Native Hawaiians, and other Pacific Islanders. In the U.S., 18.7% of non-Hispanic Blacks aged 20 years or older were diagnosed with diabetes in 2010. Prevalence rates for Hispanics were 13.8% for Puerto Ricans and 13.3% for Mexican Americans. Of the Asian American population, 8.4% of adults aged 20 years and older were diagnosed with diabetes (Centers for Disease Control and Prevention, 2011; Culica, Walton, Harker, & Prezio, 2008; Long et al., 2010). Collaborative health education efforts and preventive care practices initiated at the national, state, and local levels have reduced the progression of diabetes and increased awareness. Emphasis was placed on reducing the risk of diabetes through the implementation of culturally developed programs focused on prevention, early detection, and maintenance among those groups with higher prevalence rates (Centers for Disease Control and Prevention, 2011).

Government sponsored health insurance provides more than 60% of the costs of diabetes and diabetes related care (American Diabetes Association, 2013). Direct and indirect costs associated with diabetes in the U.S. were $174 billion in 2011, with 58 million attributed to disability, work loss, and premature death (American Diabetes Association, 2013; Centers for Disease Control and Prevention, 2013). Diabetes per-capita medical care costs in 2012 were $7,900, a 19% increase from costs in 2007. Among women, US total per-capita health expenditures in 2012 were estimated at roughly $8,331, higher compared to their male counterparts ($7,458). Total per-capita health expenditures were higher among non-Hispanic Blacks ($9,540) and women ($8,331), compared to non-Hispanic Whites ($8,101) and men ($7,458) (American Diabetes Association, 2013).
Since 2002, diabetes has been the sixth leading cause of death in Virginia. (Virginia Department of Health, 2011). In 2010, more than 531,000 Virginia adults were diagnosed with diabetes. A 2007 comprehensive report, “Diabetes in Virginia,” notes higher prevalence rates among Blacks, men, and Black men compared to other groups. According to the American Diabetes Association, an estimated 175,000 adults are living with diabetes in the Hampton Roads area of Virginia. In 2011, the Virginia Department of Health reported the diabetes prevalence rate for the Norfolk Health District rates as 10.5%.

**Diabetes Surveillance in Primary Care**

Care-management programs are coordinated partnerships that exist between the patient, the patient’s support system, the caregiver, and health care providers (Bodenheimer & Berry-Millett, 2009; Center for Health Care Strategies, Inc., 2007; Eng et al., 1999). Care management within the primary care setting offers a solution to reduce overall costs and hospital incidence rates because of ongoing chronic disease management and surveillance (Bodenheimer & Berry-Millett, 2009). These programs are designed to manage complex medical needs of patients and to improve health status more efficiently. Care management is designed to provide assistance to both the patient and the patient’s support system (Bodenheimer & Berry-Millett, 2009).

Diabetes self-management education (DSME) is defined as the facilitation of knowledge, skills, and abilities needed for the self-care of both prediabetes and diabetes (Haas, Maryniuk, Beck, Cox, Duker, Edwards, Fisher, Hanson, Kent, Kolb, McLaughlin, Orzech, Piette, Rhinehard, Rothman, Sklaroff, Tomky, & Youssef, 2012). Diabetes self-management support involves activities implemented to facilitate the management of
diabetes that supplement ongoing self-management education (Haas et al., 2012). The focus of these programs increase awareness, support decision making, and improve the patient’s clinical health processes and quality of life (Haas et al., 2012; Piette, 2007; Sanchez, 2011). Diabetes self-management support cultivates healthy environments to prevent premature mortality through active health care team partnerships which helps to reduce disease-related complications (Piette, 2007; Sanchez, 2011).

A retrospective study among 16,191 patients receiving care in 21 Houston, Texas primary clinics found that enrollment in a diabetes care management care program offering increased education about prescription therapy and lifestyle modifications reduced inpatient hospitalization stays by 16% (Greisinger et al., 2004). The study examined the predictors of subsequent hospitalization following participation in a diabetes care management program among patients with uncontrolled HbA1C levels (n=16,191; RR: 66%) in a Houston, Texas primary care network. Uncontrolled HbA1C levels for the study were levels greater than or equal to 9.6. Of 10,980 patients, 33.1% had uncontrolled HbA1c levels. The majority of patients were male (50.9%), with a mean age of 55.7 years. At least 40.6% of patients received treatment in the primary care setting only, 12.5% had a visit with a diabetes educator, and 23.5% participated in some type of care management. Multivariate analyses showed that significant predictors of inpatient hospital stays were among patients aged 40 years and younger, participation in a diabetes care management program, having a physical exam, a diagnosis of more than 5 comorbidities, and patients who were treated in a primary care setting only. Adults 65 years and older, with uncontrolled HbA1C levels and patients hospitalized the previous year were more likely to be hospitalized. Patients with more than 6 office visits were 3
times more likely (95% CI: 3.07-4.34; OR: 3.65) to have a subsequent hospital incidence (Greisinger et al., 2004).

Results revealed that patients reported making at least some of the proposed behavior changes (Greisinger et al., 2004). Patients and clinicians negotiated a specific action plan to assist in meeting objectives when establishing health behavior change goals. Participation in the educational session was associated with a reduction in inpatient stays among patients with controlled blood glucose levels. One of the limitations of the study was the minimal benefit experienced by patients with poor glycemic control. The study supports diabetes care management programs as an effective measure to address adherence regimens focused on glycemic control. These findings suggest that program components should target patients with uncontrolled HbA1c levels, those with multiple comorbidities, aging adults, and patients with multiple office visits. Among patients having some control over symptoms, coordinated and collaborative approaches were effective in meeting specific health behavior change goals (Greisinger et al., 2004).

Primary care practices play an instrumental functioning in helping patients make lifestyle modifications to reduce the complications associated with diabetes, with a leading role shifted to the individual (Gustafson et al., 1999; Kovner, Knickman, & Jonas, 2008; Sanchez, 2011). One of the goals of a DSME program is to foster environments in which individuals are empowered to understand the pathology of the disease and its related complications (Balamurugan, Ohsfeldt, Hughe, & Phillips, 2006; Philis-Tsimikas, Walker, Rivard, Talavera, Reimann, Salmon, & Araujo, 2004; Sanchez, 2011). Applications of such programs supplement the continuity of care for patients
diagnosed with diabetes. Effective communication between the healthcare provider and the patient is linked to improved clinical processes and outcomes (Greisinger et al., 2004).

**Shared Medical Appointments**

Shared medical appointments are a multidisciplinary approach designed to enhance the health delivery system of patients managing chronic diseases (Dickman, Pintz, Gold, & Kivlahan, 2012; Sanchez, 2011; Wall-Haas, 2012). Providing comprehensive patient education in a group setting is the principle on which shared medical appointments are built (Sanchez, 2011; Wall-Haas, 2012). This coordinated approach tailors interventions that are based on the standards of care to reduce disease incidence. Shared medical appointments are a sustainable effort for the facility to host group visits with emphasis placed on improving health outcomes for patients managing the chronic disease diabetes (Sanchez, 2011). Basic proficiency levels for self-management of health conditions are taught in a large group setting with multiple patients in an environment conducive to open discussions and peer support. The shared medical appointments increases productivity and efficiency, with minimal delivery costs for health care providers with limited financial resources (Dickman et al., 2012; Fotheringham, Owies, Leslie, & Owen, 2000; Sanchez, 2011; Wall-Haas, 2012;).

The shared medical appointment model is an innovative solution to challenges commonly faced in clinical encounters such as limited face-to-face time with patients managing complex health conditions (Dickman et al., 2012). A study examining clinical outcomes of pediatric patients with asthma and their caregivers (n=51; RR=76.5%) in an eastern Massachusetts non-profit medical group practice found improved patient
satisfaction and quality of care among patients using the shared medical appointment model (Wall-Haas, 2012). A four month analysis evaluated clinical encounters, health outcomes, and prescription access. Results showed the number of hospitalizations and emergency department visits following the implementation of shared medical appointments decreased. Qualitative results revealed caregivers were receptive to the overall concept because of group interactions and the availability of peer support and peer information exchanged during the large group sessions. Caregiver benefits included receiving instructions on self-monitoring and asthma triggers, early detection, monitoring, and medication administration. The findings from the study suggests shared medical appointments as an effective method in improving access, reducing risks for complications, emergency department utilization, and hospitalization incidence rates (Wall-Haas, 2012). Findings support shared medical appointments as a tool to enhance patient education and the reinforcement of self-care behaviors in diabetes management and care (Wall-Haas, 2012).

A quasi-experimental design evaluating self-management behaviors among patients diagnosed with diabetes and/or hypertension (n=37; RR=81%) seen in a free clinic found an increase in self-care behaviors and decreased values in clinical outcomes (Dickman et al., 2012). The majority of patients were Spanish speaking, female, with a mean age of 57 years. Each patient was assigned to one of three groups, Spanish-speaking, bilingual or English-speaking, during the four monthly shared medical appointments. A significant increase in physical activity (p=.016) was found among patients from baseline to follow-up. Patients self-reported positive changes in health status. The majority of patients (97%) reported meeting identified goals and would
recommend participation in shared medical appointments to members within their social support system. The findings from the study suggests shared medical appointments as an alternative solution to meet ongoing training and support needs of patients managing chronic diseases (Dickman et al., 2012).

A retrospective study evaluating the effects of group visits on clinical outcomes of diabetes care among adults (n=300; RR: 96%) in an urban family practice affiliated with a large, private university in a metropolitan city showed that the Cochran Mantel Haenszel statistic for hemoglobin concentration was statistically significant (CMH=4.6613, p=0.0309) in patients participating in group visits (Reitz, Sarfaty, Diamong, & Salzman, 2012). Of those participating in the group visit (n=52), 80.8% were Black, with 94.2% having hypertension. Patients in the comparison group (n=236) were largely Black (87.3%), with 92% having a hypertension diagnosis. The majority of patients were obese and female, with a mean age of 45 years. Patients in both groups used both oral antidiabetic medications and insulin to manage diabetes. Of 288 patients, 46% attended at least three (2.7±2.8) sessions. The results showed positive correlations between participation in group visits and clinical outcome measures. These findings suggests that group visits were associated with clinical improvements in blood pressure readings less than 140/90 mmHg (millimeters of mercury) (p=0.0455) and hemoglobin concentration levels below 7% (p=0.0309). Patients assigned to the control group were adult patients seeking services in the family medicine practice, while patients assigned to the intervention group were previous participants of a group visit. Although matched on gender, age, race/ethnicity, and zip code, the number of participants in the group visit sessions (n=52) and the comparison group (n=236) made it challenging to randomly
assign patients to respective groups. The evaluation of the impact of the group visits occurred during the initial implementation. The program's management processes and educational materials were in its infancy stages, thus creating a second limitation. Shared medical appointments may be a feasible and effective solution compared to the traditional patient encounter in the primary care setting (Trento, Passera, Tomalino, Bajardi, Pomero, Allione, Vaccari, Molinatti, & Porta, 2001). Findings from the study suggests group visits or the shared medical appointment model as an environment conducive to offering productive exchanges between the provider and the patients, along with ongoing support that enhances self-management of diabetes (Reitz et al., 2012; Trento et al., 2001; Watts, Gee, O'Day, Schaub, Lawrence, Aron, & Kirsh, 2009).

Significance of the Study

Self-management behaviors and education are vital components of diabetes care management (Duncan, Ahmed, Li, Stetson, Ruggiero, Burton, Rosenthal, & Fitzner, 2011; Norris, Lau, Smith, Schmid, & Engelgau, 2002). The key to reducing the impact of risk factors is the ability to prevent as appropriate, manage, and to provide ongoing education, training, and support (Duncan et al., 2011). Practitioners have insufficient time to monitor and treat all clinical issues surrounding diabetes, thus imposing a limit on the amount and level of diabetes education provided in a patient visit (Fitzner & Moss, 2013). Health care reform offers solutions for providers to supplement on-going diabetes education utilizing health information technologies to deliver self-care behavior messages, monitor clinical outcomes, and to transmit data. As a result, there is a shifting of knowledge of the disease and associated risk factors using multidisciplinary and patient-centered approaches (Piette, McPhee, Weinberger, Mah, & Kraemer, 1999).
The American Association of Diabetes Educators (AADE) has an established educational curriculum, the AADE7 that has been accredited by the Centers for Medicare and Medicaid Services (Duncan et al., 2011). The curriculum was designed to enhance self-management behaviors and is titled the AADE7 Self-Care Behaviors (Mulcahy, Maryniuk, Peeples, Peyrot, Tomky, Weaver, & Yarborough, 2003). The AADE7 focuses on seven measurable self-care behaviors: health eating; physical activity; medication instruction; blood glucose monitoring; problem solving; reducing complications; and psychosocial coping. This program is facilitated by its Certified Diabetes Educators (CDE), practitioners who provide structured behavior change goals to patients managing diabetes. There are an estimated 200 CDE’s and nine accredited diabetes management programs for the Commonwealth of Virginia (American Association of Diabetes Educators, 2014). Of the total number of CDE’s for Virginia, 10 are available in health care facilities to patients managing diabetes in Norfolk, Virginia (American Association of Diabetes Educators, 2014).

This study is significant because it illustrates the TAM’s ability to identify predictors of system use of technology by using a common medium form of telecommunication to reinforce good diabetes practices among those currently diagnosed. The TAM framework used in this research postulates that behavioral intention to use a new technology is an immediate determinant of behavior in the model (Davis, Bagozzi, & Warshaw, 1989; Turner, Kitchenham, Brereton, Charters, & Budgen, 2010). The characteristics of the technology directly influence perceived usefulness and perceived ease of use (Teo, 2010; Hong, Thong, Wong, & Tam, 2002). Additional categorical features such as the technology and characteristics of the user influence acceptance or
rejection of the information systems technology used to address behavior change. Just as behavior is an observed event, and is characterized as the execution of a commitment to conduct oneself in a particular manner; the actions associated with the behavior that is executed are impacted by the context in which the behavior is executed, and the time at which the behavior is performed (Fishbein & Ajzen, 2010; Ajzen, Albarracin, & Hornik, 2007; Ajzen & Fishbein, 1980).

A combination of external variables as social, economical, political, cultural, structural, and environmental conditions and challenges are essential in the willingness of the end-user to engage in technology (World Health Organization, 2013; Holden & Rada, 2011; Teo, 2011). This research examines the impact of clinical outcomes and user characteristics and their impact on the acceptance of telehealth education as a component of virtual health. The shortages in diabetes educators, the number of diabetes management programs available and preventive care barriers has resulted in the design of programs and software applications tailored to meet the needs of medically underserved communities.

**Impact of Telehealth Initiatives**

Telehealth has been used as assessments prior to and following the traditional clinical encounter, to conduct virtual visits, and to monitor and transmit clinical outcomes virtually. It has been used as a reinforcement of standards of care by providing educational messages to promote healthy lifestyle modifications and as psychosocial support for patients managing multiple chronic diseases (Eng et al., 1999; Gruman, 2011; Noell and Glasgow, 1999; Orleans, 2004; Patrick, 2000). Telehealth is increasingly used in the health care delivery model to sustain health status and functioning, improve quality
of and access to care, and to minimize costs (Gruman, 2011; Patrick, Griswold, Raab, & Intille, 2008). Research suggests telehealth methodologies as an effective method to improve metabolic control in populations that are ethnically diverse and rural (Davis et al., 2010). It is valuable because of its ability to deliver diabetes education to increase education and reduce the risk of complications experienced from a diagnosis of diabetes (Bray, Roupe, Young, Harrell, Cummings, & Whetstone, 2005; East, Krishnamurth, Freed, & Nosovitski, 2003; Gary, Turner, Bone, Yeh, Wang, Hill-Briggs, Levine, Power, Hill, Sauder, McGuire, & Brancati, 2004).

Interactive behavior change technologies (IBCT) are hardware and software computer-based applications used as electronic interventions to disseminate information on behavior change (Glasgow et al., 2004; Fotheringham & Owen, 2000; Fotheringham, Owies, Leslie, & Owen, 2000; Piette, 2007;). One of the least inexpensive forms of these technologies include telecommunication lines such as mobile or landline telephones, with more sophisticated applications utilizing virtual reality (Patrick, 2000). In primary care settings, these technologies can be used to address preventive measures and as administrative support functions (Noell and Glasgow, 1999; Orleans, 2004; Patrick, 2000).

Patients seeking care at either the Department of Veterans Affairs health care system’s patients or county clinics (n=280; RR=90%) were recruited for a randomized trial evaluating the use of a telehealth initiative to improve quality of care by having patients self-report blood glucose levels (Piette et al., 1999). The study evaluated the completion of telephone assessments by patients, the system frequency, and health status of the patient. Results showed that patients were able and willing to utilize this type of
technology to address health behavior change. An automated telephone disease management system was the technology used in the study to conduct biweekly health assessments. Patients' self-monitoring blood glucose levels were collected bi-weekly, over a 12 month period. Patients used a touch-tone telephone to respond to queries related to the management of diabetes. Queries were recorded in a human voice and inquired as to whether the patient checked blood glucose levels, the time of the last blood glucose check, and required the patient to report the test results. Questions focused on perceptions of glucose monitoring and foot care followed. Messages were translated into Spanish as needed and patients received six phone calls from the system. The majority of patients were female (59%), with a mean age of 54.5 years. Of those participating, 70% had an annual income of $10,000 or less, and 87% did not have formal education. Of the 4,141 assessments completed through the automated system, county clinic patients reported levels less frequently than Veteran's Affairs health care system's patients. Blood glucose levels were reported at least 53% of the time. Results showed that patients in lower socioeconomic status areas were receptive to interventions that deliver and collect data to monitor health status between office visits (Piette at al., 1999). One limitation of this study is that patients receiving health care services through the Veteran's Affairs health care system receive free monitoring supplies compared to the their counterparts receiving health services in a county funded system, in which costs are shifted to the individual. Medically underserved populations are adversely affected because of the inadequate access to quality healthcare (Agency for Healthcare Research and Quality, 2011; Clancy, Cope, Magruder, Huang, & Wolfman, 2003; Massey, Appel, Buchanan, & Cherrington, 2010). These findings explain reporting differences between
the two groups. The study supports automated telephone disease management systems as one cost effective strategy to improve diabetes surveillance. Findings suggest that telemedicine serves a population that would otherwise be considered geographically dispersed from quality healthcare services (Piette et al., 1999).

A one year randomized clinical trial evaluating a DSME intervention to improve adherence to ADA standards of care among patients (n=200; RR: 81%) found that linear mixed models showed improvements in glycated hemoglobin and LDL cholesterol readings in three South Carolina community health centers (Davis et al., 2010). There were no significant differences in the usual care and intervention group among gender, age, racial/ethnic make-up, and education. Both groups were majority Black/other, female, high school graduate, with a mean age of 59 years. Of the 85 patients in the intervention group, 51.3% were oral medication only, while 32.5% used both oral medication and insulin. At baseline, duration of diabetes for patients in the intervention was 8.5 years compared to the usual care group with 10.3 years. More than half of patients in the intervention group (51.9%) and the usual care group (53.3%) report yearly wages between $5,000-$14,999, with government sponsored insurance (Davis et al., 2010). The intervention included both individual and group sessions, along with interactive videoconference in which patients could participate from a remote location. A total of 13 sessions were provided to patients using two types of delivery methods, in person or using telemedicine.

The technology utilized in the study consisted of video, mobile and cellular telephones, and facsimile (Davis et al., 2010). Patients received education messages according to the guidelines outlined by the ADA (American Diabetes Association, 2013;
Davis et al., 2010). Results showed that glycated hemoglobin improved significantly in the intervention group from baseline to follow-up (9.2 ± 0.4 vs. 7.6 ± 0.5) compared to the group receiving usual care (8.7 ± 0.4 vs. 8.1 ± 0.5) through the implementation of this telehealth strategy. Compared to the usual care group, 81.2% of patients in the intervention group reported receiving an exam. One of the limitations of the study is the number of male participants. The gender ratio for the study reflected the overall population of patients seeking services at the community health center. The level of telehealth interaction between the patient and the CDE is a strength of the study because of the magnitude of change in the glycated hemoglobin levels from baseline to follow-up. Findings from the study support interactive technologies as an effective method to deliver educational messages (Davis et al., 2010; Estabrooks & Smith-Ray, 2008).

A study evaluating the efficacy of telephone follow-up as a component of a hospital based diabetes disease management program among 336 patients with diabetes found improvements in ADA standards of care for self-care behaviors (Maljanian, Grey, Staff, & Conroy, 2005). Patients received 12 weekly phone calls that reinforced diabetes education and self-care behavior skills with emphasis placed on glycemic control and the prevention of diabetes-related complications and comorbidities. Calls were recorded and delivered in English or Spanish, and message frequency was on average 5-7 minutes, with the exception of the initial call, which lasted approximately 20 minutes. The standard of care and intervention groups both received diabetes education, registered nurse visits and nutritionist visits, and coordinated care with the primary care provider. Clinical outcomes were assessed at baseline, three month, and 12 months. Of those participating, 70% were White, 53% were female, and 96% were diagnosed with type 2
diabetes, with a mean age of 58 years. The mean body mass index (BMI) of patients was 32. Patients in the intervention group complied with ADA standards of care for physician foot exams and retinal eye exams. At the three month and 12 month follow-up, the percent of patients in the intervention group having a physician foot exam increased from 83% to 90% and 70% to 82% respectively. Compared to baseline data, the three month follow-up showed a significant higher proportion of patients that adhered to the glycemic control of 7% or less (36% vs. 65%), blood glucose self-monitoring (55% vs. 86%), and the foot self-exam (36% vs. 51%). Findings from the study suggest the addition of a telephone intervention in a disease management program has the potential to improve the self-care behaviors (Maljanian et al., 2005).

A study examining the association between user characteristics and reminder modality in two Boston urban health centers to deliver reminders for cancer prevention found that 72% of participants preferred automated voice reminder messages compared to those electing short message service reminders (28%) (Greaney, Puleo, Sprunck-Harrild, Bennett, Cunningham, Gillman, Coeling, & Emmons, 2012). Behavioral interventions focused on physical activity, health food choices, meat consumption, vitamin use, and smoking. Participants self-selected the modality to receive behavior change interventions. Of those participants, 59% were female, having a mean age of 50 years. Patients married or living with a partner accounted for 65% of the sample. Predictors of preferred modality were age, comfort level with computers, internet frequency, and frequency to send/receive messages. Findings from the study support automated voice messages as an effective method to deliver behavioral change messages.
Automated Telephone Disease Management Call Duration and Frequency

Time duration for the delivery of health behavior messages using an automated system in the literature support calls that are five to ten minutes (Estabrooks & Smith-Ray, 2008); less than one minute (Estabrooks & Smith-Ray, 2008); four minutes (Friedman, Kazis, Jette, Smith, Stollerman, Torgerson, & Carey, 1996); and five to eight minutes (Piette, Weinberger, Kraemer, & McPhee, 2001). An automated telephone disease management that recorded self-monitored blood glucose readings, self-care behaviors, perceptions of diabetes care, and the utilization of recommended standards of care report outbound call duration as five to eight minutes (Piette et al., 2001).

A study evaluating the effectiveness of a computer based telecommunications system designed for monitoring, medication adherence, and blood pressure control in which patients respond to inquiries about health status showed the average time patients spent on a call was four minutes (Friedman et al., 1996). In the study, patients interacted with the system by entering self-reported blood pressure readings. The computer-controlled system reinforced the patient’s understanding of established treatment regimens and whether any adverse health outcomes were experienced as a result of the antihypertensive medications (Friedman et al., 1996).

A study evaluating the effectiveness of an automated telephone disease management system to be used as a supplemental tool for diabetes care and management found that patients between the ages of 55-64 years reported that the system was helpful and did not report any difficulties in responding to the inquiries (Piette & Mah, 1997). Patients were recruited from three California clinics. Of the total patient population (n=65), the majority were White (61.5%), married (53.1%), and were unemployed/retired
(67.2%). Patients received weekly calls over a one month period. The human voice interactive system queried information regarding symptoms or adverse health outcomes, issues experienced with glucose monitoring and foot care, diet and medication adherence and schedules. Messages were developed based on a review of the determinants of health and self-care behaviors experienced amongst patients managing diabetes. Patients had the option to self-select preventive behavioral messages. Data were stored and analyzed on the successful completion of 216 calls, as calls were placed during convenient times for the patient. Results showed that of the 71% of patients who successfully completed two or more of the optional preventive behavioral messages, 74.4% were between 55 and 64 years. Patients reported that the calls were helpful (57%) and 98% had no difficulty interacting with the system. A separate method assess patient satisfaction to evaluate the interaction of the system would have improved any bias. Findings suggests that automated telephone disease management systems are cost effective and can be used as an educational intervention to address preventive care, self-care behaviors for monitoring, and to complement health education received during the traditional patient visit (Piette & Mah, 1997).

Patients of Kaiser Permanente health clinics in a Denver metropolitan area (n=205; RR: 38%) were recruited to participate in a study evaluating the feasibility of an interactive voice response system for adults at risk for diabetes (Estabrooks & Smith-Ray, 2008). The randomized control trial included patients who participated in a 90-minute diabetes prevention class. The majority of patients were 59 years, 69% were White, and more than half were married (61%) and female (71%). Patients in the usual care group did not receive treatment after attending the 90-minute prevention class.
Intervention group participants received health behavior messages delivered once per week for 12 weeks. Of the 12 weekly calls, seven calls had a duration time of five to ten minutes, while the remaining calls were delivered at less than one minute each. The system allowed the patient to listen to optional physical activity or dietary messages that focused on goal setting for behavior change. Results showed that patients received nine of the 12 calls. Patients were more likely to listen to nutritional messages (3.9±1.8) compared to physical activity messages (1.7±1.4). The results showed that patients in the intervention group strongly agreed or agreed that the system was easy to use and encouraged a healthful diet, 77% and 73.1% respectively. Findings from the study support the use of frequent and brief health behavior messages to enhance behavior change among patients with diabetes following a health care visit with a provider (Trento et al., 2001; Estabrooks & Smith-Ray, 2008).

Limitations of Previous Research

Telehealth has been successful in transitioning from monitoring health outcomes to the transmission of clinical data and the reinforcement of the information provided in a traditional, patient face-to-face visit (Davis et al., 2010; Eng et al, 1999; Gruman, 2011; Noell and Glasgow, 1999; Orleans, 2004; Patrick, 2000;). The literature supports the application of telehealth initiatives to address the management of diabetes and to supplement treatment regimes by providing self-care behavior education. Findings do not suggest the replacement of clinical vigilance in diabetes care and management with telehealth. Research addresses the utility, cost effectiveness, and feasibility of shared medical appointment models, the effectiveness of telehealth initiatives to improve health outcomes, and the integral role of each within the patient-centered medical home
(Berger-Fiffy, 2012; Dickman et al., 2012; Fotheringham et al., 2000; Reitz et al., 2012; Sanchez, 2011; Trento et al., 2001; Wall-Haas, 2012; Watts et al., 2009). A review of literature separately addresses the integral role of telehealth messages preceding group visits, shared medical appointments, and automated voice message communication systems within the patient’s primary medical home. Limited published research is available on the implementation of a telehealth messages preceding a shared medical appointment in the primary care setting to enhance self-care management strategies and adherence to diabetes standards of care among adults, aged 18-65 years managing diabetes in primary care settings.

The application of telehealth education reinforces diabetes health practices and increases the level of knowledge retained by adults managing diabetes. There exists no research utilizing the TAM that evaluates the explanatory powers of adult provider-diagnosed with diabetes and the telehealth component of an Interactive Behavior Change Technology of telephonic self-care behavior messages as developed by the AADE. The current study asserts that interactive behavior change technologies are effective in delivering telehealth messages focused on self-care behavior messages to adult patients diagnosed with diabetes in a primary care setting.

Assumptions

This research study made the following assumptions:

1. Health care providers were board certified by the American Board of Family Medicine or the American Academy of Nurse Practitioners.

2. Health care providers comply with the standards of care established by the ADA in offering the health education component.
3. Participants’ self-reported responses are a precise description of actual behavior.

4. Clinical data entered by the health care provider and analyzed by the researcher will be accurate, unbiased, and complete.

5. Virtual health education will improve diabetes clinical outcome measures.

6. Telehealth messages delivered will improve clinical outcomes.

Definition of Terms

Actual system use. An end user’s subjective decision to utilize an information system (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989). In this study, actual system is categorized as actual system use of technology and will include the total number of messages successfully delivered to the participant and listened to in their entirety over the study period.


Ambulatory care setting. This is an entity that “provides healthcare on an outpatient basis within a large variety of healthcare settings that include but are not limited to physician offices, urgent care centers, dialysis facilities, ambulatory surgical centers, cancer clinics, imaging centers, endoscopy clinics, public health clinics, and other types of outpatient clinics” (Virginia Department of Health, 2012).

Age in years. The length of time a person has lived in complete years (United States Census Bureau, 2013).

Attitude toward using. An evaluative approach of behavior beliefs to determine the positive or negative consequence of an action (Ajzen et al., 2007; Fishbein & Ajzen,
Behavior Score Instrument (BSI). A 21-item assessment developed by the AADE used to address patient-reported self-care behaviors among healthy eating, physical activity, medication instruction, blood glucose monitoring, problem solving, reducing complications, and healthy coping.

Behavioral intention to use. The execution of a commitment to conduct oneself in a particular manner (Ajzen & Fishbein, 1980; Ajzen et al., 2007; Fishbein & Ajzen, 2010). In this study, behavioral intention to use is the participant’s likelihood to use the resources provided to enhance self-care management of diabetes.

Beliefs. Beliefs are subjective evaluations that make significant contributions in the intention to perform a behavior (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975).

Blood pressure. Blood pressure is “the force of blood against artery walls as it circulates through the body measured by systolic and diastolic numbers. Systolic is the number that represents the pressure in blood vessels when the heart beats. Diastolic is the number that represents the pressure in the vessels when the heart rests between beats.” (Centers for Disease Control and Prevention, 2013). The three categories include: normal (systolic is less than 120 mmHg, diastolic is less than 80mmHg); at risk (systolic range is 120-139mmHg, diastolic range is 80-89mmHg); and high (systolic range is 140 mmHg or higher; diastolic range is 90mmHg or higher). In this study, blood pressure is operationalized as systolic blood pressure reading and diastolic blood pressure reading.

Body mass index (BMI). A population assessment method used to compare a patient’s weight status to that of the general public (National Heart, Lung, and Blood Institute, 1998). The calculation, developed by the CDC, is based on a formula using
only height and weight.

**Clinical outcomes.** In this study, clinical outcomes is operationalized as the clinical readings for A1C, systolic blood pressure reading, diastolic blood pressure reading, weight, height, and BMI.

**Data collection site.** A physician-owned facility providing health care services in which the physician has sole ownership or an investment interest.

**Diabetes.** A metabolic disorder characterized by hyperglycemia or elevated levels of blood glucose as a result of an impaired or a deficient insulin process in the body. The three types of diabetes include type 1 (insulin deficiency), type 2 (insulin insufficiency), and gestational (insulin insufficiency during pregnancy) (American Diabetes Association, 2013). In this study, diabetes is a health provider diagnosis of type 1 or type 2.

**End-users.** Consumers of the final products and applications developed by computer software and hardware developers (Cotterman, Kumar, & Zmud, 1989; Tarafdar, Tu, & Ragu-Nathan, 2010). In this study, the end-user is the patient diagnosed with type 1 or type 2 diabetes.

**External variables.** Foundational principles that help shape beliefs as they relate to attitudes and subjective norms (Fishbein & Ajzen, 2010). In this study, external variables are clinical outcomes (A1C, systolic and diastolic blood pressure readings, weight, height, BMI) and user characteristics (age, gender, marital status, insurance status, type of insurance, and race).

**Health center.** “Community-based and patient-directed organizations that serve populations with limited access to health care” (Health Resources and Services
**Height.** Measurement from the patient's head to foot in feet and/or inches.

**Insurance status.** Coverage by a health plan as either private (non-government) or government-sponsored. Private (non-government) coverage would include employment-based, own employment-based, and direct purchase health insurance (United States Census Bureau, 2013).

**Interactive Behavior Change Technologies (IBCT).** Hardware and software computer-based applications used as electronic interventions to disseminate information on behavior change (Fotheringham & Owen, 2000; Fotheringham et al., 2000; Glasgow et al., 2004; Piette, 2007). In this study, IBCT is the mobile or landline telephone and the software installed that delivers diabetes self-care education to participants.

**Marital status.** Categorized into four groups identified as never married, married, widowed, and divorced (United States Census Bureau, 2013).

**Medical home.** This is “not simply as a place but as a model of the organization of primary care that delivers the core functions of primary health care” (Agency for Healthcare Research and Quality, 2011). In this study, the medical home is the virtual and integrated model of care designed to increase continuity of health care for patients among a team of health care professionals that offers comprehensive and continuous patient centered care. The medical home will be the physician-owned primary care practice.

**Perceived usefulness.** The end-users’ subjective evaluation regarding the impact of the resources provided to enhance self-care management of diabetes. In this study, perceived usefulness is operationalized as the System Usability Scale score. The system
usability scale assesses the patient’s perceptions of the system’s use.

**Perceived ease of use.** The end-user’s perception of the level of comfort in which minimal effort is required (Davis, Bagozzi, & Warshaw, 1989).

**Shared medical appointment.** A multidisciplinary approach in which basic proficiency levels for self-management of health conditions are taught in a large group setting with multiple patients in an environment conducive to open discussions and peer support (Dickman et al., 2012; Fotheringham et al., 2000; Sanchez, 2011; Wall-Haas, 2012).

**Race.** The “racial and national origin or sociocultural groups recognized in the United States” (United States Census Bureau, 2013). In this study, race will be categorized as White, Black, American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander.

**Sex.** Classification is based on self-identification by gender, either male or female. (United States Census Bureau, 2013). In this study, sex will be categorized as gender, female or male.

**Subjective norms.** Perceptions of what is largely considered socially acceptable. (Fishbein & Ajzen, 2010; Latimer & Ginis, 2005).

**Telehealth.** “The use of electronic information and telecommunications technologies to support long-distance clinical health care, public health, and health administration” (Health Resources and Services Administration, 2013). In this study, telehealth is the method by which the AADE7’s self-care behavior messages will be delivered.

**Telemedicine.** Telemedicine is the application of telecommunication technology
used to enhance health promotion and the delivery of health care education (Lin, 1999).

**Type of insurance.** Government-sponsored health insurance includes Medicaid, Medicare, Children’s Health Insurance, Military health care, state-specific plans, and the Indian health service (United States Census Bureau, 2013). In this study, insurance status includes currently insured as private coverage or government-sponsored coverage.

**User characteristics.** Characteristics that encompasses individual differences. In this study, user characteristics include age, gender, marital status, insurance status, type of insurance, and race.

**Weight.** The mass of the patient’s body in total number of pounds.

**Zip Code.** The self-reported city of residence where the patient resides.

**Research Questions**

1. To what extent does the Technology Acceptance Model identify predictors of system use of telehealth messages?

2. Are there statistically significant differences between patients who received telehealth messages and those in a routine care group on clinical outcomes of A1C, blood pressure, body mass index, and weight at baseline and follow-up?

3. Are there statistically significant differences between patients who received telehealth messages and those in a routine care group on patients’ self-care management of diabetes as measured by the Behavior Score Instrument over time?

**Construct Research Questions**

1. Is there a statistically significant relationship between change in clinical outcomes and actual system use?
2. Is there a statistically significant relationship between user characteristics and actual system use?

3. Is there a statistically significant relationship between perceived usefulness and behavioral intention to use?

4. Is there a statistically significant relationship between behavioral intention to use and actual system use?

5. Is there a statistically significant relationship between perceived usefulness and actual system use?

6. What combination of variables contributes to changes in clinical values?

Chapter II presents an extensive literature review on the Technology Acceptance Model as the theoretical framework used in this research.
CHAPTER II
REVIEW OF LITERATURE

Chapter II conceptualizes the Technology Acceptance Model and its implications for utilization in this research. The chapter opens with the theoretical development, followed by an extensive literature review on each of the constructs in the theoretical framework. Chapter II concludes with a discussion on the shift in health care delivery, community health centers, ambulatory facilities, and physician-owned practices.

Theoretical Development

Fishbein and Ajzen conceptualized a framework in 1975 to examine the relationship between beliefs, attitudes, intentions, and behaviors (Fishbein & Ajzen, 1975; I. Ajzen, personal communication, October, 17, 2011). Figure 1 depicts the history of the theoretical development. The conceptualized framework is shown in Figure 2. This framework suggests that consequences associated with a particular behavior are evaluated (Fishbein & Ajzen, 1975). This model was later referred to as the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980; I. Ajzen, personal communication, October, 17, 2011).

<table>
<thead>
<tr>
<th>Theoretical Framework</th>
<th>Authors</th>
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<tr>
<td>Fishbein &amp; Ajzen’s Conceptualized Framework</td>
<td>Fishbein &amp; Ajzen, 1975</td>
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<tr>
<td>Theory of Reasoned Action (TRA)</td>
<td>Ajzen and Fishbein, 1980</td>
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<td>The Theory of Planned Behavior (TPB)</td>
<td>Ajzen, 1985</td>
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<tr>
<td>Technology Acceptance Model (TAM)</td>
<td>Davis, Bagozzi, &amp; Warshaw, 1989</td>
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The TRA examines the relationship between beliefs, attitudes, intentions, and behaviors
The model has six constructs: beliefs about consequences of behavior, normative beliefs about behavior, attitude toward the behavior, subjective norm, intention to perform behavior, and the outcome behavior. A central tenet of TRA suggests that attitude and subjective norm are conscious when an individual evaluates the cost and benefits of performing a certain behavior (Henry, Shtivelband, Comello, & Slater, 2011; Poss, 2001).

Figure 2. Fishbein and Ajzen's Conceptualized Framework

![Figure 2. Fishbein and Ajzen's Conceptualized Framework](image)


The TRA model was designed to address behaviors that are not under complete volitional control (Ajzen, Albarracin, & Hornik, 2007; Ajzen, 2001). The TRA has been modified
since its inception and has emerged over the years as the Theory of Planned Behavior (TPB) (Ajzen, Albarracin, & Hornik, 2007). The TPB postulates that behavior is deliberate and planned and added the construct perceived behavioral control.

The Technology Acceptance Model (TAM) is an extension of the TRA and was developed to predict and explain information system usage among end-users (Davis, Bagozzi, & Warshaw, 1989). The present study assessed effectiveness of the TAM as a theoretical framework to identify predictors of system use of telehealth messages among diabetes patients in a primary care setting. The TAM is shown in Figure 3.

**Figure 3. The Technology Acceptance Model**

The TAM asserts there are factors that contribute to an end-user's interaction, behavioral intention to use, acceptance, utilization, and adoption or rejection of a new technology (Davis, Bagozzi, & Warshaw, 1989; Venkatesh & Davis, 2000). There are six constructs in the Technology Acceptance Model. These constructs are external variables, perceived usefulness, perceived ease of use, attitude toward using, behavioral intention to use, and actual system use. The TAM framework explores factors that predict and explain end-user acceptance and adoption of a new technology (Davis, Bagozzi, & Warshaw, 1989). The model suggests that intention and acceptance of technology are mediated by perceived ease of use and perceived usefulness (Davis, Bagozzi, & Warshaw, 1989).

The TAM framework has been modified since it was originally introduced to include two iterations, with additional constructs. Research efforts have been able to trace the impact of system features and characteristics of the user on technology acceptance behaviors (Davis, Bagozzi, & Warshaw, 1989). The utility of the TAM framework has been tested to examine consciously intended human behavior in a variety of settings such as the diffusion of a new technology in corporations (Agarwal & Prasad, 1999; Amoako-Gyampah, 2007; Davis, 1993; Igbaria, Zinatelli, Cragg, & Cavaye, 1997); web-based course management use among college students (Sivo & Pan, 2005); physician acceptance of a computerized order entry system (Paré et al., 2006); intention to use a computer (Davis, Bagozzi, & Warshaw, 1989); internet use (Porter & Donthu, 2006); intention to vaccinate, integrate tobacco education, and provide Medicare therapy management services (Askelson, Campo, & Lowe, 2010; Heath & Crowell, 2007; Herbert, Urmie, Newland, & Farris, 2006); and acceptance of a data sharing system (Hu,
Chen, Hu, Larson, & Butierez, 2011). A central tenet of the TAM suggests that the user's acceptance or rejection of a new technology can be traced to the impact of external variables, perceptions of use and ease, attitude, and behavioral intention on actual system use. The TAM framework was chosen because of its applicability to theoretically predict and synthesize factors that contribute to an end-user's acceptance of new technologies (Davis, Bagozzi, & Warshaw, 1989). The TAM was modified for the present study to examine the effectiveness of the framework to identify predictors of system use of telehealth messages among adult diabetes patients, aged 18-65 in a primary care setting (Figure 4). Adaptations included adding the words "of technology" to the constructs perceived usefulness and actual system use. The word "technology" was added to the construct behavioral intention to use. Modifications of the construct titles reflect technology management and information systems utilization.

**External variables.** External variables are incorporated into the TAM model to better evaluate the effect of background factors on perceived usefulness and perceived ease of use (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989). The inclusion and identification of external variables is dependent upon the features of the technology and the research setting (Teo, 2010). Applications of the TAM framework in the literature has categorized external variables as social influences and voluntariness (Wu & Lederer, 2009); system and user characteristics (Chen, Yang, Tang, Huang, & Yu, 2008; Davis, Bagozzi, & Warshaw, 1989; Venkatesh & Davis, 2000); internet and organizational factors (Chen et al., 2008); individual differences (Agarwal & Prasad, 1999); environmental and technical factors (Teo, 2010); social, cognitive, and development processes (Venkatesh & Davis, 2000); self-efficacy (Igbaria & Iivari, 1995); computer self-efficacy and subjective norms (Pan, Sivo, Gunter, & Cornell, 2005); end user training (Davis, Bagozzi, & Warshaw, 1989; Venkatesh, 2000). External variables in this study are described as user characteristics (Chen et al., 2008; Davis, Bagozzi, & Warshaw, 1989; Wu & Lederer, 2009) and clinical outcomes.

A study evaluating user and system characteristics and attitudes about a web-based course management system among undergraduate engineering and psychology students (n=460; RR=82.1%) showed that normative influences had a stronger impact on perceptions of use and attitudes (Sivo & Pan, 2005). The subjects responded to a 21-item, seven point Likert scale survey online. The questionnaire measured attitude toward the web-based course management system, subjective norms, and perceptions of relative ease and usefulness. Subjective norms were the external variable in the study. Study results show that subjective norms had a stronger effect on perceived usefulness and
perceived ease of use for both undergraduate engineering and psychology students. Findings suggest that the referent groups had a direct effect on the student’s utility of the system and overall acceptance of the web-based course management system. This study implies that faculty members mediated and exerted more influence regarding the utility and usability of the web-based course management system use among engineering students (Sivo & Pan, 2005).

A study evaluating individual differences and the diffusion of a new technology among employees of a Midwest Fortune 100 corporation (n=468; RR=49%) showed that the model explained roughly 57% of the variability in perceived usefulness (Agarwal & Prasad, 1999). The researcher-developed survey instrument used a seven point Likert scale that ranged from strongly disagree and strongly agree to measure responses to items. The independent variables in the study were perceptions of usefulness, ease of use, attitudes, intentions, individual differences, prior experience with technology, workforce tenure, education, prior or similar experiences, and participation in training. Study results showed that 18% of the variability in perceived ease of use was explained by the external variables in the study. Information system users or providers with at least a baccalaureate degree, having prior experience were significant determinants of the technology’s relative ease of use. Findings suggested that training is significantly associated with relative ease of use. Employees participating in training perceived an enhanced work performance with the implementation of the new system (Agarwal & Prasad, 1999).

User characteristics. A study evaluating behavioral intention toward web-based learning among 202 public health nurses in Taiwan health centers found that 91%
favored this modality of continuing education (Chen et al., 2008). External variables in the study were user characteristics, internet access factors, and organizational factors. Age, education, years of work experience, employment status, computer competency, and previous experiences using web-based learning were included within each user characteristic category. Participants responded to computer competency using 26 items, on a five point Likert scale that ranged from 1 (incapable) to 5 (very proficient). The majority of participants were between 30 and 49 years (73%), college graduate (69%), and were registered nurses (72%). Multivariate analyses showed that user characteristics such as age, education, years of work experience, employment status, and previous web-based learning experiences did not have a significant effect on perceived usefulness and perceived ease of use. A linear regression model revealed that computer competence had a significant effect on the construct perceived usefulness and internet access had a significant effect on the construct perceived ease of use. Findings from the study suggest that such demographic user characteristics as age and education did not impact behavioral intention toward web-based learning (Chen et al., 2008).

**Age.** A study evaluating telephone usage among 609 older adults living in New York, California, and northern Florida found that 86% of participants reported daily telephone use (Mann, Belchior, Tomita, & Kemp, 2005). The majority were women (68%), self-reporting a not married status (59%), with a mean age of 74 years. At least one telephone was located in the home of the participating adult. Among those participating, the top three reasons for telephone usage included social contacts, medical appointments, and refilling prescriptions. Results showed that 90.3% of older adults with touch-tone phones reported a very important status when asked if the telephone was an
important device. Forty-six percent of participants responded yes when asked whether they had time to get to the phone when receiving a telephone call. Findings of the study support the utilization of the standard telephone for the adult population as a telehealth avenue to deliver health information to help monitor health status (Mann et al., 2005).

A study examining factors associated with internet information seeking behavior among patients with multiple sclerosis (MS) (n=1000; RR: 41%) found that the regression model including the demographic variables roughly explained 29% of the variance (Bishop, Frain, Espinosa, & Stenhoff, 2009). The demographic variables in the study included age, gender, ethnicity, marital status, education, employment status, and income. Of those participating, 65% were married, 84% were female, with more than 98% as high school graduates. Bivariate correlations showed that internet use was associated with age, age at onset, gender, marital status, education, employment status, and duration of MS. Age, marital status, and employment status were among the strongest demographic variables that significantly predicted use. Multivariate models showed that compared to participants aged 60 and over, adults aged 30-40 years were 21 times more likely to report the internet as the primary source for information. A logistic regression model revealed that married adults were 3 times as likely to use the internet as their information source. Findings showed that among demographic characteristics, age was the most significant (p < 0.001). This suggests the aging population is reluctant to rely on the internet as the primary modality to obtaining MS information. Those extremely unlikely to use the internet as a primary source of information related to MS were adults, aged 50 years and over, with less than a college education, having an MS onset of more than 10 years (Bishop et al., 2009).
**Gender.** Research has shown that females are active participants in health care utilization, thus allowing the health care practitioner to provide aggressive care management (Bertakis, Azari, Helms, Callahan, & Robbins, 2000; Song, Chang, Manheim, & Dunlop, 2006). A study examining gender differences within health care services utilization and associated charges of care among new patients at a university medical center (n=956; RR: 53%) found that women had higher primary care, specialty care, emergency treatment, diagnostic services, and annual total charges (Bertakis et al., 2000). While there were no significant differences in mean age and ethnicity, females had lower mean education and income compared to their male counterparts. Student t tests assessed gender differences and found that females had a higher number of primary care visits (Bertakis et al., 2000).

**Marital status.** Black Americans are at a greater risk of the development and increased risks of premature mortality because of such chronic diseases as hypertension, coronary heart disease, and diabetes. Research has shown a link between marriage and improved health outcomes (Koball, Moiduddin, Henderson, Goesling, & Besculides, 2010; Schwandt, Coresh & Hindin, 2010). Data from the 1987-1989 and 1990-1992 African American Atherosclerosis Risk in Communities (ARIC) cohort were analyzed to examine the relationship between marital status on hypertension, coronary heart disease, and diabetes among adults (n=3,425) from two communities in the U.S. from North Carolina and Mississippi (Schwandt et al., 2010). An analysis occurred every 3 years from 1987-1998. At baseline the majority were married (64%), high school graduate (60%) with a mean age of 53 years. Results showed that married participants were overall healthier, older, had lower BMI scores, and self-reported a non-smoker status. At
visit 2, married women were less likely to have hypertension compared to single women. Compared to women who remained married at visit 2, the diabetes incidence and mortality rates were more prevalent amongst women who remained single. Males remaining single at visit 2 had an increased risk of mortality compared to married males. Limitations of the study include the omission of marital duration and a marital status category for cohabitation. Findings of the study suggest that although marital status was not the single predictor of chronic disease incidence, married individuals were less likely to develop hypertension, coronary heart disease, and diabetes and had lower mortality risks (Schwandt et al., 2010).

**Insurance status.** A retrospective study using National Hospital Ambulatory Medical Survey Data between 1999-2008 found patients with private insurance were less likely to be diagnosed with an illness compared to those with public insurance (Mannix, Stack, & Chiang, 2012). Correlations between insurance status and care patterns were examined among 178,276 ED visits in adults aged 19-64 years, using private insurance, Medicaid, and no insurance. Medicare recipients were excluded. Public insurance, Medicaid, recipients were majority aged 19-45 years (71%) and female (68%). Multivariate models showed that those patients with private insurance were more likely to receive tests, medication, and undergo medical procedures compared to those with public insurance. The results showed that patients with public insurance were more likely to be diagnosed with a significant illness compared to patients with private insurance. Findings from the study suggest that insurance status impacts clinical decision making (Mannix et al., 2012).

**Race.** A studying examining physicians’ perceptions found that among post-
angiogram encounters (n=842; RR: 73%) in New York State hospitals, race and socio-economic status impacted perceptions (van Ryn & Burke, 2000). Of the encounters, 53% were male, 43% were Black, with a mean age of 65 years. Of 143 physicians, 88% were cardiologists, with a mean age of 45 years. Race was recorded as either White or Black. A 24-item questionnaire assessed physician perceptions and attitudes toward patients using Likert-type responses on physicians' perceptions of patients' abilities and personality characteristics, physicians' feeling of affiliation toward the patient, and perceived behavioral likelihoods and role demands. Results of the study showed that race was associated with the physician's perceptions of the patient's level of intelligence, feelings of affiliation, and the patient's likelihood of adhering to medical advice. Compared to their White counterparts, Black patients were less likely to comply with treatment regimes and rehabilitation. These results showed that other culture factors may contribute to the patient's non-compliance with treatment regimens. Findings of the study suggest the development of culturally appropriate interventions to address treatment regimens (van Ryn & Burke, 2000).

**Perceived usefulness.** A study examining the psychological ownership of acceptance of a computerized order entry system among physicians in Canadian clinics (n=125; RR: 72.8%) showed that the linear regression model explained roughly 55% of the variability in system use (Paré et al., 2006). The researcher-developed survey instrument used a 10 point Likert scale to measure responses to items. The responses categories ranged from strongly disagree to strongly agree. The independent variables were system use, attitudes, perceptions of usefulness and relative ease, psychological ownership, communication, hands-on activities, and overall responsibility. The mail
survey measured participants' perceptions of usefulness, ease of use, attitudes toward, participation, responsibility, and interaction with the system. The computerized order entry system was designed to improve patient data sharing among physicians. Subjects had 11 or more years of medical experience and spent an average of seven hours (7.5±10.6) using the system per week. Study results showed that perceived usefulness had a significant effect on attitudes and system use. A multivariate analysis showed that perceptions of the system’s usefulness and relative ease explained roughly 78% of the variability in the formation of attitudes toward acceptance. Physician’s perception of the system’s usefulness was a stronger predictor of intention to adopt the computerized order entry system. Ownership and perceptions of relative ease had a direct effect on physicians’ perception that implemented entry system would improve performance. Psychological ownership and perceived ease of use explained roughly 76% of the variability in perceived usefulness. Findings suggested that one will employ a particular technology if the utility enhances and improves personal performance, self-assessment, self-continuity, self-efficacy, and control (Paré et al., 2006).

A study examining the acceptance or rejection of a new technology software system among professional- and managerial-level employees of a corporation based in North America (n=120, RR: 93.3%) showed that the linear regression model explained roughly 37% of the variability in actual system use (Davis, 1993). The researcher-developed tool used a seven point semantic scale to measure responses to items focused on the subjects’ perceptions of usefulness and relative ease, attitudes toward using the system, and actual use of the current system. Inclusion criteria were former and direct experience with the objects of interest which were an electronic mail system and a text
editor. Multivariate models showed that perceived usefulness had a significant effect on attitude. Perceived usefulness and perceived ease of use explained 55% of the variability in attitude toward system use. Perceived usefulness was a stronger predictor in employees' attitude and actual system use. Findings suggested that perceptions about improved performance impacted actual system use (Davis, 1993).

Factors that impact the perception of perceived usefulness, actual system usage, and the end-user's intention to use a system can define effectual usage and affect decision making. System implementation is a very lengthy and costly software technology adoption to a corporation (Amoako-Gyampah, 2007). A study evaluating factors affecting adoption of a currently operating software system among end-users (n=1,562; RR=37%) showed that the model explained roughly 25% of the variability in behavioral intention and 67% of the variability in perceived usefulness (Amoako-Gyampah, 2007). Participants represented both corporate and field level positions in a global healthcare corporation. The researcher-developed survey instrument used both a six point and a seven point Likert scale that ranged from 1 (agree) to 7 (disagree), 1 (frequently) to 7 (infrequently), 1 (very useful) to 7 (useless) and 1 (not at all) to 6 (very much) to measure item responses. The independent variables were behavioral intention, ease of use, intrinsic involvement, prior usage, perceived usefulness, situational involvement, and argument for change. The implemented software manages such corporate functions as finance management, human resources administration, manufacturing processes, materials procurement, and productivity. Multivariate analyses showed that behavioral intention is directly impacted by the construct perceived usefulness. This suggests perceived usefulness of the technology had a positive effect on the behavioral intention to
use the system. Findings suggested that perceptions of usefulness have a greater impact on behavior intention than does relative use of the technology (Amoako-Gyampah, 2007).

**Perceived ease of use.** Perceived ease of use is a significant predictor in behavior intention and attitude in the TAM framework (Davis, Bagozzi, & Warshaw, 1989). A study evaluating intention to use a computer among managers in a manufacturing firm located in the southwest region of the United States (n=172, RR: 54%) showed that the model explained roughly 38% of the variance in behavioral intention to use (Fagan, Neill, & Wooldridge, 2008). The researcher-developed survey instrument used a five point Likert scale to measures responses to perceived enjoyment, usefulness, ease of use, and behavioral intention relating to the use of computers. Response categories ranged from 1 (strongly agree) to 5 (strongly disagree). Study results showed a statistically significant and positive relationship between perceived ease of use and behavioral intention. A multivariate analysis explained roughly 39% of the variability in perceived ease of use. Findings suggested that perceived ease of use had a significant positive relationship with behavioral intention to use the technology and perceived usefulness (Fagan et al., 2008).

A study evaluating computer technology acceptance among employees of small manufacturing firms in New Zealand (n=596; RR:60%) showed that the model explained roughly 52% of the variability in actual system use (Igbaria et al., 1997). Of 596 study participants, 358 responded to the five to six point Likert scale survey. The mail survey measured participants’ acceptance, usage, perceived usefulness, relative ease, intra- and extra- organizational factors relating to technology acceptance on a five point Likert scale. Response items ranged from 1 (strongly disagree) to 5 (strongly agree). Study
results show that perceived ease of use had a significant effect on perceived usefulness in mediating computer acceptance among employees. Perceived ease of use explained roughly 81% of the variability in computer acceptance. A significant finding in this study is the relationship between the constructs perceived ease of use and perceived usefulness. External training had a positive direct effect on perceived ease of use and perceived system usage. Findings suggested that user friendly technologies that required little or minimal effort to operate were adopted when end-users had been in receipt of external computing support and training (Igbaria et al., 1997).

A study exploring factors predicting usage and adoption of Google Scholar among University of Minnesota graduate students (n=9,998; RR=11.4%) showed that the model explained roughly 64.5% of the variability in intended use (Cothran, 2011). The online survey measured participants' perceived usefulness, perceived ease of use, satisfaction, subjective norms, and intended use relating to Google Scholar's accessibility, quality, and comprehensiveness. Response category items ranged from 1 (strongly disagree) to 5 (strongly agree). Linear regression analyses showed that perceived ease of use was a significant determinant of intended use, perceived usefulness, and system satisfaction (p<0.001). Perceived ease of use of use explained roughly 28.5% of the variability in system satisfaction. This suggests relative ease of the academic search engine was influenced by the student's overall satisfaction. Perceptions of ease were a significant determinant in the usefulness of Google Scholar. The variability in perceived usefulness (55.7%) is explained by subjective norm, comprehensiveness, and perceived ease of use combined. System quality and accessibility accounted for 55.1% of the variability in perceived ease of use. Findings suggested that relative ease of a system
correlates with perceptions of the system's usefulness. Perceptions of use are a contributing factor and impact the perception of relative ease of the system (Cothran, 2011).

**Attitude toward using.** Attitude is based on a set of principles used to determine the positive or negative consequences of actions (Ajzen & Fishbein, 1980; Montano & Taplin, 1991; O'Boyle et al., 2001). This construct is equated by two parts, a direct and an indirect measure. A direct measure of attitude is the belief of an intended outcome as a result of performing the behavior. An indirect measure of attitude is the evaluation of the consequences of performing a behavior (Poss, 2001; Randolph, Pinkerton, Somlai, Kelly, McAuliffe, Gibson, & Hackl, 2009). Attitude has been measured as a function of beliefs by which a person evaluates the impact of a particular outcome (Ajzen & Fishbein, 1980; Montano & Taplin, 1991; O'Boyle et al., 2001). Its utilization by social scientists in predicting the impact on behavior has revealed that attitude plays the role of a mediating variable and outcome variable, and thus modifiable for some research focuses (Ajzen et al., 2007).

A study assessing perceptions of ease of use of a software used to deliver exams among students majoring in business (n=98; RR=61%) showed that the linear regression model explained roughly 83% of the variability in behavioral intention to use the software (Baker-Eveleth, Eveleth, & O’Neill, 2006). The researcher-developed survey instrument used a five point Likert scale with items that ranged from 1 (strongly disagree) to 5 (strongly agree) to measure item responses. The independent variables in the study were perceived usefulness and ease of system use, attitudes toward the software, faculty and technical support, and behavioral intention relating to the use of the software.
Participants were assessed on variables impacting acceptance of the examination software. Study results show that students with majors in the business core engaged in the system when the perception of the computer based examination suggested minimal effort required on the part of the student. Linear regression analyses showed roughly 81% of the variability in the model was explained by attitudes toward the system, while 77% of the variability was explained by relative ease. Relative ease about the software’s usefulness impacted attitude. Findings suggest that faculty support of the system mediated acceptance, and ultimately actual system use through the constructs perceived usefulness and perceived ease of use (Baker-Eveleth et al., 2006).

A study evaluating attitudes toward computer use among pre-service Singapore teachers (n=239) showed that the model explained roughly 48.7% of the variability in attitude (Teo, 2010). Participants responded to a 20-item questionnaire using a five point Likert scale that ranged from 1 (strongly disagree) to 5 (strongly agree). The independent variables were perceived usefulness, perceived ease of use, subjective norms, technological complexities, facilitating conditions, and attitudes relating to computer use. Multivariate analyses showed that subjective norm, facilitating conditions, and technological complexity, had direct and significant effects on attitude. A positive attitude toward computer usage was associated with perceptions of relative ease. Findings suggested that pre-service teacher’s attitudes were influenced by their perceptions of usefulness and relative ease (Teo, 2010).

A study examining attitudes toward internet usage among consumers in a metropolitan, Southeastern US city (n=614; RR=87.8%) showed an acceptable fit of attitude toward internet use using a confirmatory factor analysis (Porter & Donthu, 2006).
Likert type scale responses were used on a 15-item questionnaire to measure participant responses to items. Perceptions of relative ease, usefulness, access barriers, actual internet use, and attitudes toward internet usage were the independent variables in the study. Study results showed that favorable attitudes toward internet usage were associated with perceptions of usefulness and perceptions of relative ease, and ultimately influenced internet usage. Age, education, and income were significant predictors of attitude. Sub group samples were created in a post hoc analysis to further examine the impact of demographic variables on internet usage. Study results showed that less educated consumers, 50 years of age or older, had lower perceptions of relative ease. Findings suggested that demographic variables such as age, education, and income impacted and contributed to consumer attitudes and beliefs about internet use (Porter & Donthu, 2006).

Behavioral intention to use. Behavioral and normative beliefs are subjective evaluations that make significant contributions in the intention to perform a behavior (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). Behavioral beliefs are characterized as the antecedents of the construct attitude. These underlying beliefs determine whether the impact of performing a behavior results in a favorable or unfavorable condition. Beliefs characterize user behavior and the motivation to perform a given behavior in the model (Agarwal & Prasad, 1997).

Social pressures play a major contributing factor in the formation of normative beliefs (Ajzen et al., 2007; Ajzen, 1991). Subjective norms are based on the perceptions of what is largely considered socially acceptable (Fishbein & Ajzen, 2010; Latimer & Ginis, 2005). In the TRA model, subjective norm is conceptualized as the analysis of
societal perceptions and their positive or negative influence to engage in a behavior. An accurate direct measure of subjective norm is the individual’s perception of how others may regard a decision made (Poss, 2011; Randolph et al., 2009; Sable, Schwartz, Kelly, Lisbon, & Hall, 2006). Subjective norms are a function of normative beliefs. Normative beliefs are indirect measures of subjective norm that are highly rated by the individual, based on a smaller group of influential referents. These beliefs determine the individual’s attitude toward that behavior and the motivation to comply (Ajzen & Fishbein, 1980; Poss, 2011).

A study evaluating intentions among mothers living in a Midwestern, rural state (n=1,207; RR:25.43%) to vaccinate their daughters, aged 9-15 years, against human papillomavirus showed that the linear regression model explained roughly 66% of the variability in intention (Askelson et al., 2010). The mail survey used a seven point Likert scale to measure responses to the participants’ attitudes, subjective norms, and perceived behavioral control relating to intentions to vaccinate. The independent variables in the study were behavioral intentions, attitudes, perceived behavioral control, subjective norms, maternal perceptions of risks, vaccine perceptions, and experience with sexually transmitted infections. Linear regression analyses showed that attitude (β=.61, p <.001) and subjective norms (β=.16, p<.05) were predictors of intentions to vaccinate. Findings suggested that attitude was a stronger predictor of intent to vaccinate in the study (Askelson et al., 2010).

A survey examining factors influencing intentions to integrate tobacco education in the nursing curricula among nursing faculty (n=387; RR=42%) showed that the linear regression model explained roughly 67% of the variability in intentions to integrate
tobacco education (Heath & Crowell, 2007). The researcher-developed survey instrument used a five point Likert scale to measure responses to curricula items relating to the integration of tobacco education. A multivariate analysis showed a significant relationship existed between number of years of teaching and intentions to integrate tobacco education in the nursing curricula. Higher intention scores were found among participants having 1-8 year(s) of teaching experience. The variability in intention was explained by external factors and behavioral, normative, and control beliefs. Findings suggested that behavioral beliefs were a stronger predictor of the faculty’s intent to integrate tobacco education (Heath & Crowell, 2007).

A study evaluating intention to provide Medicare therapy management services among pharmacists in Iowa (n=500, RR: 41%) showed that the linear regression model explained roughly 63.2% of the variability in intention (Herbert et al., 2006). The researcher-developed survey instrument used a five point Likert scale survey to measure responses to items. The independent variables were attitude, subjective norms, perceptions of behavioral control, gender, years of practice, degree, practice setting, past participation in a pharmacy program, time spent providing reimbursable care-based services, and payment received for services. Response category items ranged from strongly disagree to strongly agree. The participants were largely male (n=117, 57.6%), working in an independent pharmacy practice setting (n=102, 50.2%), with 21-30 years of experience (n=59, 29.1%). Study results showed that variability in intention is explained by the pharmacist’s attitude, subjective norm, and perceived behavioral control. Findings suggested these variables were significant predictors of intent to provide Medicare therapy management services in the study (Herbert et al., 2006).
Actual system use. The evaluation of positive or negative feelings about performing a specific behavior and the perceptions of a social support system are major determinants in the likelihood of performing a specific behavior (Bell, Harrison, & McLaughlin, 2000; Doswell, Braxter, Cha, & Kim, 2011). Intentions are a major determinant of actual system use in the TAM framework (Davis, Bagozzi, & Warshaw, 1989). A study evaluating factors that influence acceptance of data-sharing system among law enforcement field officers (n=153; RR=26.14) showed that the model explained roughly 64% of the variability in actual system use (Hu et al., 2011). The researcher-developed survey instrument used a seven point Likert scale to measure responses to items. The independent variables were efficiency gain, timely assistance, perceived usefulness, perceived ease of use, facilitating conditions, social influences, intention to use, and technology usage. The survey measured participants’ intentions relating to actual system usage. The system’s interoperability was designed to improve data-sharing among the officers across agencies. The officer’s perceptions of the system’s usefulness were a stronger predictor of acceptance. Path analyses indicated a significant association between acceptance and actual system use. Findings suggested intentions predict and influence actual system use (Hu et al., 2011).

The Shift in Health Care Delivery - The Medical Home

Health care delivery in the U.S. has shifted from traditional and independent suppliers, where corporations and organizations owned the physician practice and therefore profited from the physician’s work, to a variety of alternate forms. These alternate forms include community health centers, ambulatory care centers, and integrated modern business models incorporating physician owned practices. These
health service centers are cost effective, accessible, and encourage a strong provider-patient relationship which is significant for chronic condition management (Lowell-Smith, 1994). This shift has occurred over the past two decades due to the need for patient-centered care, practice standardization, and enhanced accountability. With this shift also came a refined approach to methodologies that support prevention and wellness and the medical home theoretical concept, particularly for patients diagnosed with chronic conditions that require maintenance and medication (Carrier, 2009; Lowell-Smith, 1994). The newest concept in health services delivery is the medical home concept. Given the fact there are alternative models of health services delivery, the one that seems to create opportunities for patients to engage in self-management training is with the medical home.

Prior to this reorganization, studies showed that the medically underserved population utilized hospital services for chronic care management, including using the emergency department for less urgent visits and increasing the number of hospitalizations for diabetes related complications. A longitudinal, retrospective study evaluating inappropriate use of ED services in eight Louisiana hospitals among patients with type 2 diabetes (n=8,596) found that of 39,853 visits, more than half (n=22,395) were considered inappropriate or less urgent. Participation in a diabetes management programs for at least 31 months decreased the number of inappropriate visits (Shang-Jyh, Campbell, Myers, Culbertson, & Horswell, 2010). A vast majority of the participating patients were Black (54%), female (59.3%), with a mean age of 51.5 years. Estimating equation regression models assessed associations with emergency department visits to determine which factors would remain after variable adjustment. The results of the
model showed that patients with more than four co-morbid conditions had higher utilization rates that were less urgent. Patients who were Black, insured patients, and those seeking healthcare services in large facilities within the Louisiana Health Care Services Divisions were factors that predicted higher utilization. The study's intervention involved a diabetes management program for its patients designed to collaborate with primary care services that increased office hours, offered personal care management services, and educated its patients on how to lessen their ED use for diabetes management. This suggests patients have to be reengaged into establishing a relationship for chronic care management with a primary care facility rather than inappropriately using ED services (Shang-Jyh et al., 2010).

A study evaluating the increase hospitalization rate for episodic complications among patients diagnosed with coronary artery disease and either medium- or high-risk diabetes (n=526; RR: 68%) found that participation in a telephonic diabetes management intervention significantly reduced hospital visits for diabetes related complications (Rosenzweig, Taitel, Norman, Moore, Turenne, & Tang, 2010). Medicare-enrolled members of a national health plan for at least 24 months participated in the study. Patient demographic characteristics were similar in both the intervention and control group. The majority of patients in the intervention group were female (43.5%), with a mean age of 74 years, while control group participants were 43.5% and 74.9 years respectively. A pre-post test design was used to evaluate clinical changes in the intervention group. The admission rate among the intervention group for diabetes and non diabetes related utilization showed a reduction for ED visits and hospitalizations (0.841 to 0.729) for each participant over a 12 month period. Results showed a greater difference among the
intervention group and the control group in terms of diabetes related ED visit reductions (0.148 to 0.146 per member, per year), with the control group results showing an increase in ED utilization (0.095 to 0.171 per member, per year). This suggests patients participating in a diabetes management intervention that provides instruction on self-care behaviors, telephonic nurse care services, and the use of telehealth to transmit clinical readings had a decrease in the number of hospitalizations and ED visits related to diabetes. Results of the study supports the utilization of telephonic services to improve quality measures of diabetes self management care, specifically when blood glucose readings and patient education can be transmitted respectively using telehealth devices (Rosenzweig et al., 2010).

The integration of the medical home concept offers comprehensive and coordinated care delivery to patients who would otherwise not be medically managed (Carrier, 2009). Medical homes are able to minimize ED utilization and promote the primary care provider as the coordinator for overall care management (Carrier, 2009; Flinter, 2005; Rust, Baltrus, Jiali, Daniels, Quarshie, Boumbulian, & Strothers, 2009). The medical home provides a team approach model of continuity of care that includes prevention, early detection, reduction in incidence rates, and minimization of risk complications for diabetes care. What was once a treatment-centered care approach, having a medical home provides comprehensive and continuous patient-centered care approach with sub-specialty care referring for adults managing such chronic conditions as diabetes (Flinter, 2005).

Community Health Centers

Community health centers offer strategies to promote health education, preventive
practices, and early detection (Gold, Devoe, Sha, & Chauvie, 2009; Rust et al., 2009; Samuels, Xirasagar, Elder, & Probst, 2008). A cross sectional study examining the relationship between continuity of care, blood glucose control, and stages of change in diet and exercise among adults, diagnosed with type 2 diabetes (n=374; RR=68%) showed that a linear regression model explained roughly 42% of the variability in improved glucose control impacted by diet (Parchman et al., 2002). Adults seeking care in five community health centers in a Midwestern state participated in the study. Of those participating, 71.6% were female, with a mean age of 58.7 years. The portion of the intervention dedicated to improving nutrition was referred to as stages of change for diet and was categorized as advancement, no change, and relapse. Stages of change for diet accounted for roughly 8% of the variability and mediated the relationship between continuity of care and controlled blood glucose levels. Study results showed that variables significantly associated with controlled HbA1c levels were stage of change for diet and continuity of care. This suggests those patients who received education on nutrition, exercise, blood glucose management, and self-care were more likely to have lower blood glucose readings if they were advancing in stage of change for diet (Parchman et al., 2002).

Patients with three or more primary care visits had controlled blood glucose levels compared to counterparts with fewer visits (Parchman et al., 2002). Findings also supported a statistically significant relationship between continuity of care and controlled blood glucose levels. One limitation of this study is that patients may have been sensitized to the study’s expected outcomes following exposure to the appropriate level of self-management behaviors for blood glucose control. Disclosure of environmental
and other societal factors relevant to the patient's health improves continuity of care because patients are more receptive to physician recommended self-care behaviors. Findings from this study suggest that continuity of care may impact the decision making process among physicians in adult diabetes care and management (Parchman et al., 2002).

A randomized control trial evaluating the effectiveness of collaborations between physicians and nurse care managers and their impact on the diagnosis of type 2 diabetes among adults (n=220; RR=76%) showed that individualized intervention provided by the nurse care manager improved clinical outcomes among patients in the treatment group (Hiss et al., 2007). Patients were recruited from two community health centers and one public health department in a large, Detroit, Michigan metropolitan area. More than half of the patients were White (n=129; 65%), male (n=66; 34%), and managing diabetes for at least 7.4 years. Of those participating, 83% had either employer provided or government sponsored health insurance. A Spearman correlation showed a statistically significant and negative relationship between nurse care manager contacts and clinical outcomes (p=.01). This outcome suggests increased contact with the nurse care manager resulted in improvements in A1C levels. The findings from the study suggest that the expansion of the nurse care manager within community oriented primary care delivery systems has the potential to enhance diabetes care and management among adult patients with diabetes.

Partnerships expanding the role of the nurse care manager have the potential to enhance diabetes care and management among adult patients with diabetes (Hiss, Arbruster, Gillard, & Mcclure, 2007). The integration of partnerships such as this within
community based primary care settings improves care coordination and clinical outcomes, and increases health related quality of life years for patients because emphasis are placed on continuity of care, individualized self-care plans, and appropriate use of patient surveillance resources to comply with guidelines established by the American Diabetes Association (Gabbay, Lendel, Saleem, Shaeffer, Adelman, Mauger, Collins, & Polamano, 2006; Hiss et al., 2007).

**Ambulatory Care Facilities**

A retrospective study evaluated predictors of blood pressure control among patients diagnosed with diabetes and hypertension (n=1,231; RR: 88%) seen in primary clinics in Rochester, Minnesota (Duggirala, Cuddihy, Cuddihy, Naessens, Cha, Madrekar, & Leibson, 2005). Logistic regression models identified statistically significant clinical predictors among patients with either medically controlled or medically uncontrolled hypertension. Of 431 patients with medically controlled hypertension, 41% were on an oral diabetes treatment regimen of hypoglycemic drugs. Medically uncontrolled hypertension patients (n=659) were female (51%) and more than half were on a diabetes treatment regimen of diet and exercise only. Patients in both categories made at least one annual primary care visit. The strongest predictors of poor blood pressure control were isolated systolic hypertension and uncontrolled blood pressure at inception, use of oral hypoglycemic drugs, taking three or more antihypertensive drugs, and older age (Duggirala et al., 2005). In the logistic regression model for predictors of poor blood pressure control, the strongest predictors were patients with isolated hypertension, uncontrolled blood pressure at baseline; use of both oral hypoglycemic medication and three or more antihypertensive medications; and older age.
The relationship between diabetes management and oral hypoglycemic regimens revealed that differing types of oral hypoglycemic drugs may impact blood pressure values negatively. This study found that patients on a hypoglycemic medication regimen had poorer blood pressure control. In the logistic regression model for predictors of better blood pressure control, the strongest predictors were patients using nitrates, those with a history of coronary heart disease at inception, and having at least one annual visit to a subspecialist physician. The study did not reveal information on the participants' compliance of treatment regimens, nor their disease duration of diabetes and high blood pressure. A second limitation was the lack of racial diversity amongst the sample population, as 90% of total participants were White. Findings from the study suggest an awareness to address and monitor blood pressure control among patients managing diabetes. Findings also support diabetes management programs incorporating the impact of diet and salt intake to address diabetes related complications (Duggirala et al., 2005).

A study evaluating short-term clinical outcomes among patients and covered dependents (n=193; RR: 51%) participating in a diabetes management program hosted by an employer sponsored ambulatory facility in North Carolina found improvements in glycemic control, and systolic and diastolic blood pressure readings (Yoder, 2012). The majority of patients were Caucasian (n=71, 72.4%), female (n=74; 75.5%) with a mean age of 52.4 years. Glycemic values decreased by 0.7% from baseline to follow up (7.8% vs. 7.1%), while more than half of patients (n=50) met ADA goals having values less than or equal to 7.0%. Findings showed that implementing a team approach and incorporating diabetes education, preventive care access, and lifestyle behavioral changes were key in glycemic control improvements among participants. Systolic blood pressure
showed a slight reduction from baseline (128.8 mmHg) to follow-up (124.9 mmHg) among patients. A limitation of this study was the lack of racial diversity among the sample population. A second limitation was the absence of a control group to compare standard care and the intervention offered by the ambulatory care facility. Observed reductions in clinical values of patients with lower risks of developing diabetes-related complications suggested that patients with poor glycemic control may experience more benefits from collaborative partnerships designed to improve clinical outcomes (Yoder, 2012). The findings from the study support investments in interventions that address lifestyle modifications and monitoring therapy through initial assessment, proper diagnosis and effective treatment regimens to reduce disease burden.

**Physician-Owned Practices**

A study examining outcomes of specialty referrals among primary care physicians (n=342; RR: 42%) found that insured male patients, those aged 17 years older, and presenting with problems uncommonly managed by the practitioner were almost twice as likely to receive a referral (Forrest, Nutting, von Schrader, Rohde, & Starfield, 2006). Specialty referrals accounted for 5.2% of the total patient encounters (n=34,069) across the 142 providers. Of those patient encounters, 55.8% of patients had private insurance and 62% were female, with a mean age of 42.3 years. Medicare patients were less likely (OR 0.70, 95% CI; 0.52–0.95) to be referred for care at any single visit, but overall were considered high users of care and therefore, over a period of time will have accumulated more referrals for care compared to non-Medicare patients. Logistic regression models showed that predictors of referrals were made for patients with uncommon presenting problems, high morbidity burden, and those with health plan gate-keeping arrangements.
The study showed that insurance type was a statistically significant predictor of referrals among large group practices, those with four or more providers because if insurances had capitation rates in place, there was a limit on the type of service received at the primary care location. Physicians in larger group practices were more likely to refer patients for specialty care compared to small group, which are two or three providers or those with only one practitioner (Forrest et al., 2006). Findings from the study suggests that practices of no more than three providers were more likely to manage chronic conditions within that primary care setting because they offered an extensive range of services to patients, therefore reducing the number of referrals required for specialty care. Patients of small group practices were less likely to be referred for specialty services, provided the practitioner had the expertise to treat and provide ongoing health maintenance of the presenting problem in house (Forrest et al., 2006).

Gate-keeping arrangements used by health maintenance organizations require the primary care provider to facilitate the coordination of integrated care by authorizing sub-specialty referrals for the patient (Pati, Shea, Rabinowitz, & Carrasquillo, 2005). For the study, gate-keeping arrangements were defined as protocols implemented by the insurance companies to encumber patients’ access to direct specialty care usually due to cost (Pati et al., 2005). The role played by the primary care provider is vital to increase accessibility to preventive and quality care, early detection, and on-going health maintenance of health problems. In the study, gate-keeping protocol reduces the number of referrals for specialty care due to disease-related complications that could otherwise be managed at the primary care provider level (Continelli, McGinnis, & Holmes, 2010).
Modification of the Theoretical Framework

Based on communication with the author of the TAM, the framework used for the current study eliminates the constructs: perceived ease of use and attitude. Davis et al. (1989) found that attitude did not mediate perceptions of usefulness and relative ease in the TAM framework, and therefore, was eliminated from the final model (F. Davis, personal communication, October 13, 2011). Attitude has taken on several theoretical and operational concepts in the literature. Research has depicted attitude as an external, a mediating, an outcome variable, and as an individual construct for theoretical models (Ajzen et al., 2007). The construct perceived ease of use was not evaluated in this study, as emphasis is placed on the level of comfort in which minimal effort is required.

The research study's methodology, sampling procedures, research design, experimental interventions, measures, procedures, and protection of human subjects are presented in Chapter III. The chapter concludes with the statistical analysis plan for the data.
CHAPTER III

METHOD

The purpose of this study was to examine the effectiveness of the Technology Acceptance Model as a theoretical framework to identify predictors of system use of telehealth messages among diabetes patients in a primary care setting. This chapter describes the research design, sample, data collection measures, pilot study, procedures, and the statistical analysis for this research.

Participants

The sample for this study was recruited from adult patients having a diabetes-related primary care visit in a physician-owned practice providing primary care in a metropolitan city in Virginia. This practice was selected as it offers a diabetes management program that is accredited by the American Association of Diabetes Educators. Following a diagnosis of diabetes at this practice, patients are scheduled for a three- to four-monthly routine, follow-up visit and are also extended an invitation to participate in a shared medical appointment held at the primary care office.

Sampling Procedures

The final sample was drawn for all patients having a diabetes-related visit at this practice over a four month period. Participants (150) were recruited and enrolled in the study by invitation or through recruitment efforts in which participants were targeted based on the physician-diagnosis of diabetes. The medical doctor provided approval for patients to be contacted for research purposes during diabetes-related visits. Participants were adults, aged 18-65 years, diagnosed with type 2 diabetes by their health care provider, prescribed a medication regimen of either insulin or an oral prescription to
manage or treat their diabetes, have the ability to clearly understand English via telephone, and have weekly access to an operable landline telephone or a cell phone. Those aged 65 years and older, patients with gestational diabetes at the time of the study, Spanish-only speaking patients, current enrollment in another intervention, and patients not having had a provider visit within the past 12 months were excluded from participation in this research study. Approximately 75 participants were randomly assigned to routine care, while the remaining half were assigned to the telehealth educational messages only group using a systematic sampling approach based on the treatment assignment sheet. The random starting point for the treatment assignment was the control group. Participants received an incentive for their participation at the conclusion of the research study.

**Data collection site.** The host site was a physician-owned primary care practice providing acute, chronic, preventive, and health maintenance. This primary care office is a subsidiary of a large, Tier 1 Trauma Center located in a metropolitan city in Virginia. The medical practice is staffed by one medical doctor and two nurse practitioners, one of whom serves additionally as the Certified Diabetes Educator (CDE). The primary care practice has a multifaceted diabetes center accredited by the American Association of Diabetes Educators (AADE), which offers ongoing diabetes management surveillance, education, training, and support. Additional on-site services are offered to increase health maintenance of patients to accommodate access barriers. This health care delivery model is ideal because of its ability to offer comprehensive services in one location to assist with the continuum care. The hours of operation were Monday through Friday, 8:00am until 4:30pm.
Research Design

This study employed a mixed methods research design. The quantitative survey methodology used a randomized, pretest-posttest research design with one control and one experimental group. This research design was selected for this study because this design is most effective in measuring the degree of change as a result of the implemented treatment or intervention. Subjects were randomly selected to experience seven weeks of telehealth messages on self-care behaviors delivered by an automated voice message communication system (experimental group) (Appendix A) or to receive educational handouts (control group) (Appendix B). The qualitative methodology consisted of an open-ended question evaluating the subject's likelihood of using the resources provided to enhance the self-care management of diabetes. Participants were asked to respond to the question "How likely are you to use these resources to help manage your diabetes care" using a Likert scale with anchors that ranged from 1 to 5. As a follow-up, participants were asked to respond to an open ended question, "why or why not?" Quantitative results were coded using a thematic analysis. Patterns and recurring themes were derived from the content (Patton, 2002).

Experimental Interventions

The diabetes related office visit consisted of a diabetes-related routine follow-up with the health care provider that incorporates the AADE7 framework to explore self-care management of diabetes (American Association of Diabetes Educators, 2014). The AADE7 framework focuses on healthy eating, physical activity, medication instruction, blood glucose monitoring, problem solving, reducing complications, and healthy coping. Participants experienced a physical examination, a review of symptoms, diabetes
education and self-management care, and medical management provided by the health care provider. Educational material provided by the AADE related to the care and management of diabetes was provided to each participant.

The telehealth educational messages consisted of seven pre-recorded audio files covering the AADE’s seven self-care behaviors delivered by an automated voice message communication system over a seven week period, presenting one self-care behavior each week. The messages average 5 minutes and 4 seconds in length. The messages focused on Healthy Eating, Message Length: 4:55; Being Active, Message Length: 4:55; Monitoring, Message Length: 5:38; Taking Medication, Message Length: 4:53; Problem Solving, Message Length: 4:13; Reducing Risks, Message Length: 5:41; Healthy Coping, Message Length: 4:13. Total content message time for the seven pre-recorded audio file was 34 minutes and 28 seconds. The messages were made available by the AADE and were professionally recorded in a female voice. The automated voice message communication system made three attempts to reach participants in the event of a busy line signal, hang-up, voicemail or answering machine. The system required that the participant answers the telephone and listen to the message in its entirety to be recorded as a successful call. The automated system recorded the total number of messages successfully delivered to the potential participants, messages listened to in their entirety, number of failed messages, failed or incomplete calls due to voicemail status, line busy status, non-pick-up status, disconnect status (hang-up), and call error status because of a non-servicing number or tower interruption of service.

Measures

Five data sources assessed the efficacy of the study’s intervention. The primary
variable, actual system use, was calculated from data recorded in the automated voice message communication system. Secondary variables were self-care behavior change derived from the AADE’s Behavior Score Instrument (BSI) (AADE, 2013) (Appendix C), behavioral intention to use the treatment (Appendix D), and perceived usefulness of the system measured through the System Usability Scale (Appendix E) (Bangor, 2008). User characteristic data was extracted from the electronic medical record to verify participant eligibility and to summarize demographic data for the study sample (Appendix F).

**Clinical Outcomes.** The electronic medical record was reviewed to extract the practitioner-recorded clinical outcome values at baseline and during follow-up (Appendix G). Recorded outcome values included laboratory tests appropriate to diabetes management including weight, height, BMI, A1C, level, systolic, and diastolic blood pressure readings. Clinical outcomes were assessed 3-4 months following the intervention to evaluate changes in laboratory test values.

**User Characteristics.** The electronic medical record was reviewed to extract user characteristics prior to the intervention. User characteristics collected from the electronic medical record included the participant’s age, gender, marital status, race, insurance status, and type of insurance.

**Behavioral intention to use.** A study assessing the constructs of TRA and TAM among graduate students at the University of Michigan evaluated intention to use a word processing system (Davis, Bagozzi, & Warshaw, 1989). Behavioral intention to use was assessed at two intervals, at the beginning and at the end of the semester. Cronbach alpha reliabilities were 0.84 (baseline) and 0.90 (follow-up). Results showed that behavioral
intention roughly explained 47% of the variance at the beginning of the semester, and roughly 51% at the end of the semester.

Based on Davis, Bagozzi, & Warshaw, 1989, a qualitative item was added to capture intention to use prior to and following the intervention. In the present study, participants responded to the likelihood of using the resources provided to enhance self-care management of diabetes to assess behavioral intention to use. The question reads: "How likely are you to use these resources to help manage your diabetes care. A five point Likert scale with anchors that range from 1 (strongly disagree) to 5 (strongly agree) was utilized. The qualitative component captured participant responses to an open-ended question "why or why not" following the initial inquiry as to the likelihood of using the resources to help manage diabetes.

**Behavior Score Instrument.** The Behavior Score Instrument (BSI) is a 21-item question assessment developed by the AADE's Behavior Work Group (AADE, 2011). The BSI was included in the Initial Patient Self-Assessment for this study and can be used as a stand-alone metric to initiate the diabetes care and management process between the patient and the provider to address behavior change. The dashboard is the interactive component within the AADE7 System which provides a visual representation. This comprehensive patient-reported assessment is comprised of subscales for each of the AADE’s seven self-care behavior measures. Three questions addressed each of the subscales to assess patient-reported self-care behaviors. The AADE reports that low scores are indicative of behaviors the patient finds challenging to maintain or experience difficulty in completing. For this study, the interactive scoring tool found in the stand-alone metric was used to establish an overall BSI score for each participant at three
intervals, baseline, two months, and at follow-up.

A prospective pilot study evaluating the BSI among patients (n=92) within the Grady Health System in Atlanta, Georgia assessed changes at three intervals, baseline, three months, and during a six month follow-up (Gonzalez & Lipman, 2012). Three additional metrics were used in addition to an evaluation of the clinical outcomes of A1C, blood pressure, weight, and BMI. In the study, participants were majority female (63%), with a high school education (53%), having a mean age of 55 years. More than 70% had an income of less than $15,000. At baseline and follow-up, the mean BSI score 2.64 and 2.7, respectively. Results showed that roughly 70% of the variability was explained by being active and taking medication, and health coping and monitoring behaviors. Healthy eating and monitoring were significant at follow up (p<.01). An extensive literature search suggests that the BSI is in its infancy stages of development (AADE, 2014). The AADE reports that studies are on-going to establish reliability and validity. The present research study used the BSI to assess participant-reported self-care behaviors at baseline, two month follow-up, and at the four month follow-up to contribute to the reliability and validity of the tool.

Perceived usefulness of technology. The System Usability Scale (SUS) (Bangor, Kortum, & Miller, 2008; Brooke, 2013) measured perceived usefulness of the system and its ability to deliver diabetes education. The SUS assesses subjective usability of a product, service or system (Bangor, Kortum, & Miller, 2008; Brooke, 2013; Lewis, 2012). The instrument consists of 10 items measuring system usability on a five point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The assessment uses reversed wording in which odd numbered items are positively worded,
while even numbered items are negatively worded. The responses are anchored from 1 (strongly disagree) to 5 (strongly agree), in which 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree (Baker-Eveleth et al., 2006; Fagan et al., 2008).

The SUS scores provide a single number to measure system usability. The total score contribution for each item ranges from 0 to 4. Odd numbered items are calculated as the total scale contribution minus one. Even numbered items are calculated as five minus the scale contribution. Participants who failed to respond to an item, the score assignment 3 is assigned, which represents the center of the scale. Total score contributions for each item range from zero to four. The sum of the transformed scores is multiplied by 2.5 to provide an overall SUS score that ranges from 0-100. Higher scores are indicative of better usability (Lewis, 2012).

When the SUS was initially developed, senior level managers were more receptive to perceived usability scores that ranged from 0 to 100 (Brooke, 2013; Bangor et al., 2008). A study examining 206 studies using the SUS found an overall mean score of 70.14 (Bangor et al., 2008). The reliability coefficient for the study was 0.91. Six user interfaces were evaluated using 2,247 SUS questionnaires. Results from the study showed that SUS scores vary based on the interface that is tested. Using a subset of 213 surveys, results showed a correlation between SUS score and age (p = .003). There were no significant differences between SUS scores of women and men. A seven point adjective rating scale with Likert anchors was introduced in the study (Brooke, 2013; Bangor et al., 2008). The 11th question is qualitative in nature and reads: “Overall, I would rate the user-friendliness of this product as”. The adjective rating scale for this question is anchored from 1 to 7, with 1 = worst imaginable; 2 = awful; 3 = poor; 4 = ok;
5 = good; 6 = excellent; and 7 = best imaginable. The summative question provides a qualitative response of the end users usability that is used with the interpretation of the SUS score. The results showed a correlation of the summative question with SUS scores, r = 0.81 using a subset of questionnaires (Bangor et al., 2008).

An on-line study measuring the usability of software products adopted by US consumers among participants from Rice University and Amazon’s Mechanical Turk (n=1,058; RR: 97%) found no gender differences in SUS scores (Kortum & Bangor, 2013). Undergraduate students from Rice University received course credit for participation, while the remaining 559 participants were compensated with two US dollars. The Amazon Mechanical Turk participants had a mean age of 31 years and were college graduates (56%), while the undergraduate students had an age range of 18 to 22 years. Of the 1,031 participants, 58% were female. Participants responded to the usability of consumer products to include Excel, GPS,DVR, PPT, Word, Wii, iPhone, Amazon, ATM, Gmail, Microwaves, Landline, Browser, and Google search. ANOVA results showed a significant difference in usability among browsers (p < .000). A post hoc comparison indicated that Apple Safari and Chrome had higher usability rates compared to Firefox and Internet Explorer. Participants were also asked to complete the summative question and assign a letter grade regarding the overall user-friendliness of the product. The results showed a correlation of the summative question with SUS scores, r = 0.68. Multivariate models showed that roughly 21% of the variance was in experience. When assessing the usability of all products, experience had a significant effect on scores. This suggests higher scores were indicative of novice and expert users (Kortum & Bangor, 2013).
**Reliability and validity.** The SUS is an established scale to measure end-user system usability with a variety of interfaces (Bangor, Kortum, & Miller, 2009). Reliability coefficients for the tool have been reported between 0.85 - 0.91, exceeding the minimal measurement reliability of 0.70 for research evaluation studies (Bangor et al., 2008; Lewis & Sauro, 2009). An analysis of 324 questionnaires assessed reliability of the SUS, and results showed the coefficient alpha as 0.92 (Lewis & Sauro, 2009). The 99.9% confidence interval ranged from 58.3 to 65.9, with a mean distribution of 62.1 (Lewis & Sauro, 2009). While the SUS questionnaire addresses the participant’s experience when evaluating usability, a factor analysis revealed a second dimension, learnability. SUS items 1, 2, 3, 5, 6, 7, 8, and 9 are items defined measures for usability, while items 4 and 10 constitute the learnability scale. The coefficient alpha for the new scales are .91 and .70.

**Actual system use.** The primary dependent variable in this study, actual system use, is measured using data recorded from the automated voice message communication system. Actual system use will be calculated using the total number of messages successfully delivered to the participant and listened to in their entirety over the study period. Each participant had the potential to receive and listen to 7 complete calls. Incomplete calls were recorded in order to assess system reliability during the data collection period. The total number of messages not delivered ranged from one to seven. Incomplete calls included the total number of messages failed due to voicemail status, line busy status, non-pick-up status, disconnect status (hang-up), and call error status due to non-servicing number or tower interruption of service. The study treatments and associated measures are illustrated in Figure 2.
**Figure 5. Study Treatments and Associated Measures**

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Pre Treatment (Initial Visit)</th>
<th>Intervention (7 Weeks)</th>
<th>Post Treatment (2 Month Follow-up)</th>
<th>Post Treatment (3-4 Month Follow-up)</th>
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</thead>
<tbody>
<tr>
<td><strong>Control Group (n=75)</strong></td>
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<td></td>
<td>EMR Abstraction (Quantitative) User Characteristics Clinical Outcomes</td>
<td>Routine Diabetes Related Visit</td>
<td>Behavior Score Instrument (Quantitative)</td>
<td>EMR Abstraction (Quantitative) Clinical Outcomes</td>
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<td></td>
<td></td>
<td>AADE Handouts on the Seven Self-Care Behaviors</td>
<td>Behavior Score Instrument (Quantitative)</td>
<td>Behavior Score Instrument (Quantitative)</td>
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<td>Behavioral Intention to Use (Qualitative)</td>
<td>Behavioral Intention to Use (Qualitative)</td>
<td>Behavioral Intention to Use (Qualitative)</td>
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<tr>
<td><strong>Experimental Group (n=75) (Telehealth Messages)</strong></td>
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<td></td>
<td>EMR Abstraction User Characteristics Clinical Outcomes (Quantitative)</td>
<td>Routine Diabetes Related Visit</td>
<td>System Usability Scale (Quantitative)</td>
<td>EMR Abstraction Clinical Outcomes</td>
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<tr>
<td></td>
<td></td>
<td>7 Telehealth Messages over 7 Weeks</td>
<td>Behavior Score Instrument (Quantitative)</td>
<td>Behavior Score Instrument (Quantitative)</td>
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<td></td>
<td></td>
<td>Behavioral Intention to Use (Qualitative)</td>
<td>Behavioral Intention to Use (Qualitative)</td>
<td>Actual System Use Outcomes (Quantitative)</td>
</tr>
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</table>

**Pilot Study**

A pilot study was conducted May 2013 to examine the feasibility in logistics,
determine changes needed in the administration of the telehealth messages, and survey administration prior to the full study. Results of the pilot study did not warrant amendments to survey instruments, but rather modifications to the electronic data collection variables. Blood glucose serum levels, employment, educational, and income status were eliminated prior to the full study. Blood glucose serum levels were eliminated because of the inconsistencies in the method of collection across patients. The practitioner-recorded A1C provided the most accurate method of average blood glucose for the past two to three months. Employment, educational, and income status was either limited or unavailable in the electronic medical record. Employment status was limited to the type for some patients, but did not include the status. These variables were excluded from this research study. Additionally, telehealth messages were streamlined, using a patient preferred time slot of morning, afternoon or evening. Following the pilot study, the full implementation of the study began June 2013, after committee approval.

**Procedures**

Participants were recruited and enrolled over a four-month period from the host data collection site. Recruitment occurred through a flier (Appendix H), a Potential Participant Letter (Appendix I), and individual contact with participants made by the researcher or the Center's staff during office visits. The researcher orally confirmed eligibility of participants and arranged a time to meet individuals at the primary care office for formal enrollment. Recruitment occurred until 150 participants were enrolled. During the enrollment session, participants completed the informed consent document (Appendix J) and the electronic medical record authorization form (Appendix K). Participants were randomly assigned to interventions and all study procedures for the
specific assignment group were explained. The intervention protocol used in this research study was financially supported by the Virginia Commonwealth University's Center on Health Disparities. At the end of the research study, all participants received a $20.00 gift card to a local retailer.

Participants in the control group participated in a routine diabetes related visit with a primary care provider, completed the BSI as an initial assessment, the behavioral intention to use questionnaire and received the printed handouts of the AADE's seven self-care behaviors. Experimental group participants participated in a routine diabetes related visit with a primary care provider, completed the BSI as an initial assessment, the behavioral intention to use questionnaire and received seven weeks of telehealth messages. Paper questionnaires were made available to participants in addition to oral administration. Participants in the experimental group received a schedule indicating the time and date of the delivery of each message and title of the message for each respective week. Following the completion of all study data collection, participants assigned to the messages only group were provided the handouts of the AADE's seven self-care behaviors.

At the completion of the intervention, participants from both the control and experimental groups completed the BSI for the two month follow-up. In addition, participants receiving the telehealth messages completed the SUS, with the added 11th question to assess perceived usefulness. Total time to complete the SUS was approximately 10 minutes. At the three- four-month follow-up, all participants completed the BSI to assess short-term and long-term self-care behavior change. Additionally, participants completed the one item behavior intention scale to assess the
likelihood of using similar systems if offered again in the future and the resources provided. Participants had the questionnaire administered over the phone or in person during a diabetes related visit.

**Protection of Human Subjects**

This study was reviewed and approved by the Old Dominion University’s Institutional Review Board as Project Number 12-179 (Appendix L) on August 30, 2012. Data was collected to ensure that specific data were in no way connected to specific subjects’ names. The participant’s name and contact information were listed on a Sign-up Sheet (Appendix N). An arbitrary identification number was used on the Intervention Assignment Sheet (Appendix N) to link subjects to their information and included the group to which the participant was assigned. This list was kept in a secure location in the office of the Responsible Project Investigator. Upon completion of the study, the sign-up sheet and the treatment assignment sheet was shredded. The participant’s decision to participate was not reported to anyone. Data obtained from all sources were aggregated into an SPSS database, linked by each participant’s arbitrary identification number.

**Statistical Analysis**

The quantitative data for this study was entered and analyzed using the Statistical Package for Social Science (SPSS), version 22.0 (IBM Corp., 2012). Descriptive statistics were calculated using the aggregated data extracted from the electronic medical record to report the characteristics of the sample. Frequencies and percentages were conducted on gender, city of residence, marital status, insurance type, race, behavioral intention to use technology, and intervention assignment. Means and standard deviations were conducted on A1C, systolic and diastolic blood pressure, BMI, weight, and system
usability scores. Behavioral intention to use technology, A1C, systolic and diastolic blood pressure, BMI, and weight were assessed at baseline and at follow-up. The BSI scores were assessed at three time intervals, baseline, at two months, and at follow-up. Data were screened for outlying scores or extreme cases. Any participants with univariate and multivariate outliers were removed from the study.

The mean, median, range, standard deviations, and frequencies were reported on the clinical outcomes (A1C, systolic and diastolic readings, weight, height, BMI) and user characteristics (age, gender, marital status, insurance status, insurance type, and race). In all cases, a p-value of <.05 was used to test significance. All statistical results from the SUS were transformed scores from the raw scores. Raw scores calculated from the behavioral intention to use questionnaire were used to calculate an overall mean score. A combination of bivariate and multivariate statistical tests assessed the model constructs to examine the relationships among the primary and secondary variables (Appendix O).

The purpose of the MANOVA statistical test is to investigate the effects of the independent variables simultaneously and the interrelationships of the dependent variable. This statistic was chosen because of its ability to identify the variances and covariances of measures. MANOVA was used in this study to calculate difference scores in baseline and follow-up clinical values (weight, height, BMI, A1C, systolic and diastolic blood pressure readings), user characteristics (age, gender, marital status, insurance status, type of insurance, and race), changes in self-care behaviors (Behavior Score Instrument) perceived usefulness (System Usability Scale), behavioral intention to use, to identify those variables that contributed to the significant overall effect on actual
system use (sum total number of messages successfully delivered and listened to). Results are presented in a table list and include the sum of squares, degrees of freedom, mean square, the F statistic, the overall significance level, and the R squared to determine the level of variability and the magnitude of differences. Statistical findings established the significance and determined specific variables that contributed to the significant overall effect.

Correlations were used to assess statistical associations and strength of relationships among variables. Cohen's standard was used to evaluate the correlation coefficient to determine the strength of the relationship, where coefficients between 0.10 and 0.29 represent a small association; coefficients between 0.30 and 0.49 represent a medium association; and coefficients above 0.50 represent a large association or relationship (Cohen, 1988).

Regression models were used to roughly explain the variability. Results presented in a table list include the odds ratio, unstandardized β, the adjusted regression coefficients (β) with the statistical significance of each coefficient establish the contribution, direction, and relative strength to determine the strongest predictors of actual system use, and odds ratios with the 95% confidence intervals.

**Power Analysis and Sample Size**

This study used a convenience sample drawn on all patients having a diabetes-related visit at the host data collection site. Minimum sample size to conduct regression analyses uses a reasonable rule of thumb that includes the number of cases, desired power, alpha level, number of predictors, and the expected effect sizes (Tabachnick & Fidell, 2007). The formula used to test predictors is \( N \geq 104 + m \) and to test multiple
correlations is \( N \geq 50 + 8m \), where \( N \) is the sample size and \( m \) is the number of independent variables. The alpha level is assumed to be 0.05, while the beta coefficient is 0.20.

The main research questions were examined with three parametric analyses: a one-within, one-between MANOVA (10 scores), a one-within, one-between ANOVA (three scores), and five multiple linear regressions using 13 predictor variables. Of these three analyses, the one-within, one-between MANOVA requires the most stringent sample size. Power analysis for the study was conducted based on the one-within, one-between MANOVA. Power analysis was conducted using G*Power 3.1.7 on a one-within, one-between MANOVA with 10 scores, two groups, a power of 0.80, an alpha of 0.05, and a medium effect size \((f = 0.25)\). The calculated minimum required sample size to achieve empirical validity was 259 participants. Figure 5 details the research questions, measures, and appropriate statistical tests.
**Figure 6. Research Questions and Measures**

<table>
<thead>
<tr>
<th>Main Research Question</th>
<th>Measures</th>
<th>Statistical Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>To what extent does the Technology Acceptance Model identify predictors of system use of telehealth messages?</td>
<td>Clinical Outcomes and User Characteristics</td>
<td>Multiple Linear Regression</td>
</tr>
<tr>
<td></td>
<td>Sum total number of messages successfully delivered and listened to</td>
<td></td>
</tr>
<tr>
<td></td>
<td>System Usability Scale questions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Behavior Score Instrument</td>
<td></td>
</tr>
<tr>
<td>Are there statistically significant differences between patients who received telehealth messages and those in a routine care group on clinical outcomes of A1C, Blood Pressure, Body Mass Index, and Weight at baseline and follow-up?</td>
<td>Clinical Outcomes (A1C, BP, BMI, and Weight)</td>
<td>MANOVA</td>
</tr>
<tr>
<td>Are there statistically statistically significant differences between patients who received telehealth messages and those in a routine care group on patients’ self-care management of diabetes as measured by the Behavior Score Instrument over time?</td>
<td>Behavior Score Instrument</td>
<td>ANOVA</td>
</tr>
</tbody>
</table>
CHAPTER IV

RESULTS

The purpose of this study was to examine the effectiveness of the Technology Acceptance Model as a theoretical framework to identify predictors of system use of telehealth messages among diabetes patients in a primary care setting. A total of 150 participants consented to complete the research study. The responses from those participants were analyzed for the study.

Data were examined for outliers or extreme cases on the continuous variables of interest. Univariate outliers from clinical outcome scores (A1C, systolic and diastolic blood pressure, BMI, and weight) were examined at baseline and follow-up. Height was originally proposed to be examined as a clinical outcome, however, height scores were not assessed at follow-up; thus, height was not examined in the study. Univariate outliers from BSI scores were examined at baseline, two months, and at follow-up. Univariate outliers from perceived usefulness of technology (system usability scale transformed scores) and actual system use of technology (the number of messages listened to) were also examined for. The presence of univariate outliers was assessed by checking the standardized values or z scores, on each of the aforementioned variables. Univariate outliers are defined as standardized values below -3.29 and above 3.29 (Tabachnick & Fidell, 2012). Ten univariate outliers were found from eight participants and were removed from the data set.

A one-within, one-between MANOVA was proposed for the study. Multivariate outliers were assessed for on the variables in the MANOVA model, BMI, weight, diastolic and systolic blood pressure, and A1C. Mahalanobis distance values were used
to assess multivariate outliers. Given the number of dependent variables, the critical value was determined at $\chi^2(10) = 29.59$, $p = .001$ (Tabachnick & Fidell, 2012). Two participants had a Mahalanobis distance value that exceeded the critical value and were removed from the data set. The results from the remaining 138 participants were examined in the final analyses.

**Participants**

Descriptive statistics were conducted on intervention assignment (control vs. experimental), city of residence, actual system use of technology (number of messages listened to), behavioral intention to use technology at baseline and follow-up, and six user characteristics (age, race, gender, marital status, insurance type, and insurance status at baseline and follow-up). Participants' ages ranged from 21 to 65 years old, with a mean of 52.68 (SD=9.59). The majority of participants were Black (n=132, 96%), female (n=93, 67%), single or never married (n=68, 49%), and had government sponsored insurance (n=75; 54%). Insurance status remained the same at baseline and follow-up, where 132 (96%) participants had insurance and 6 (4%) participants did not. Of the experimental group participants, 82% (n=55) listened to seven messages. The majority of participants responded with strongly agreed when asked about intention to use the resources provided at baseline and follow-up, 99% (n=137) and 91% (n=125) respectively. Frequencies and percentages for participants' demographics are presented in Table 1. All participants were diagnosed with type 2 diabetes by a health care provider at the host primary care practice and prescribed a medication regimen of either insulin or an oral prescription to manage or treat their diabetes. Among clinical outcomes, A1C levels had a mean value of 8.23 (SD=2.43) and average blood pressure reading was
141/78 mmHg. Of the clinical outcomes at baseline and follow-up, weight (in pounds) at baseline had the highest average with a mean of 219.25, and A1C at follow-up had the lowest average with a mean of 8.23. Of the change scores (from baseline to follow-up), systolic blood pressure had the highest mean decrease of 5.56 mmHg and BMI had a mean increase of 0.02. Means and standard deviations on the clinical outcomes are presented in Table 2.

Table 1

Frequencies and Percentages on Participants’ Demographics

<table>
<thead>
<tr>
<th>Demographic Characteristic</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>93</td>
<td>67</td>
</tr>
<tr>
<td>Male</td>
<td>45</td>
<td>33</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never married/single</td>
<td>68</td>
<td>49</td>
</tr>
<tr>
<td>Married</td>
<td>47</td>
<td>34</td>
</tr>
<tr>
<td>Widowed</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Divorced</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Legally separated</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Not recorded in electronic medical record</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Insurance status at baseline and follow-up</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Yes</td>
<td>132</td>
<td>96</td>
</tr>
<tr>
<td><strong>Insurance type</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash Patient</td>
<td>6</td>
<td>.04</td>
</tr>
<tr>
<td>Private</td>
<td>57</td>
<td>41</td>
</tr>
<tr>
<td>Government-Sponsored</td>
<td>75</td>
<td>54</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Black</td>
<td>132</td>
<td>96</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

*Note.* Percentages may not total 100 due to rounding error.
Of the three time intervals BSI scores were examined, BSI scores at two months and at follow-up had the highest average with a mean of 2.83, and BSI scores at baseline had the lowest average, with a mean of 2.81. Means and standard deviations on BSI scores at baseline, two months, and at follow-up are presented in Table 3.

Table 2
Means and Standard Deviations on Clinical Outcomes

<table>
<thead>
<tr>
<th>Clinical Outcome</th>
<th>Baseline</th>
<th></th>
<th></th>
<th>Follow-up</th>
<th></th>
<th></th>
<th>Change scores</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>M</td>
<td>SD</td>
<td>n</td>
<td>M</td>
<td>SD</td>
<td>n</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>A1C</td>
<td>138</td>
<td>8.28</td>
<td>2.43</td>
<td>119</td>
<td>8.23</td>
<td>2.36</td>
<td>119</td>
<td>-0.01</td>
<td>1.84</td>
</tr>
<tr>
<td>Systolic</td>
<td>138</td>
<td>141.78</td>
<td>21.15</td>
<td>125</td>
<td>136.90</td>
<td>16.53</td>
<td>125</td>
<td>-5.56</td>
<td>17.03</td>
</tr>
<tr>
<td>Diastolic</td>
<td>138</td>
<td>78.20</td>
<td>12.97</td>
<td>125</td>
<td>76.13</td>
<td>11.37</td>
<td>125</td>
<td>-2.14</td>
<td>11.38</td>
</tr>
<tr>
<td>BMI</td>
<td>138</td>
<td>35.33</td>
<td>7.58</td>
<td>125</td>
<td>35.47</td>
<td>7.46</td>
<td>125</td>
<td>0.02</td>
<td>1.28</td>
</tr>
<tr>
<td>Weight</td>
<td>138</td>
<td>219.25</td>
<td>49.19</td>
<td>125</td>
<td>218.62</td>
<td>48.74</td>
<td>125</td>
<td>-0.25</td>
<td>6.14</td>
</tr>
</tbody>
</table>

Table 3
Means and Standard Deviations on BSI Scores at Baseline, Two Months, and Follow-up

| Measure | Baseline | | | Two months | | | Follow-up | | |
|---|---|---|---|---|---|---|---|---|
| | n | M | SD | n | M | SD | n | M | SD |
| BSI | 138 | 2.81 | 0.12 | 138 | 2.83 | 0.11 | 138 | 2.83 | 0.11 |

Telehealth Messages

Three attempts were made to deliver the seven pre-recorded audio files to participants in the intervention group using a patient preferred time slot of morning, afternoon or evening. Telehealth messages could have been received between the hours of 9am-9pm, seven days per week. Following the initial call, two additional attempts
were made in the event of a busy line signal, hang-up, voicemail or answering machine status. Each participant received one call per week over a seven week period that focused on the AADE’s self-care behaviors. Telehealth messages were delivered in a format that mirrors the educational curriculum of the Primary Care Physician and CDE. Messages were on average 330 seconds, and were structured with four sections, using a familiar, professionally recorded female voice. The greeting included a short question inquiring as to whether the participant was a patient at the respective primary care office and to press 1 for yes or press 2 for no. The respective self-care behavior content for that week was provided, followed by a conclusion section, extending a thank you to the participant for listening to the message. Message length for each content area varied, Healthy Eating 375 seconds, Being Active 322 seconds, Taking Medication 316 seconds, Monitoring Glucose 381 seconds, Problem Solving, 276 seconds, Reducing Risks 364 seconds, and Healthy Coping 277 seconds.

The automated voice message communication system recorded 651 calls made to 75 participants. Of those 651 calls made to participants, 73% (n=475) were successful. Successful calls were those in which the patient listened to the message in its entirety. The automated voice message communication system detected 8 calls were answered by a voicemail box. Two additional attempts were made to reach participants in the event of a voicemail, line busy, and hang-up status. Of the second and third attempts, the system failed to reach 8 subjects.

Actual system use of technology (total number of messages listened to) ranged from 3 to 7, with a mean of 6.48 (SD=1.22). Perceived usefulness of technology (system usability scale transformed scores) ranged from 85 to 100, with a mean of 94.29
Research Question One

To what extent does the Technology Acceptance Model identify predictors of system use of telehealth messages?

**H01a:** There are no statistically significant predictors of change scores for A1C (from baseline to follow-up).

**H01b:** There are no statistically significant predictors of change scores for BMI (from baseline to follow-up).

**H01c:** There are no statistically significant predictors of change scores for blood pressure (from baseline to follow-up).

**H01d:** There are no statistically significant predictors of change scores for weight (from baseline to follow-up).

To address research question one, five multiple linear regressions were conducted to determine if user characteristics, actual system use (total number of messages listened to), perceived usefulness of technology (SUS transformed scores), BSI scores (at baseline, two months, and follow-up), and behavioral intention to use (intention to listen to message at baseline and follow-up) effectively predict the following five clinical outcomes change scores: change scores for A1C (from baseline to follow-up), change scores for BMI (from baseline to follow-up), change scores for diastolic (from baseline to follow-up), change scores for systolic (from baseline to follow-up), and change scores for weight (from baseline to follow-up). Research question one was assessed for the experimental group only.

Prior to analysis, correlation analyses were conducted to determine which of the
potential predictors are statistically significantly related to the dependent variables; only those predictors with statistically significant correlations were used in the regression models. Statistical significance was determined using an alpha of 0.05. The categorical predictors were dummy coded as follows: marital status (1 = never married/single, $n = 33$, vs. 0 = other, $n = 34$), insurance type (1 = government, $n = 33$ vs. 0 = private, $n = 32$; cash patient, $n = 2$, not included), actual system use of technology (1 = seven messages, $n = 55$ vs. 0 = less than seven messages, $n = 12$). Race was not included because of the extreme difference in sample sizes: 63 Black participants vs. 4 other racial group participants. Insurance status was not included because of the extreme difference in one group, 65 participants said yes vs. 2 participants said no. Intention to use baseline was not included because all experimental group participants strongly agreed to utilize the provided resources. Intention to use follow-up was not included because of the relatively low responses in at least one group. At follow-up, 6 participants agreed and 61 participants strongly agreed to utilize the resources provided.

Of the 45 correlations conducted, only three yielded statistically significant results. Systolic change scores were statistically significantly related to marital status (never married/single vs. other), $r = -0.30$, $p < 0.05$. BSI baseline scores were statistically significantly related to weight change scores, $r = -0.28$, $p < .05$, and to BMI change scores, $r = -0.32$, $p < .05$. Because only these three correlations were found to be statistically significant, only the following regressions were conducted: marital status (never married/single vs. other) predicting systolic change scores, BSI baseline scores predicting weight change scores, and BSI baseline scores predicting BMI change scores. The correlation matrix depicting which potential predictors are statistically significantly
related to the five clinical outcome change scores are presented in Table 4.

Prior to the regression analyses, the assumptions of normality and homoscedasticity were assessed with scatterplots (Stevens, 2009) and assumptions were met. The regression with marital status (never married/single vs. other) predicting systolic change scores was statistically significant, $F(1, 60) = 5.87, p = .018, R^2 = 0.09, B = -10.11$. Findings indicated that marital status roughly accounted for 9% of the variance in systolic change scores. For every participant who is never married/single, systolic change scores decreased by 10.11 units.

Table 4

**Correlation Matrix between Potential Predictors and Clinical Outcome Change Scores (Experimental Group Only)**

<table>
<thead>
<tr>
<th>Potential predictors</th>
<th>User characteristics</th>
<th>Actual system use</th>
<th>BSI</th>
<th>Perceived usefulness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical outcome change scores</td>
<td>Age</td>
<td>Gender</td>
<td>Marital status</td>
<td>Insurance type</td>
</tr>
<tr>
<td>Weight</td>
<td>.06</td>
<td>-.06</td>
<td>-.09</td>
<td>-.17</td>
</tr>
<tr>
<td>BMI</td>
<td>.03</td>
<td>-.05</td>
<td>-.20</td>
<td>-.25</td>
</tr>
<tr>
<td>A1C</td>
<td>.13</td>
<td>.06</td>
<td>.08</td>
<td>.03</td>
</tr>
<tr>
<td>Systolic</td>
<td>-.09</td>
<td>.13</td>
<td>-.30*</td>
<td>-.03</td>
</tr>
<tr>
<td>Diastolic</td>
<td>.17</td>
<td>.24</td>
<td>-.12</td>
<td>.06</td>
</tr>
</tbody>
</table>

*Note. * $p < .05$, ** $p < .01$.*

The regression with BSI baseline scores predicting weight change scores was statistically significant, $F(1, 60) = 4.99, p = .029, R^2 = 0.08, B = -14.07$. Findings indicated that BSI baseline scores roughly accounted for 8% of the variability in weight.
change scores. As BSI baseline scores increased by one unit, weight change scores decrease by 14.07 units. The regression with BSI baseline scores predicting BMI change scores was statistically significant, $F(1, 60) = 6.79$, $p = .012$, $R^2 = 0.10$, $B = -3.83$, indicating that BSI baseline scores accounted for roughly 10% of the variability in BMI change scores. As BSI baseline scores increased by one unit, BMI change scores decreased by 3.83 units. The null hypothesis was rejected. The results of the three simple linear regressions are presented in Table 5.

Table 5

<table>
<thead>
<tr>
<th>Source</th>
<th>$B$</th>
<th>$SE$</th>
<th>$\beta$</th>
<th>$t$</th>
<th>$p$</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marital status predicting systolic change scores</td>
<td>-10.11</td>
<td>4.17</td>
<td>-.30</td>
<td>-2.42</td>
<td>.018</td>
<td>[-18.46, -1.77]</td>
</tr>
<tr>
<td>BSI baseline scores predicting weight change scores</td>
<td>-14.07</td>
<td>6.30</td>
<td>-.28</td>
<td>-2.23</td>
<td>.029</td>
<td>[-26.68, -1.47]</td>
</tr>
<tr>
<td>BSI baseline scores predicting BMI change scores</td>
<td>-3.83</td>
<td>1.47</td>
<td>-.32</td>
<td>-2.61</td>
<td>.012</td>
<td>[6.76, -0.89]</td>
</tr>
</tbody>
</table>

A multiple linear regression was conducted to determine if user characteristics, perceived usefulness, and behavioral intention to use effectively predicted actual system use. The independent variables were age, gender, marital status (coded 0 = no vs. 1 = never married/single), insurance type (0 = private vs. 1 = government), perceived usefulness (SUS transformed scores) and intention to use post (coded 4 = agree vs. 5 = strongly agree). Intention to use pre was not included because all experimental group participants selected strongly agree (n = 67), and thus, it was a constant. Prior to
analysis, the assumptions of linearity, homoscedasticity, and absence of multicollinearity were assessed. The assumptions were met. The results of the regression model were statistically significant, $F(6, 58) = 4.52, p = .001, R^2 = 0.32$. These findings indicate that age, gender, marital status, insurance type, perceived usefulness, and intention to use roughly explained 32% of the variability in actual system use. Of those variables, age offered a unique, significant contribution towards the prediction of actual system use, $B = 0.06, p < .001$. This result suggests age is the strongest predictor of actual system use. For every unit increase in age, actual system use increased by 0.06 units. The results are presented in Table 6.

Table 6

<table>
<thead>
<tr>
<th>Source</th>
<th>$B$</th>
<th>SE</th>
<th>$\beta$</th>
<th>t</th>
<th>p</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.06</td>
<td>0.02</td>
<td>.48</td>
<td>3.90</td>
<td>.000</td>
<td>[0.03, 0.09]</td>
</tr>
<tr>
<td>Gender</td>
<td>0.11</td>
<td>0.34</td>
<td>.04</td>
<td>0.33</td>
<td>.743</td>
<td>[-0.58, 0.80]</td>
</tr>
<tr>
<td>Marital status</td>
<td>0.52</td>
<td>0.29</td>
<td>.21</td>
<td>1.81</td>
<td>.076</td>
<td>[-0.06, 1.10]</td>
</tr>
<tr>
<td>Insurance type</td>
<td>0.18</td>
<td>0.29</td>
<td>.07</td>
<td>0.63</td>
<td>.531</td>
<td>[-0.40, 0.76]</td>
</tr>
<tr>
<td>Perceived usefulness</td>
<td>0.03</td>
<td>0.05</td>
<td>.07</td>
<td>0.60</td>
<td>.548</td>
<td>[-0.06, 0.12]</td>
</tr>
<tr>
<td>Intention to use post</td>
<td>0.50</td>
<td>0.52</td>
<td>.12</td>
<td>0.96</td>
<td>.343</td>
<td>[-0.55, 1.55]</td>
</tr>
</tbody>
</table>

Note. $F(6, 58) = 4.52, p = .001, R^2 = .32$

Research Question Two

Are there statistically significant differences between patients who received telehealth messages and those in a routine care group on clinical outcomes of A1C, blood pressure, body mass index, and weight at baseline and follow-up?
**H₀₂a:** There are no statistically significant differences between patients who received telehealth messages and those in a routine care group on clinical outcomes of A₁C at baseline and follow-up.

**H₀₂b:** There are no statistically significant differences between patients who received telehealth messages and those in a routine care group on clinical outcomes of blood pressure at baseline and follow-up.

**H₀₂c:** There are no statistically significant differences between patients who received telehealth messages and those in a routine care group on clinical outcomes of body mass index (BMI) at baseline and follow-up.

**H₀₂d:** There are no statistically significant differences between patients who received telehealth messages and those in a routine care group on clinical outcomes of weight at baseline and follow-up.

To address research question two, a one-within, one-between MANOVA was conducted to determine if statistically significant differences existed on A₁C, systolic and diastolic blood pressure, BMI, and weight by time (baseline vs. follow-up) and group (control vs. experimental). The within-subjects variable is baseline vs. follow-up and the between-subjects variable is control vs. experimental. Statistical significance was determined using an alpha value of .05. Prior to analysis, the assumptions of normality, absence of multicollinearity, and equality of variance/covariance were assessed. Normality was assessed with skew and kurtosis, where normality is defined as skew values between -2.00 and 2.00 and kurtosis values between -7.00 and 7.00. No values were beyond the aforementioned parameters and the assumption of normality was met. Absence of multicollinearity among the dependent variables was assessed with Pearson
correlations, where multicollinearity is defined as correlation values above $r = 0.90$ (Tabachnick & Fidell, 2012). No correlation values were above 0.90 and thus the assumption was met. Equality of variance was assessed with Levene’s tests and results did not yield a statistically significant finding, and thus, the assumption was met. Equality of covariance was assessed with Box’s M test. The result was not statistically significant, and the assumption was met. The interaction between time and group on the five scores was assessed to determine if the impact of group is statistically significantly influenced by time. The interaction between time and group did not yield statistically significant findings, $F(5, 113) = 1.19, p = .318$, partial $\eta^2 = 0.05$, indicating that distinct statistical differences can be made on the scores by time alone and by group alone.

The with-in subjects effect yielded statistically significant findings, $F(5, 113) = 3.00, p = .014$, partial $\eta^2 = .12$, suggesting that the scores are statistically significantly different by time (baseline vs. follow-up). The MANOVA model’s effect size (partial $\eta^2$) of .12 indicates that a small difference exist on the scores between baseline and follow-up (Morgan, Leech, Gloekner & Barrett, 2007). To determine where the statistically significant differences lie, the individual ANOVAs (one per dependent variable) were interpreted: only systolic scores ($p = .001$) and diastolic scores ($p = .007$) were statistically significantly different between baseline and follow-up; no other score was statistically significantly different by time. Systolic scores were statistically significantly higher at baseline $(M = 142.00)$ than at follow-up $(M = 136.48)$ and diastolic scores were statistically significantly higher at baseline $(M = 78.22)$ than at follow-up $(M = 75.59)$.

The between-subjects effect did not yield statistically significant findings, $F(5, 113) = 0.71, p = .615$, partial $\eta^2 = 0.03$, suggesting that the clinical outcome scores are not
statistically significantly different by group (control vs. experimental). No statistical significance can be interpreted on the scores between participants in the control group and participants in the experimental group. Therefore, we fail to reject the null hypothesis, as there are no statistically significant differences between patients who received telehealth messages and those in a routine care group on clinical outcomes of blood pressure at baseline and follow-up. We fail to reject the null hypothesis because there are differences in the systolic and diastolic blood pressure readings from baseline to follow-up in the experimental treatment. Means and standard deviations on the dependent variables matched by time and group are presented in Table 7. The results of the one-within, one-between MANOVA are presented in Table 8.

**Table 7**

| Means and Standard Deviations BMI, Weight, A1C, Systolic, and Diastolic Scores by Group and Time |
|---|---|---|---|---|---|---|---|---|---|
| Variable | Baseline | | | | | | | | |
| | Control (N = 60) | Experimental (N = 59) | Total (N = 119) | | | | | | |
| | M | SD | M | SD | M | SD | M | SD | |
| BMI | 35.41 | 7.51 | 35.75 | 7.68 | 35.58 | 7.56 | | | |
| Systolic | 143.13 | 21.41 | 140.85 | 20.10 | 142.00 | 20.72 | | | |
| Diastolic | 77.23 | 11.05 | 79.22 | 12.92 | 78.22 | 12.01 | | | |
| Weight | 220.45 | 52.06 | 218.86 | 47.04 | 219.66 | 49.43 | | | |
| A1C | 8.12 | 2.49 | 8.36 | 2.39 | 8.24 | 2.44 | | | |
| Follow-up | | | | | | | | | |
| | Control (N = 60) | Experimental (N = 59) | Total (N = 119) | | | | | | |
| | M | SD | M | SD | M | SD | M | SD | |
| BMI | 35.37 | 7.47 | 35.77 | 7.41 | 35.57 | 7.41 | | | |
| Systolic | 138.85 | 16.53 | 134.07 | 15.52 | 136.48 | 16.15 | | | |
| Diastolic | 76.23 | 11.05 | 79.22 | 12.92 | 78.22 | 12.01 | | | |
| Weight | 219.95 | 52.15 | 218.47 | 45.65 | 219.66 | 48.84 | | | |
| A1C | 8.06 | 2.46 | 8.41 | 2.26 | 8.23 | 2.36 | | | |
Table 8

One-Between One-Within MANOVA on BMI, Weight, A1C, Systolic, and Diastolic Scores by Group and Time

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p</th>
<th>partial $\eta^2$</th>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Group</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>BMI</td>
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<td>0.07</td>
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<td>.00</td>
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<tr>
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<td>1</td>
<td>743.07</td>
<td>1.37</td>
<td>.244</td>
<td>.01</td>
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<tr>
<td>Diastolic</td>
<td>6.46</td>
<td>1</td>
<td>6.46</td>
<td>0.03</td>
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<td>.00</td>
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<td>Weight</td>
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<td>139.37</td>
<td>0.03</td>
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<td>.00</td>
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<tr>
<td>A1C</td>
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<td>1</td>
<td>5.17</td>
<td>0.53</td>
<td>.470</td>
<td>.00</td>
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<td></td>
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</tr>
<tr>
<td>BMI</td>
<td>13133.01</td>
<td>117</td>
<td>112.25</td>
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<tr>
<td>Systolic</td>
<td>63427.78</td>
<td>117</td>
<td>542.12</td>
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</tr>
<tr>
<td>Diastolic</td>
<td>24571.82</td>
<td>117</td>
<td>210.02</td>
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<td>—</td>
<td>—</td>
</tr>
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<td>Weight</td>
<td>567354.81</td>
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<td>4849.19</td>
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</tr>
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<td>A1C</td>
<td>1151.10</td>
<td>117</td>
<td>9.84</td>
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<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>Within-subjects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Time</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
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<td>1</td>
<td>0.01</td>
<td>0.01</td>
<td>.934</td>
<td>.00</td>
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<tr>
<td>Systolic</td>
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<td>1</td>
<td>1820.42</td>
<td>12.43</td>
<td>.001</td>
<td>.10</td>
</tr>
<tr>
<td>Diastolic</td>
<td>417.72</td>
<td>1</td>
<td>417.72</td>
<td>7.61</td>
<td>.007</td>
<td>.06</td>
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<tr>
<td>Weight</td>
<td>11.78</td>
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<td>11.78</td>
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<td>.01</td>
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<td>.971</td>
<td>.00</td>
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<tr>
<td>Time*Group</td>
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<td></td>
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</tr>
<tr>
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<td>0.06</td>
<td>0.07</td>
<td>.786</td>
<td>.00</td>
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<tr>
<td>Systolic</td>
<td>92.69</td>
<td>1</td>
<td>92.69</td>
<td>0.63</td>
<td>.428</td>
<td>.01</td>
</tr>
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<td>.017</td>
<td>.05</td>
</tr>
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<td>1</td>
<td>0.18</td>
<td>0.01</td>
<td>.923</td>
<td>.00</td>
</tr>
<tr>
<td>A1C</td>
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<td>1</td>
<td>0.19</td>
<td>0.11</td>
<td>.737</td>
<td>.00</td>
</tr>
<tr>
<td>Error</td>
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<td></td>
</tr>
<tr>
<td>BMI</td>
<td>99.24</td>
<td>117</td>
<td>0.85</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Systolic</td>
<td>17140.16</td>
<td>117</td>
<td>146.50</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Diastolic</td>
<td>6419.63</td>
<td>117</td>
<td>54.87</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Weight</td>
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<td>19.18</td>
<td>—</td>
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</tr>
<tr>
<td>A1C</td>
<td>199.46</td>
<td>117</td>
<td>1.71</td>
<td>—</td>
<td>—</td>
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</tr>
</tbody>
</table>

*Note. F statistics are Wilks' Lambda approximation. Between-subjects: $F(5, 113) = 0.71, p = .615$, partial $\eta^2 = .03$. Within-subjects: $F(5, 113) = 3.00, p = .014$, partial $\eta^2 = .12$. Interaction: $F(5, 113) = 1.19, p = .318$, partial $\eta^2 = .05$.

The BSI assessed management of diabetes as it relates to self-care behaviors. Nearly half
of participants (43%) followed a healthy eating plan 4 to 6 days in the last 7 days at baseline. The majority of participants reported no physical activity (n=76; 54%) when asked about being active in the last 7 days. Nearly half of all participants (n=65; 46%) monitored blood sugar levels at least once per day at baseline, while 30% (n=42) participants responded to daily checks. The majority of participants (75%) reported not taking any diabetes medicines as recommended in the previous week at baseline. When asked over the past week or last 7 days, how many days were you able to cope in a healthy way when faced with stress, emotional or family problems, 54% (n=75) participants reported 4 to 6 days. Of the total participants, nearly half (n=69; 49%) used problem solving 4 to 6 days of the previous week to make challenging decisions regarding the self-care management of diabetes.

The reducing risks component allowed patients an opportunity to self-report behaviors used to prevent or reduce complications over the previous 12 months to include an eye, foot, and oral examination. Baseline self-care behaviors indicated that 71% had an eye exam with an optometrist, 96% had a foot examination by health care provider, 51% had an oral examination by a dental care provider and 53% received a flu and/or pneumonia vaccination. Of the total participants, 96% reported having cholesterol and triglycerides checked (n=135), while all (n=138) received an A1C test and had their blood pressure checked within the previous twelve months.

**Research Question Three**

Are there statistically significant differences between patients who received telehealth messages and those in a routine care group on patients’ self-care management of diabetes as measured by the Behavior Score Instrument over time?
**Hₐ₃:** There are no statistically significant differences between patients who received telehealth messages and those in a routine care group on patients’ self-care management of diabetes as measured by the Behavior Score Instrument over time.

To address research question three, a one-within, one-between ANOVA was conducted to determine if statistically significant differences existed on BSI scores by time (baseline vs. at second month vs. follow-up) and group (control vs. experimental). The within-subjects variable is baseline vs. at second month vs. follow-up. The between-subjects variable is control vs. experimental. Statistical significance was determined using an alpha value of 0.05. Prior to analysis, the assumptions of normality and equality of variance/covariance were assessed. Normality was assessed with skew and kurtosis, where normality is defined as skew values between -2.00 and 2.00 and kurtosis values between -7.00 and 7.00. No values were beyond the aforementioned parameters and the assumption of normality was met. Equality of variance was assessed with Levene’s tests and results did not indicate a statistically significant finding, and thus the assumption was met. Equality of covariance was assessed with Box’s M test and the result was statistically significant \((p < .001)\), indicating the assumption was not met. Due to this violation, Pillai’s Trace approximation of \(F\) was reported. The interaction between time and group on BSI scores was assessed to determine if the impact of group is statistically significantly influenced by time. The interaction between time and group yielded statistically significant findings, \(F(2, 135) = 4.13, p = .018,\) partial \(\eta^2 = 0.06\), indicating that distinct statistical differences cannot be made on the scores by time alone and by group alone. The impact of group is statistically significantly influenced by time. The model’s effect size (partial \(\eta^2\) ) = 0.06 indicates that very small statistical differences.
Because the interaction term was found to be statistically significant, post-hoc analyses were conducted to determine where the significant differences lie. For the control group, no statistically significant differences were found on BSI scores by time, $F(2, 71) = 0.74$, $p = .480$, partial $\eta^2 = 0.01$. No statistical significance can be interpreted for the control group on BSI scores by time. For the experimental group, statistically significant differences were found, $F(2, 132) = 12.36$, $p < .001$, partial $\eta^2 = 0.16$, indicating BSI scores were statistically lower at baseline ($M = 2.82$) than at 2 months ($M = 2.84$) and at follow-up ($M = 2.84$); no other statistically significant differences were found. The experimental group's effect size (partial $\eta^2$) of 0.16 indicates that small statistically significant differences existed on BSI score at baseline vs. at 2 months and at baseline vs. follow-up. The null hypothesis was rejected. The results of the one-between, one-within ANOVA are presented in Table 9. The results of the post-hoc analyses are presented in Table 10. The means and standard deviations on BSI scores by time and group are presented in Table 11.

**Construct Research Question One**

Is there a statistically significant relationship between change in clinical outcomes and actual system use?

$H_0$: Change in clinical outcomes does not statistically significantly predict actual system use, as measured by the total number of messages successfully delivered.

To address construct research question one, five Pearson correlations were conducted to determine if a statistical association exists between actual system use (total number of messages listened to) and the five clinical outcome change scores.

Statistical significance was determined using an alpha of .05. The five
correlations did not yield statistically significant findings. These results suggest that no relationship exists between the change in clinical outcome scores and actual system use. With no statistical significance, we fail to reject the null hypothesis. The results of the five Pearson correlations are presented in Table 12.

Table 9

One-Between One-Within ANOVA on BSI Scores by Group and Time

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p</th>
<th>partial $\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Between-subjects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BSI</td>
<td>0.04</td>
<td>1</td>
<td>0.04</td>
<td>0.99</td>
<td>.323</td>
<td>.01</td>
</tr>
<tr>
<td>Error</td>
<td>4.93</td>
<td>136</td>
<td>0.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Within-subjects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BSI</td>
<td>0.01</td>
<td>2</td>
<td>0.01</td>
<td>11.45</td>
<td>.001</td>
<td>.08</td>
</tr>
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<td>Time*Group</td>
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<td></td>
</tr>
<tr>
<td>BSI</td>
<td>0.01</td>
<td>2</td>
<td>0.00</td>
<td>4.13</td>
<td>.018</td>
<td>.06</td>
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<td>Error</td>
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<td>272</td>
<td>0.00</td>
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</table>

*Note. F statistics are Pillai’s Trace approximation. Between-subjects: $F(1, 136) = 0.99, p = .323$, partial $\eta^2 = .01$. Within-subjects: $F(2, 272) = 11.45, p = .001$, partial $\eta^2 = .08$. Interaction: $F(2, 135) = 4.13, p = .018$, partial $\eta^2 = .06$.*

Table 10

Post-hoc Analyses on BSI Scores by Group and Time

<table>
<thead>
<tr>
<th>Source</th>
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<th>MS</th>
<th>F</th>
<th>p</th>
<th>partial $\eta^2$</th>
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<tr>
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<td>0.00</td>
<td>0.74</td>
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<td>.01</td>
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<td>Experimental group</td>
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<td>12.36</td>
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<td>132</td>
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</table>

*Note. F statistics are Pillai’s Trace approximation. Control group: $F(2, 140) = 0.74, p = .480$, partial $\eta^2 = .01$. Experimental group: $F(2, 132) = 12.36, p < .001$, partial $\eta^2 = .16$.***
Table 11

Means and Standard Deviations on BSI Scores by Group and Time

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<thead>
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<th>Baseline</th>
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</thead>
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<tr>
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<td>Control (N=71) M(SD)</td>
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<td>BSI Score</td>
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</tr>
<tr>
<td></td>
<td>Experimental (N=67) M(SD)</td>
</tr>
<tr>
<td></td>
<td>2.82(0.12)</td>
</tr>
<tr>
<td></td>
<td>Total (N=138) M(SD)</td>
</tr>
<tr>
<td></td>
<td>2.81(0.12)</td>
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</table>

<table>
<thead>
<tr>
<th>Measure</th>
<th>Two Months</th>
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<td>2.81(0.11)</td>
</tr>
<tr>
<td></td>
<td>Experimental (N=67) M(SD)</td>
</tr>
<tr>
<td></td>
<td>2.84(0.11)</td>
</tr>
<tr>
<td></td>
<td>Total (N=138) M(SD)</td>
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<td></td>
<td>2.83(0.11)</td>
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<table>
<thead>
<tr>
<th>Measure</th>
<th>Follow-up at 3-4 Months</th>
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<td>2.81(0.11)</td>
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<td>Experimental (N=67) M(SD)</td>
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<td>2.84(0.11)</td>
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<td></td>
<td>Total (N=138) M(SD)</td>
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<tr>
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<td>2.83(0.11)</td>
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</tbody>
</table>

Table 12

Pearson Correlations between Actual System Use and Five Clinical Outcome Change Scores

<table>
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<th>Clinical outcome change scores</th>
<th>Actual system use (number of messages listened to)</th>
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</thead>
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<tr>
<td>Weight</td>
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<td>BMI</td>
<td>-.16</td>
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<tr>
<td>A1C</td>
<td>.24</td>
</tr>
<tr>
<td>Systolic</td>
<td>.07</td>
</tr>
<tr>
<td>Diastolic</td>
<td>.20</td>
</tr>
</tbody>
</table>

Note. * p < .05, ** p < .01.

Construct Research Question Two

Is there a statistically significant relationship between user characteristics and actual
system use?

**H₀2c:** User characteristics do not statistically significantly predict actual system use, as measured by the total number of messages successfully delivered.

To address construct research question two, six Pearson correlations were proposed to determine if a statistically significant association exists between actual system use (number of messages listened to) and the six user characteristics (age, gender, marital status, race, insurance status, and type of insurance). Marital status and type of insurance were dummy coded as indicated in main research question one. However, as also indicated in main research question one, race and insurance status were excluded from the analysis due to the relatively low number in at least one group; thus, only four Pearson correlations were conducted to answer construct research question two. Of the four correlation analyses, only one yielded statistically significant findings. Age was statistically significantly related to actual system use (number of messages listened to), $r = 0.50$, $p < .001$, indicating a large statistical association exists: as age increases, number of messages listened to also tends to increase. The null hypothesis was rejected. The results are of the correlations are presented in Table 13.

**Table 13**

**Pearson Correlations between Actual System Use and User Characteristics**

<table>
<thead>
<tr>
<th>User characteristics</th>
<th>Actual system use (number of messages listened to)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>.50**</td>
</tr>
<tr>
<td>Gender</td>
<td>.12</td>
</tr>
<tr>
<td>Marital status</td>
<td>.10</td>
</tr>
<tr>
<td>Insurance type</td>
<td>.09</td>
</tr>
</tbody>
</table>

*Note. * $p < .05$, ** $p < .01$.}
**Construct Research Question Three**

Is there a statistically significant relationship between perceived usefulness and behavioral intention to use?

**H₀₃c**: There is no statistically significant relationship between perceived usefulness and behavioral intention to use.

To address construct research question three, two Spearman rho correlations were conducted to determine if a statistical association existed between perceived usefulness (SUS transformed scores) and intention to use at baseline and follow-up. The first Spearman correlation was conducted between intention to use pre-intervention and perceived usefulness. All, with the exception of one participant, indicated a 5 or "Strongly agree" on the intention to use scale, and a correlation could not be conducted. The second Spearman correlation was conducted between intention to use following the intervention and perceived usefulness, and indicated no statistically significant correlation ($r_s = -0.02, p = .866$). Thus, we fail to reject the null hypothesis.

**Construct Research Question Four**

Is there a statistically significant relationship between behavioral intention to use and actual system use?

**H₀₄c**: There is no statistically significant relationship between behavioral intention to use and actual system use.

To address construct research question four, two Spearman correlations were conducted. The first Spearman correlation was conducted between intention to use at baseline and actual system use. All, with the exception of one participant, indicated a 5 or "Strongly agree" on the intention to use scale, and a correlation could not be conducted.
The second Spearman correlation was conducted between intention to use following the intervention and actual system use, and indicated a statistically significant correlation \( r_s = 0.29, p = .018 \), a near medium strength of relationship. As intention to use at follow-up increases in agreement, the number of messages listened to also increased.

**Construct Research Question Five**

Is there a statistically significant relationship between perceived usefulness and actual system use?

**Hₐ₅c**: There is no statistically significant relationship between perceived usefulness and actual system use.

To address construct research question five, a Pearson correlation was conducted between perceived usefulness and actual system use. Results of the Pearson correlation did not indicate a statistically significant association \( r = 0.10, p = .442 \). We fail to reject the null hypothesis, as there is no statistically significant relationship between perceived usefulness and actual system use.

**Construct Research Question Six**

What combination of variables contributes to changes in clinical values?

**Hₐ₆c**: None of the variables are statistically significant predictors of changes in clinical values.

To address construct research question six, a correlation matrix was created between the six change scores and all previous variables for the experimental group only. Statistically significant correlations were found between systolic pressure change scores and marital status \( r_{pb} = 0.32, p = .011 \), change in weight and intent to use at follow-up \( r = -0.31, p = .015 \), and diastolic pressure change scores and actual system use \( r = 0.28, \)
were found to hold statistically significant associations. Three simple regression analyses were conducted, and all three predictor variables were included in each. Marital status was dummy coded to include divorced versus married, and other versus married.

The statistically significantly correlated variables were used to predict change in weight scores. Prior to analysis the assumptions of normality and homoscedasticity were visually assessed using scatterplots. Both assumptions were met. The absence of multicollinearity was assessed using variance inflation factors and the assumption was met for all variables. Results of the first multiple linear regression did not indicate a statistically significant model ($F(4, 57) = 1.77, p = .147, R^2 = 0.11$), and no further examination was conducted. Results of the first multiple linear regression are presented in Table 14.

The statistically significantly correlated variables were used to predict change in diastolic pressure scores. Prior to analysis the assumptions of normality and homoscedasticity were visually assessed using scatterplots; both assumptions were met. The absence of multicollinearity was assessed using variance inflation factors and the assumption was met for all variables. Results of the first multiple linear regression did not indicate a statistically significant model ($F(4, 57) = 1.56, p = .198, R^2 = 0.10$), and no further examination was conducted. Results of this multiple linear regression are presented in Table 15.

The statistically significantly correlated variables were then used to predict change in systolic pressure scores. Prior to analysis the assumptions of normality and homoscedasticity were visually assessed using scatterplots; both assumptions were met. The absence of multicollinearity was assessed using variance inflation factors and the
assumption was met for all variables. Results of the first multiple linear regression indicated a statistically significant model \( F(4, 57) = 2.53, p = .050, R^2 = 0.15 \). The \( R^2 \) value of 0.15 indicated that roughly 15% of the variation in systolic pressure change was accounted for by the combination of independent variables. Individual \( t \) tests indicated that being divorced was a statistically significant predictor of systolic pressure change following the intervention \( (t = 2.89, p = .005) \), and the corresponding \( B \) value suggested that divorcees had an average increase in systolic pressure 13.88 mmHg greater than married participants. Results of this multiple linear regression are presented in Table 16.

### Table 14

Results for Multiple Linear Regression with Intent to Use, Actual Use, and Marital Status Predicting Change in Weight

<table>
<thead>
<tr>
<th>Source</th>
<th>( B )</th>
<th>( SE )</th>
<th>( \beta )</th>
<th>( t )</th>
<th>( p )</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intent to use</td>
<td>-7.86</td>
<td>3.08</td>
<td>-.35</td>
<td>-2.55</td>
<td>.013</td>
<td>[-14.02, -1.70]</td>
</tr>
<tr>
<td>Actual use</td>
<td>0.62</td>
<td>0.67</td>
<td>.13</td>
<td>0.93</td>
<td>.356</td>
<td>[-0.72, 1.96]</td>
</tr>
<tr>
<td>Marital status (divorce)</td>
<td>0.59</td>
<td>1.78</td>
<td>.05</td>
<td>0.33</td>
<td>.741</td>
<td>[-2.97, 4.15]</td>
</tr>
<tr>
<td>Marital status (other)</td>
<td>0.58</td>
<td>2.07</td>
<td>.04</td>
<td>0.28</td>
<td>.780</td>
<td>[-3.56, 4.71]</td>
</tr>
</tbody>
</table>

*Note. \( F(4, 57) = 1.77, p = .147, R^2 = .11 \).*

### Table 15

Results for Multiple Linear Regression with Intent to Use, Actual Use, and Marital Status Predicting Change in Diastolic Pressure

<table>
<thead>
<tr>
<th>Source</th>
<th>( B )</th>
<th>( SE )</th>
<th>( \beta )</th>
<th>( t )</th>
<th>( p )</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intent to use</td>
<td>0.27</td>
<td>6.09</td>
<td>.01</td>
<td>0.04</td>
<td>.965</td>
<td>[-11.93, 12.47]</td>
</tr>
<tr>
<td>Actual use</td>
<td>2.82</td>
<td>1.32</td>
<td>.29</td>
<td>2.13</td>
<td>.038</td>
<td>[0.17, 5.47]</td>
</tr>
<tr>
<td>Marital status (divorce)</td>
<td>3.90</td>
<td>3.52</td>
<td>.15</td>
<td>1.11</td>
<td>.273</td>
<td>[-3.15, 10.95]</td>
</tr>
<tr>
<td>Marital status (other)</td>
<td>3.02</td>
<td>4.09</td>
<td>.10</td>
<td>0.74</td>
<td>.464</td>
<td>[-5.17, 11.20]</td>
</tr>
</tbody>
</table>

*Note. \( F(4, 57) = 1.56, p = .198, R^2 = .10 \).*
Table 16

Results for Multiple Linear Regression with Intent to Use, Actual Use, and Marital Status Predicting Change in Systolic Pressure

<table>
<thead>
<tr>
<th>Source</th>
<th>B</th>
<th>SE</th>
<th>β</th>
<th>t</th>
<th>p</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intent to use</td>
<td>-4.37</td>
<td>8.31</td>
<td>-0.07</td>
<td>-0.53</td>
<td>.601</td>
<td>[-21.02, 12.28]</td>
</tr>
<tr>
<td>Actual use</td>
<td>2.76</td>
<td>1.81</td>
<td>0.20</td>
<td>1.53</td>
<td>.132</td>
<td>[0.86, 6.38]</td>
</tr>
<tr>
<td>Marital status (divorce)</td>
<td>13.88</td>
<td>4.81</td>
<td>0.38</td>
<td>2.89</td>
<td>.005</td>
<td>[4.26, 23.50]</td>
</tr>
<tr>
<td>Marital status (other)</td>
<td>4.64</td>
<td>5.58</td>
<td>0.11</td>
<td>0.83</td>
<td>.409</td>
<td>[-6.53, 15.81]</td>
</tr>
</tbody>
</table>

*Note. F(4, 57) = 2.53, p = .050, R² = .15*

The qualitative methodology consisted of an open-ended question. Participants responded to the question “How likely are you to use these resources to help manage your diabetes care” using a Likert scale with anchors that ranged from 1 to 5. As a follow-up, participants were asked to respond to an open ended question, “why or why not?” Responses were recorded at enrollment and at the follow-up period either in person at a diabetes related visit or over the telephone. Patterns and recurring themes were derived from the content using a thematic analysis (Patton, 2002). The most frequently reported intention to utilize the resources provided was the need to make better food choices. Patterns were categorized from this qualitative component into four emerging themes:

**Medication Adherence / Reminders / Alerts:**

1. “Is this system going to remind me to take my medicine?”
2. “I think listening to the messages will help me to remember what I need to do as far as taking my meds, eating right, and checking my sugar.”

**Weight Control/Weight Management:**

1. “I definitely need to lose more weight, so I am sure I am going to listen to
these messages.”

2. “I used to think that because I work 5 days a week, I am working out. But that does not count. I need to learn other things I can do at my job that will count as physical activity.”

Culturally Appropriate Food / Taste Preferences:

1. “Doctor says I need to stop using so much salt and eating greasy foods.”

2. “Listening to the messages will be a reminder that I should not be eating so much salt.”

3. “I need to know what I can eat so that my blood sugars won’t go up or down.”

4. “I just need to be mindful of what I am eating so that my sugars don’t go up.”

5. “I am sure I am going to listen to these messages because I have been making certain foods for years with certain ingredients. Now the doctor is telling me that I have to switch out some of the ingredients that I use. I think it will taste differently.”

6. “Maybe these messages will encourage me to ‘do better’ in terms of what I am eating.”

7. “I said I was going to eat better in the New Year, so this will definitely help because the only food places near me are fast food places.”

8. “How am I suppose to eat right when everything near me is bad?”

9. “In my mind, I am eating healthy. Maybe this information will help me with that.”
10. “I may not eat healthy at each meal, but I try to eat healthy for one meal. But I can tell by the way I feel if my sugars are up or down.”

**Problem Solving / Support System:**

1. “Sometimes I skip meals because of my work schedule. Maybe this information will show me quick things I can pack with me to take to work.”
2. “Because of the type of work I do, I just stop somewhere on my route and eat something quick and I know this isn’t healthy.”
3. “My mother, brother, and sister had diabetes. So anything that’s gonna help me, I need it; and it will help him to. I also don’t want my daughter to get diabetes.”
4. “My brother has diabetes, and I have to cook for him and me. Maybe me listening to the messages will help both of us out.”
5. “This will help me and my wife.”
6. “I do all the cooking for my husband, so this will help him eat better.”

A discussion of the study results, limitations, policy implications, and future directions are presented in Chapter V.
CHAPTER V

SUMMARY AND CONCLUSIONS

Self-care management of a disease is multifaceted due to the premise that the patient assumes a proactive role in the patient-provider relationship (Millard, Elliott, Girdler, 2013), while the provider administers key processes in the continuity of care to reduce associated complications. With shortages in certified diabetes educators, the interactive behavior change technology used in this research study does not replace the clinical vigilance, but rather augments existing diabetes education and experimental regimens by providing access to on-going training and support for diabetes self-care management within the patient centered medical home using an interactive behavior change technology. Specifically, this study integrated the application of a user-friendly technological mechanism to address self-care behavior and lifestyle modification changes among patients diagnosed with diabetes.

Researchers who examine technology based interventions suggest that the use of mobile communication devices is among the next generation of evolving technologies that will improve the delivery of health services (Catalani, Philbrick, Fraser, Mechael, & Israelski, 2013; mHealth Alliance, 2014). The evolving areas of technology that will impact public health and the delivery of health services in the next decade will include cell phone, text messaging, and computerized interventions along with the use of avatars (Pellowski & Kalichman, 2013). Technology based interventions will increase access to care and health education and promotion for chronic disease and management (Catalani, Philbrick, Fraser, Mechael, & Israelski, 2013; mHealth Alliance, 2014). The use of these technological mechanisms has the potential to make a significant impact on the delivery
of behavioral interventions virtually. Globally, the use of technology based interventions offers an opportunity to improve the processes and outcomes of care for patients managing diabetes, while reducing economic costs.

Diabetes self management education and training has been supported in the literature as an underutilized service by patients (Fitzner & Moss, 2013). Specifically for health education and promotion, the integration of technology and traditional behavioral change interventions will increase delivery of diabetes self-care management. Technology based interventions have been documented in the literature as an effective medium by which to address disease surveillance and provide interventions (Catalani, Philbrick, Fraser, Mechael, & Israelski, 2013; Pellowski & Kalichman, 2013). Pellowski and Kalichman (2013) suggest that emerging technologies such as mobile phones and voice technologies as the next generation of cost-effective mechanisms to address behavioral intervention.

The purpose of this study was to examine the effectiveness of the Technology Acceptance Model as a theoretical framework to identify predictors of system use of telehealth messages among diabetes patients in a primary care setting. This study also investigated the effect of the interventions on clinical outcomes and diabetes self-care behaviors. Results revealed that the theoretical framework used in this research was able to indicate those factors that contributed to actual system use. In the TAM framework, intention to use involves the conscious and willful decision made by the individual to engage in a particular behavior (Doswell et al., 2011). Findings in this study revealed that as intention to use the system increased in agreement, the number of messages participants listened to increased. This finding is supported by Hu et al. (2011) in that
intentions predict and influence actual system use. The variability in actual system use was accounted for by age, gender, marital status, insurance type, perceived usefulness, and intention to use. The user characteristic age was the strongest predictor of actual system use of telehealth messages. Age was statistically significantly related to actual system use. This finding is consisted with research conducted by Mann et al (2005), in that the use of a telephone is effective in delivering health information to older adult populations. In the current research study, as age increased, the number of messages listened to increased.

Findings in this study are consistent with results echoed in similar research studies in that experimental participants’ perceptions of the systems usability reflected the system’s ease of use (Estabrooks & Smith-Ray, 2008; Trento et al., 2001). Participants strongly agreed or agreed to the statements “I think that I would like to use this system frequently” and “I thought this system was easy to use”. The telephone is one of the least expensive communication mediums that can be coupled with traditional in-office visits as a tool to engage patients on healthier lifestyle modifications and on-going training and support to manage diabetes and reduce its associated complications. Additionally, a statistically significant relationship existed between behavioral intention to use and actual system use in this research. Telehealth, when delivered appropriately, is feasible in costs, and increases access to consistent self-care messages disseminated to patients managing diabetes (Fitzner & Moss, 2013).

In this study, clinical outcomes were statistically significantly different by time, but not by group. Multivariate analyses revealed that blood pressure was statistically significantly higher at baseline compared to follow-up. These findings are supported by
Morrison and colleagues (2012) in that monthly lifestyle counseling within primary care impacts the clinical outcomes of A1C, blood pressure, and LDL cholesterol. Specifically for the present research study, time may have been predictive because subjects in both the control and experimental group received either a telehealth message or an educational handout focused on reducing risks. Diabetes self-care management requires frequent surveillance, and ongoing, meticulous education and support (Fitzner & Moss, 2013). Additionally, the authors suggest that education and health promotion need to be ongoing based on clinical outcomes, patient self-reports, continuous assessment, and interprofessional team approach.

**Limitations**

This study employed convenience sampling from one patient-centered medical home. The calculated minimum required sample size to achieve empirical validity was 259 potential participants. Therefore, the enrolled sample of 138 participants from one primary care office implies that the results are not generalizable.

This research analyzed BSI responses, which were self-reported behaviors of the previous week's management of diabetes. Testing and bias was a threat to the internal validity of this research, as the BSI may have sensitized the participants to the nature of the research in discussing their self-care management of diabetes. BSI data were collected at three intervals: baseline, immediately following the intervention, and at 3-4 month follow-up. As a result, participants may have modified or improved self-care behavior management of diabetes in response to this research study.

Multiple study interference was another potential threat to the external validity of this research. Participants in the study may have experienced a shared medical
appointment within the previous year in which the same curriculum is used to address the AADE’s seven self-care behaviors. Given these threats to external and internal validity, generalizations should be made with caution with populations outside of this study’s sample.

**Policy Implications**

Among the adult participants in the present study, the majority had some type of health insurance coverage, whether private or government sponsored. More than half had government sponsored insurance. Medicare covers self-management training for diabetes, diabetes prescreening tests, supplies for monitoring, flu and pneumonia vaccinations, foot examinations and treatment services, eye examinations, and medication therapy services (National Diabetes Information Clearinghouse, 2012). Although these services and supplies are covered, mandates in place requiring patients attend one diabetes self-management training within their respective medical home would improve patient education and reinforce effective diabetes management practices.

Health care providers within the patient-centered medical home assume much of the responsibility for the management of continuity of care for patients. Patient-centered medical homes are increasing the types of services offered for patients managing chronic illnesses such as diabetes to include shared medical appointments, in-home telemonitoring, weight loss educational sessions, and telehealth solutions that are culturally appropriate to delay diabetes complications.

**Health Services Research Implications**

Based on present study’s findings, future qualitative research is needed to address the four emerging themes derived from the qualitative component: Medication
Adherence/Reminders/Alerts, Weight Control/Weight Management, Culturally Appropriate Food/Taste Preferences, and Problem Solving/Support System. The need to make better food choices was the most frequently reported intention to utilize the provided resources. When asked, how many days in the past week were you able to follow a healthy eating plan, the responses were prefaced with, “I try to eat healthy every day”. Future research is recommended to explore these qualitative themes to determine the role, if any, of food deserts and how they may impact or impede the self-care management of diabetes.

Future research also is needed to address links between oral care and diabetes, as nearly half of participants in this research study reported not receiving an oral examination by a dental care provider. Among this group, when asked about a visit with a dentist in the past 12 months during enrollment, participants commented that “I haven’t been to the dentist in years. I have dentures, so there is no need for me to go.” Future studies should consider examining the impact of foregoing standards of care checks, such as an oral examination by a dental care provider, and its impact on diabetes. This information may provide additional insight on the relationship between edentulism and diabetes among this population. More specifically, the need for participants with dentures or those classified with edentulism to continue with yearly oral health care checks.

The Centers for Disease Control and Prevention reports that between 1980 and 2011, diabetes was more prevalent among Blacks, predominantly Black females (Centers for Disease Control and Prevention, 2013). In the present study, the majority of the participants were Black and 67% were female. These findings suggest that Blacks,
particularly Black Women, are disproportionately affected by the chronic disease diabetes. Exploring which genetic factors are stronger predictors of developing diabetes is an area of research that should be examined in the future. Additionally, exploring culturally appropriate interventions focused on continued lifestyle modification change and self-care behavior management may be beneficial in lowering complications associated with diabetes among this subgroup.

The most frequently reported intention to utilize the resources provided at follow-up was the need to modify current, sedentary lifestyle behaviors and yearly self-care behavior management practices. More than half of the participants in the present study report foregoing an eye examination and receiving the recommended vaccinations in the previous 12 months. Participants shared their likelihood of engaging in a visit with an optometrist and to receive a flu and/or pneumonia vaccination with a healthcare provider based on resources that were provided. In addition, participants self-reported wanting to modify their current, sedentary lifestyles by increasing weekly physical activity. Future studies are recommended to examine intention to engage in recommended examinations and actual behavior and its impact on clinical outcomes based on data received and tracked by the primary care medical home from the team of healthcare providers managing the patient’s diabetes.

More qualitative research is needed among these participants to examine medication adherence. Seventy-five percent of participants missed taking their diabetes medications as recommended by their health care provider. Conceptualizing this chronic disease may empower the health care team to have active relationships with patients in an effort to provide on-going training and support to effectively manage diabetes and the
complications surrounding this chronic disease.

**Telehealth Messaging Implications**

Future studies on participants in this research are needed to explore a six-month and 12-month intervention follow-up for the impact of the telehealth messages on the clinical outcomes of A1C, BMI, blood pressure, and weight. Participants may benefit from continuous telehealth messages focused on self-care management of diabetes. Personalized telehealth messages may lead to clinically improved diabetes outcomes compared to generic messages. Personalized messages would include a familiar voice from the respective patient center medical home. Diabetes practices may be reinforced if the provider's voice, a familiar tone, is used to record the messages. Testing the utility of the TAM framework may be useful for future studies with system use of telehealth messages focused on other chronic diseases utilizing more sophisticated applications of technology. Because health services research is an interprofessional and multidisciplinary scientific field, preliminary findings of this research suggest the need to focus on an integrated conceptual framework to provide interpretations of longitudinal data addressing social factors and organizational processes.

**Conclusions**

This research study examined the application of technology to provide participants with education on diabetes self-care practices using an automated voice message communication system. The goal of this research was to test the application of the technology and evaluate the participant’s self-care management of diabetes. Effective utilization of the automated system required participants to actively listen to one message per week using either a land-line or cellular phone. Findings from the study echo similar
observations found in that telehealth can supplement diabetes surveillance (Piette et al., 1999; Davis et al., 2010; Maljanian et al., 2005). In the present study, the use of a landline or cellular telephone was successful in educating adults managing type 2 diabetes on the appropriate self-care behaviors. Appropriate diabetes management coupled with surveillance improves compliance with guidelines and standards of care established by the American Diabetes Association.

The evolution of innovative technologies plays a vital role in increasing access to quality care. Prior research has focused on sophisticated applications of telehealth to address health behavior change. This research’s telehealth mechanism utilized the telephone as the technology to address self-care behavior management for diabetes. The applicable technology in this research did not require additional configurations for its application or use. The telephone as a communication medium, coupled with traditional face-to-face self-care diabetes management education offers an opportunity to reinforce good diabetes practices and provide an immediate intervention to engage patients on healthier lifestyle modifications to manage diabetes and reduce its associated complications.
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APPENDIX A

VIRTUAL HEALTH EDUCATION TRANSCRIPT

The group education curriculum and the virtual health messages will incorporate the American Association of Diabetes Educators Seven Self-Care Behaviors (AADE7) framework to explore self-care and management of diabetes (American Association of Diabetes Educators, 2012). The AADE7 framework focuses on seven, measurable self-care behaviors which include: health eating, physical activity, medication instruction, blood glucose monitoring, problem solving, reducing complications, and psychosocial coping. The virtual messages are listed below in minutes and seconds.

- **Healthy Eating**
  Message Length: 5:55

- **Being Active**
  Message Length: 5:00

- **Monitoring**
  Message Length: 5:37

- **Taking Medication**
  Message Length: 4:53

- **Problem Solving**
  Message Length: 4:11

- **Reducing Risks**
  Message Length: 5:40

- **Healthy Coping**
  Message Length: 4:15

Complete messages found at:
http://www.diabeteseducator.org/DiabetesEducation/Patient_Resources/AADE7_Patient Handouts.html
APPENDIX B

EDUCATIONAL HANDOUTS (AADE, 2013)

If you’ve just learned that you have diabetes or prediabetes, you probably have a lot of questions about what you can or can’t eat. Do you wonder if you can ever have your favorite food again? What happens when you are eating at a restaurant or a friend’s house? Do you have to change your whole diet just because you have diabetes?

The answer is NO. There is nothing that you can’t eat. You don’t have to give up your favorite foods or stop eating at restaurants.

But it’s important to know that everything you eat has an effect on your blood sugar. Learning to eat regular meals, control the amount you eat, and making healthy food choices can help you manage your diabetes better and prevent other health problems.

Some skills are more complex, but your diabetes educator or dietitian can help you learn about:

- Counting carbohydrates
- Reading food labels
- Measuring the amount of a serving
- Developing a practical meal plan
- Preventing high or low blood sugar
- Serving goals for healthy eating

Pick one or two of these skills, and discuss them with your healthcare provider.

DID YOU KNOW?

There are only 3 main types of nutrients in food: carbohydrates, proteins, and fats. A healthy meal will include all these types.

TRUE OR FALSE:

People with diabetes can’t have sugar.

FALSE. Sugar is just another carbohydrate and can fit into a meal plan. Sugary foods, however, do not have the same nutrient as grains or vegetables, and can often be high in fat and calories. It’s best to limit sugary foods to small portions, and be sure to count the carbohydrates toward the total recommended in your meal plan.

QUICK TIPS

Eat breakfast every day. Breakfast helps begin the calorie-burning process that provides you with energy. Include small snacks between meals as part of your daily intake to help keep your body going.

Space your meals throughout the day. Going too long without eating may result in excessive hunger, which can lead to overeating later on. Try to eat every 4 to 5 hours during waking hours.

Supported by an educational grant from Eli Lilly and Company.
ASK YOURSELF
When I think about healthy eating, I feel ___________________________ and ___________________________. (Pick 3 words to fill in the blanks)

What do you eat for a home-cooked meal? ________________________________________________

Is there anything you could have done to make your meal healthier? ________________________________________________

For you, what is the hardest part about healthy eating? ________________________________________________

What is the best part about healthy eating? ________________________________________________

REMEMBER THAT A HEALTHY MEAL PLAN SHOULD INCLUDE:

- Complex carbohydrates such as whole grain bread
- Fiber, which is found in beans, whole grains, fruits, and vegetables
- Lean protein, such as chicken, turkey, or fish
- Lots of vegetables—especially the green leafy ones
- A limited amount of heart-healthy fats, such as olive or canola oil, walnuts, almonds, and flax seed

A good first step is to follow the “plate method” of meal planning, which includes a healthy balance of foods and controlled portions.

Visually divide your plate into sections. For lunch or dinner, fill ½ the plate with non-starchy vegetables (such as greens, green beans, broccoli, cabbages, ¼ should contain meat or other protein (fish, eggs, low-fat cheese, cottage cheese, beans, or legumes); ⅔ of the plate should contain starch such as a potato or whole grain bread). On the side include an 8 ounce glass of low-fat milk or a small piece of fruit.

PLAN A HEALTHY DINNER THAT YOU WILL ENJOY IN THE SPACE BELOW.

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

AADE American Association of Diabetes Educators
Being active is not just about losing weight. It has many health benefits like lowering cholesterol, improving blood pressure, lowering stress and anxiety, and improving your mood. If you have diabetes, physical activity can also help keep your blood sugar levels closer to normal and help you keep your diabetes in control.

It can be difficult to find the time or the motivation to start an exercise program. Everyone's physical abilities and schedules are different, so choose the best ways to fit physical activity into your daily life—whether it's walking to work, doing chair exercises, or working out at the gym.

The important thing to remember is to choose activities that you enjoy doing and to set goals that are realistic.

Your healthcare provider can help you design an activity plan that works for you.

**DID YOU KNOW?**

Breaking activity into three 10-minute sessions throughout the day is as good as one 30-minute session. This can help you fit exercise into your schedule.

**TRUE OR FALSE?**

You are not working out hard enough if you can carry on a conversation.

FALSE: You should be able to talk while doing an activity. If you can't, then you're working too hard and you need to slow your pace.

---

**Word Wall**

**Exercise (or Physical Activity):**

- **Cardio:** Activities that get your body moving and help you stay healthy.
- **Resistance Training:** Activities that help you build muscle and strength.

**Quick Tips**

Any amount of physical activity is better than none at all. Making physical activity part of your daily lifestyle burns calories even if it's not part of a structured plan.

Even if you are inactive and out of shape now, you can improve your health by moving just a little more. Take small steps to add more movement into your daily lifestyle. In time, you will find that you are stronger and will be able to move even more.

Check your glucose before and after physical activity to learn how your body responds.
ACTIVITIES

ASK YOURSELF

What is your favorite activity that gets you moving?

What stops you from doing it? Think it over...

- Not enough time
- Too out of shape
- Too tired
- Not motivated
- Can't afford it
- My __________________ runs too much

What can you do to start doing this activity or working up to it?

For some other activities that you enjoy doing:

MAKE A FITT PLAN FOR YOUR PHYSICAL ACTIVITY:

- Frequency—How often will you do this activity? Work up to 5 or more days a week.
- Intensity—How hard should you be working? Remember you should be able to talk but not sing during an activity.
- Time—How long will you do it? Be realistic. Start with 5 or 10 minutes and work up to 30 minutes.
- Type of Activity—What will you be doing? Do something you enjoy.

GET CREATIVE!

- Rather than a treadmill, try creative ways to be more physically active.
- Take your dog for a walk or play fetch at the park.
- Call a friend to go dancing or put on your favorite song and make the living room your personal dance floor.
- Find a gym buddy to motivate you to stay active.
- Take the stairs instead of the elevator.
- If you eat lunch with a coworker, ask him/her to join you for a short walk after you eat.

American Association of Diabetes Educators
A A D E™ SELF-CARE BEHAVIORS
MONITORING

Checking your blood sugar levels regularly gives you vital information about your diabetes control. Monitoring helps you know when your blood sugar levels are on target. It helps you make food and activity adjustments so that your body can perform at its best. It takes some time and experience to figure out how your daily activities and actions affect your blood sugar.

Your diabetes educator can help you learn:

- How to use a blood sugar (glucose) meter
- When to check your blood sugar and what the numbers mean
- What to do when your numbers are out of your target range
- How to record your blood sugar results

Checking your blood sugar is an important part of diabetes self-care, but monitoring your overall health includes a lot of other things too, especially when you have diabetes. You and your healthcare team will also need to monitor your:

- Long-term blood sugar control—A1C, eAG
- Cardiovascular health—blood pressure, weight and essential levels
- Kidney health—urine and blood testing
- Eye health—dilated eye exams
- Foot health—foot exams and sensory testing

DID YOU KNOW?
The American Diabetes Association recommends an A1C goal below 7% (lA1C ~ 154 mg/dL), the American Association of Clinical Endocrinologists recommends below 6.5% (lA1C ~ 140 mg/dL).

TRUE OR FALSE?
If you want to see how your body responds to your meal, wait 2 hours after eating to check your blood sugar levels.

TRUE. Your blood sugar rises in response to what you've eaten. It takes about 2 hours for the numbers to reflect the change.

METER:
A small device that is used to check blood sugar levels.

LANCET:
A small needle used to get a blood sample.

A1C:
A test that measures your average blood sugar levels during the past 2 to 3 months.

ESTIMATED AVERAGE GLUCOSE (eAG):
The number on the A1C test is changed into mg/dL like the blood sugar levels shown on your glucose meter.

Wash your hands with soap and water
and dry them thoroughly before checking your blood sugar. Substances on your skin (like dirt, food, or lotion) can cause inaccurate results.

When traveling, keep your supplies with you. Advise security personnel that you are carrying diabetes supplies.

If you have trouble affording the test strips, call the toll-free number on the back of your meter to see if coupons are available, or ask your diabetes educator about other resources.

Supported by an educational grant from Eli Lilly and Company.
Remember the way you feel does not always reflect what your blood sugar is doing. The only way you know is to check your numbers:

- Check your blood sugar levels as directed to share with your doctor or diabetes educator.
- Follow a schedule, keep a record of your daily levels, and use the numbers to make decisions about your diabetes care.
- Check your blood sugar levels if you think you're getting sick.

When you check your blood sugar levels:

- Keep a record and bring it to every health appointment.
- Try to identify patterns when your blood sugar goes up or down.

If your numbers aren't at goal, don't get down. This is useful information that can help your healthcare provider match your treatment to your needs.

If you develop a regular schedule and follow it closely, you'll learn how your blood sugar levels affect how you feel. You'll start to recognize unhealthy blood sugar trends before they get out of control.

What is your typical day like in terms of eating, activity, and diabetes medication? Record it in the space below:

---

AADE American Association of Diabetes Educators
There are several types of medications that are often recommended for people with diabetes. Insulin pills that lower your blood sugar as an insulin; blood pressure medication; cholesterol-lowering medication; or a number of others may work together to help you lower your blood sugar levels, reduce your risk of complications and help you feel better.

Your medications come with specific instructions for use—and they can affect your body differently depending on when and how you take them. It may take a while to figure out which medications work best with your body. So it's important for you to pay attention to how you feel and how your body reacts to each medication or treatment. It's up to you to tell your pharmacist, doctor, nurse practitioner, or diabetes educator if you've noticed any side effects.

It's important to know the names, doses and instructions for the medications you're taking, as well as the reasons they are recommended for you.

REMEMBER TO:

- Ask your doctor, nurse practitioner or pharmacist why the medication was recommended for you.
- Ask your diabetes educator to help you fill your medication routine into your daily schedule. Be sure to bring all medications or labels with you when you go to health appointments.
- Ask a family member to go with you to an appointment and take notes about any medication instructions. Or ask someone to remind you to take your medications if you have difficulty remembering to take them.

DID YOU KNOW?

Some over-the-counter products, supplements, or natural remedies can interfere with the effectiveness of your prescribed medicines. Tell your diabetes educator about ANY supplements you are taking so that he/she can make the best recommendations for your care.

TRUE OR FALSE?

When you inject insulin, you need to rotate your injection sites.

TRUE: If you inject insulin in the same spot every time, your tissue can become damaged and won't absorb insulin as well. Be sure to rotate your injection sites between the latter parts of your upper arm, outer thigh, buttocks, or abdomen.

INSULIN:
A hormone that helps the body use glucose (sugar) for energy.

SIDE EFFECT:
An effect that a drug has on your body that is not intended, like diarrhea, nausea, headache.

If you often forget to take your medication, try to remind yourself by linking it to a specific activity—like watching the news every night or brushing your teeth—or by setting an alarm on your watch or cell phone.

Take a pen and some paper with you to your healthcare visit and take notes when your provider tells you about your medicine.

Supported by an educational grant from Eli Lilly and Company.
ACTIVITIES

How do you feel about having to take insulin or other medicines?

What is the hardest part about taking your medications?

Name one of your medications.

How much are you supposed to take?

When are you supposed to take it and how often?

Why do you have to take this medication?

What are some of the possible side effects?

What are you supposed to do if you experience side effects?

Anything else you need to know?

What do you do if you forget to take this medication?

*Repeat this exercise for every medication. Be sure to ask your pharmacist or diabetes educator if you do not know the answers.
What do you do when you have a problem like low blood sugar: hypoglycemia? Do you know what caused it? How can you help reduce the risk of it happening in the future?

Everyone encounters problems with their diabetes control, you can't plan for every situation you may face. However, there are some problem-solving skills that can help you prepare for the unexpected—and make a plan for dealing with similar problems in the future.

Some of the most important problem-solving skills for diabetes self-care are learning how to recognize and react to high and low blood sugar levels and learning how to manage on days when you are sick.

Your diabetes educator can help you develop the skills to identify situations that could upset your diabetes control.

DID YOU KNOW?

Skipping meals and snacks, taking too much diabetes medication, engaging in physical activity and drinking too much alcohol can all cause you to experience low blood sugar problems.

TRUE OR FALSE?

Nobody has perfect diabetes management.

TRUE. You are not perfect—no one is. There WILL be problems and challenges. The important thing is to learn from each situation—what caused your blood sugar to go above or below target, and what you can do to improve your diabetes self-care.

HYPOGLYCEMIA:
Low blood sugar

HYPERGLYCEMIA:
High blood sugar

GOAL SETTING:
Choosing a specific task or activity that you want to achieve and making a plan to get there.

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ACTIVITIES

WHAT WOULD YOU DO?

Think about how the following situations may affect you—and about what steps you could take to maintain proper control of your diabetes in similar situations.

You get the flu and notice that your blood sugar levels are higher than normal. What do you do?

While on vacation, you don't have easy access to a gym or time for exercise. How will you handle this?

You have a hard time finding healthy food choices within your family's culture or taste preferences. What steps can you take?

Is there something you've been struggling with in your diabetes care? What is it?

Why do you think this is a problem? What does it mean?

Name two things you can do to fix it.

What can you do to prevent it from happening in the future?
Having diabetes puts you at a higher risk for developing other health problems. However, if you understand the risks, you can take steps now to lower your chance of diabetes-related complications.

Talk to your diabetes educator and healthcare provider about potential health issues such as kidney damage, nerve damage and vision loss. They can explain why complications happen and how they can be avoided.

But don't rely on your healthcare team to identify areas of concern—you need to play an active role in reducing your risk. Make an effort to learn about complications and consistently track your overall health. You can reduce your risks for several complications by taking these precautions:

- Don't smoke
- Schedule regular medical checkups and medical tests
- See an eye doctor at least once a year
- Keep your feet dry and clean. Look out for redness or sores, and report these to your healthcare team as soon as you find them. If you have trouble seeing the bottom of your feet, ask a family member or friend to help you.
- Be sensitive to your body—recognize when you aren't feeling well, and contact your care team if you need help identifying the problem.

DID YOU KNOW?
Lowering your cholesterol can decrease your risk for stroke, heart attack or other circulation problems.

TRUE OR FALSE?
Consulting your diabetes can help reduce your risk for heart disease.

TRUE. If your blood sugar or blood pressure levels are too high for too long, your blood vessels can become stiff. This makes it easier for blood clots to form, which can lead to a heart attack or stroke.

BLOOD PRESSURE:
The amount of pressure that is applied to your arteries when blood is pumped through your body.

CHOLESTEROL:
A waxy substance that is in your blood that exists in two types: LDL (bad) and HDL (good).

COMPLICATION:
Another health problem that can happen when you have diabetes.

HYPERTENSION:
When your blood pressure is higher than 140/90.

QUICK TIPS

Keep a Personal Care Record on a wallet card that lists all of the tests you should be regularly getting and the targets for each.

Sleep apnea affects more than half of people with diabetes and most don't know it. If you snore loudly or feel sluggish and tired during the day, ask your diabetes educator to screen you for sleep apnea.

Supported by an educational grant from Eli Lilly and Company.
THESE ARE SOME OF THE THINGS YOU CAN DO TO STAY HEALTHY AND PREVENT OTHER PROBLEMS.

- FOLLOW YOUR HEALTHY EATING PLAN
  Are you proud of the way you ate today?

- KEEP ACTIVE
  What is your favorite outdoor activity?

- TAKE MEDICATIONS
  Did you take your meds today?

- MONITOR YOUR BLOOD SUGAR
  What was your blood sugar number last time you checked?

- CHECK YOUR FEET
  Any pain or sores on your feet?

- BRUSH AND FLOSS YOUR TEETH
  When was your last dental visit?

- CHECK YOUR BLOOD PRESSURE
  Do you know what your blood pressure is?

- DON'T SMOKE
  What can help you quit?

- GET AN EYE EXAM (WHICH INCLUDES DILATING YOUR EYES) AT LEAST ONCE A YEAR
  Have you had an eye exam this year?

### RECOMMENDED TESTS, TARGET LEVELS, FREQUENCY

<table>
<thead>
<tr>
<th>Test</th>
<th>Target Levels</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1C</td>
<td>Less than 7%</td>
<td>Every 3 to 6 months</td>
</tr>
<tr>
<td>Blood Pressure</td>
<td>Less than 120/80</td>
<td>Every visit</td>
</tr>
<tr>
<td>Lipids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDL (good cholesterol)</td>
<td>Over 40 for men, Over 50 for women; less than 100 for women</td>
<td>At least every year</td>
</tr>
<tr>
<td>LDL (bad cholesterol)</td>
<td>Less than 70 if you have heart disease; less than 100</td>
<td></td>
</tr>
<tr>
<td>Triglycerides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eye Exam</td>
<td></td>
<td>Every year</td>
</tr>
<tr>
<td>Foot Exam (visual)</td>
<td></td>
<td>Every visit to your healthcare provider</td>
</tr>
<tr>
<td>Foot Exam (sensory)</td>
<td></td>
<td>Every year</td>
</tr>
</tbody>
</table>

AADE American Association of Diabetes Educators
Diabetes can affect you physically and emotionally. Living with it every day can make you feel discouraged, stressed, or even depressed. It is normal to have mixed feelings about your diabetes management and experience highs and lows. The important thing is to recognize these emotions as normal. Take steps to reduce the negative impact they could have on your self-care.

The way you deal with your emotional lows is called “coping.” There are lots of ways to cope with diabetes in your life—and not all of them are good for your health! Smoking, overeating, not finding time for activity, or avoiding people and social situations.

However, there are healthy coping methods that you can use to get you through tough times like—based activities, exercise, meditation, enjoyable hobbies, joining a support group.

Having a support network is key to healthy coping. Be sure to develop and nurture partnerships in your personal life with your spouse, loved ones, and friends. Go to group educational sessions where you can meet and relate to other people going through the same experiences. Build healthy relationships—and remember that you’re not alone.

Sometimes, emotional lows can be lengthy and have a more serious impact on your life, health, and relationships. This can be a sign of depression. Tell your diabetes educator if you:

- Don’t have interest or find pleasure in your activities
- Avoid activities you like
- Sleep more at night
- Don’t see the benefit in taking care of yourself
- Feel like diabetes is conquering you
- Feel like you can’t take care of yourself

Physical activity can influence your mood. If you are sad, anxious, stressed or upset, go for a walk, stand up and stretch, or take a bicycle ride. Exercise actually increases the chemicals in your brain that help make you feel good.

TRUE OR FALSE?

Nobody wants to hear about your problems. When you are feeling down, you should keep it to yourself.

FALSE. You need to talk about your emotions with friends, family, or your healthcare provider. Sometimes, just talking about a problem will help you solve it, and loved ones can help you gain perspective.

Recognize the power of positive thinking. When you are feeling down, think about your successes and feel good about the progress you’ve made toward a goal—even if it’s not a little bit.

Find time to do something pleasurable every day.
HEALTHY COPING

| Name 3 emotions that you feel when you think about your diabetes. |
| Who can you talk to when you feel this way? |
| Name 3 activities that will help you work through this emotion and feel better |

What might prevent you from doing these activities?

________________________________________________________________________

________________________________________________________________________

How can you overcome these obstacles?

________________________________________________________________________

________________________________________________________________________
APPENDIX C

BEHAVIOR SCORE INSTRUMENT (AADE, 2013)

Having diabetes means that you need to make choices about food, physical activity, and when and how to take medicines. You may need blood tests and other exams to monitor your diabetes health status. You also need to do things to prevent problems related to your health, know how to cope with your diabetes, and make everyday management decisions.

The following questions are about the things you need to do to stay healthy with your diabetes. These questions ask about the things you do, how often you do them, how important they are to you and how sure you are about doing them.

Please think about what has happened over the past week, or last 7 days, as you answer the following questions.

Patient Name (First and Last) :
Healthy Eating:
Following an eating plan that is good for you includes: not eating too much, counting the amount of carbohydrates you eat, not eating too much fat, keeping an eye on and/or drinking less alcohol. It also means eating fruits, vegetables, whole grains, and beans and other foods with high fiber. Following an eating plan that is good for you may also include reaching goals for losing weight, and limiting the amount of protein and salt you eat.

During the past week, or last 7 days, how many days were you able to follow a healthy eating plan? (circle one)

1  2  3  4  5  6  7

How sure are you that you can follow an eating plan that is good for you, where 0 is not sure at all and 10 is very sure? (circle one)

0  1  2  3  4  5  6  7  8  9  10

How important is it to you to follow an eating plan that is good for you, where 0 is not important at all and 10 is very important? (circle one)

0  1  2  3  4  5  6  7  8  9  10

Being Active:
Being active means you are taking part in doing things such as jogging, bicycling, golfing, gardening, or walking without stopping for at least 30 minutes most days of the week.

During the past week, or last 7 days, how many days were you able to be active? (circle one)

1  2  3  4  5  6  7

How important is it to you to be active, where 0 is not important at all and 10 is very important?

0  1  2  3  4  5  6  7  8  9  10

How sure are you that you can be active, where 0 is not sure at all and 10 is very sure?

0  1  2  3  4  5  6  7  8  9  10
Monitoring:
 Monitoring for people with diabetes means that they regularly check blood sugar. Monitoring also includes checking your blood pressure, cholesterol, and weight. For this set of questions, we will focus on blood sugar monitoring. Monitoring the level of your blood sugar means that you use a blood sugar meter to take a blood sugar reading. Monitoring may be done on your own or with the help of a health care provider.

During the past week, or last 7 days, how many days were you able to monitor your blood sugar at least once per day?

1  2  3  4  5  6  7

How important is it to you to monitor your blood sugar at least once per day, where 0 is not important at all and 10 is very important?

0  1  2  3  4  5  6  7  8  9  10

How sure are you that you can monitor your blood sugar at least once per day, where 0 is not sure at all and 10 is very sure?

0  1  2  3  4  5  6  7  8  9  10

Taking Medication:
 Taking medication means that you take medicines that have been prescribed by your healthcare provider to treat your diabetes or other health conditions. These may be pills, insulin, creams, or other medicines that you inject. For the next several questions, please answer for all the medicines that you take.

Sometimes it can be a hard to remember to take all of your medicines. Over the past week, or last 7 days, how many days have you missed taking your diabetes medicines as recommended?

1  2  3  4  5  6  7

How important is it to you to take your medicines, where 0 is not important at all and 10 is very important?

0  1  2  3  4  5  6  7  8  9  10

How sure are you that you can take your medicines, where 0 is not sure at all and 10 is very sure?

0  1  2  3  4  5  6  7  8  9  10
**Problem Solving:**

Problem solving means coming up with ways to make everyday and/or challenging decisions to stay healthy with your diabetes. When you make a decision about what to eat or how much to eat, choose which medicines to take, decide whether to take a walk, or determine how you’re going to make changes to your daily routine to help your diabetes, you are problem solving. For most situations this means figuring out the problem, finding a way to deal with it and thinking about what may prevent you from solving the problem.

Over the past week, or last 7 days, how many days have you done problem solving for everyday and/or challenging decisions?

1 2 3 4 5 6 7

How important is being able to problem solve when being faced with everyday and/or challenging decisions, where 0 is not important at all and 10 is very important?

0 1 2 3 4 5 6 7 8 9 10

How sure are you that you can problem solve when faced with everyday and/or challenging decisions, where 0 is not sure at all and 10 is very sure?

0 1 2 3 4 5 6 7 8 9 10

**Healthy Coping:**

Healthy coping is having ways to help yourself or knowing when and how to seek help when you are overwhelmed by your diabetes. Every person with diabetes has to deal with stress, strong emotions or family situations that can make it hard to manage their diabetes. How you feel and your quality of life can be affected by emotional and social problems.

Over the past week, or last 7 days, how many days were you able to cope in a healthy way when you faced stress, emotional or family problems?

1 2 3 4 5 6 7

How important is it to you to either help yourself or know when and how to seek help when you are faced with stress, emotional or family problems, where 0 is not important at all and 10 is very important?

0 1 2 3 4 5 6 7 8 9 10

How sure are you that you can help yourself or know when and how to seek help when faced with stress, emotional or family problems, where 0 is not sure at all and 10 is very sure?

0 1 2 3 4 5 6 7 8 9 10
Reducing Risks:

Reducing risks means that you are taking steps to prevent or reduce problems related to diabetes. This includes having eyes checked by an eye doctor, having feet checked by a health care provider, seeing a dentist, getting flu and/or pneumonia vaccinations, having blood pressure checked, having cholesterol and triglycerides checked, and not smoking.

Check all of the following things that have happened in the past year.

- Had an eye exam (with drops in the eyes) by an eye doctor.
- Had feet checked by a health care provider.
- Saw a dentist.
- Had a flu and/or pneumonia vaccination.
- Had blood pressure checked.
- Had cholesterol and triglycerides checked.
- Got help to stop smoking (only applicable for smokers).
- Had an A1C test.

How important do you feel it is to do the things listed above to help prevent or reduce problems related to diabetes, where 0 is not important at all and 10 is very important?

0 1 2 3 4 5 6 7 8 9 10

How sure are you that you can get the help you need to prevent or reduce problems related to diabetes, where 0 is not sure at all and 10 is very sure?

0 1 2 3 4 5 6 7 8 9 10
APPENDIX D

BEHAVIORAL INTENTION TO USE

Survey ID: ______________________

<table>
<thead>
<tr>
<th>1. How likely are you to use these resources to help manage your diabetes care?</th>
<th>STRONGLY DISAGREE</th>
<th>STRONGLY AGREE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Why or why not?

Thank you for completing this survey.
APPENDIX E

SYSTEM USABILITY SCALE

Survey ID: ______________________

SYSTEM USABILITY SCALE
(Brooke, 2013; Lewis, 2012; Bangor et al., 2009)

Instructions: For each of the statements below, circle the rating that best describes your interaction with the system that delivered the weekly telehealth messages.

<table>
<thead>
<tr>
<th></th>
<th>STRONGLY DISAGREE</th>
<th>STRONGLY AGREE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I think that I would like to use this system frequently.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>2. I found the system unnecessarily complex.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>3. I thought the system was easy to use.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>4. I think that I would need the support of a technical person to be able to use this system.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>5. I found the various functions in this system were well integrated.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>6. I thought there was too much inconsistency in this system.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>7. I would imagine that most people would learn to use this system very quickly.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>8. I found the system very cumbersome to use.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>9. I felt very confident using the system.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>10. I needed to learn a lot of things before I could get going with this system.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>

11. Overall, I would rate the user-friendliness of this product as:

<table>
<thead>
<tr>
<th></th>
<th>Worst Imaginable</th>
<th>Awful</th>
<th>Poor</th>
<th>OK</th>
<th>Good</th>
<th>Excellent</th>
<th>Best Imaginable</th>
</tr>
</thead>
</table>

Thank you for completing this survey.
APPENDIX F

BASELINE MEDICAL RECORDS ABSTRACTION FORM

<table>
<thead>
<tr>
<th>Electronic Medical Record Chart Number</th>
<th>Survey Identification Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provider Diagnosis</td>
<td>(1) Type 1 Diabetes</td>
</tr>
<tr>
<td></td>
<td>(2) Type 2 Diabetes</td>
</tr>
</tbody>
</table>

**Demographics**

<table>
<thead>
<tr>
<th>Age</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) Male</td>
</tr>
<tr>
<td></td>
<td>(2) Female</td>
</tr>
<tr>
<td>Marital Status</td>
<td>(1) Never married</td>
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<tr>
<td></td>
<td>(2) Married</td>
</tr>
<tr>
<td></td>
<td>(3) Widowed</td>
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<tr>
<td></td>
<td>(4) Divorced</td>
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</table>

<table>
<thead>
<tr>
<th>Zip Code</th>
<th>Insurance Status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) Yes</td>
</tr>
<tr>
<td></td>
<td>(2) No</td>
</tr>
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</table>

**Type of Insurance**

<table>
<thead>
<tr>
<th>Employment Status</th>
<th>Type of Insurance</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Employed for wages, full-time</td>
<td>(1) Employed for wages, part-time</td>
</tr>
<tr>
<td>(2) Employed for wages, part-time</td>
<td>(3) Self-employed</td>
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<td>(4) Out of work for more than 1 year</td>
<td>(4) Out of work for less than 1 year</td>
</tr>
<tr>
<td>(5) Out of work for less than 1 year</td>
<td>(6) A Homemaker</td>
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<tr>
<td>(6) A Homemaker</td>
<td>(7) A Student</td>
</tr>
<tr>
<td>(7) A Student</td>
<td>(8) Retired</td>
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<tr>
<td>(8) Retired</td>
<td>(9) Unable to Work / Disabled</td>
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<tr>
<td>(9) Unable to Work / Disabled</td>
<td>(10) Information unavailable</td>
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</tbody>
</table>

<table>
<thead>
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<th>Type of Insurance</th>
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<td>(1) Annual</td>
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**Race**

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<tr>
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<td>(3) American Indian or Alaska Native</td>
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<tr>
<td>(3) American Indian or Alaska Native</td>
<td>(4) Hispanic or Latino</td>
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<td>(4) Hispanic or Latino</td>
<td>(5) Asian</td>
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<tr>
<td>(5) Asian</td>
<td>(6) Native Hawaiian or Other Pacific Islander</td>
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<tr>
<td>(6) Native Hawaiian or Other Pacific Islander</td>
<td>(7) Other</td>
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**Baseline Clinical / Laboratory Values**

<table>
<thead>
<tr>
<th>Weight:</th>
<th>Height:</th>
<th>Body Mass Index:</th>
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</thead>
<tbody>
<tr>
<td>Diabetes Clinical Outcomes</td>
<td>HbA1C:</td>
<td>Blood glucose serum level:</td>
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</table>

**Blood Pressure**

<table>
<thead>
<tr>
<th>Blood Pressure</th>
<th>Systolic:</th>
<th>Diastolic:</th>
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**Intervention Assignment**

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<th>Intervention Assignment</th>
<th>(1) Control Group</th>
<th>(2) Treatment Group</th>
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APPENDIX G

FOLLOW-UP MEDICAL RECORDS ABSTRACTION FORM

<table>
<thead>
<tr>
<th>Electronic Medical Record Chart Number</th>
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<tr>
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<table>
<thead>
<tr>
<th>Survey Identification Number</th>
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<td></td>
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</table>

<table>
<thead>
<tr>
<th><strong>Demographics</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insurance Status</strong></td>
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<tr>
<td>(1) Yes  (2) No</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Baseline Clinical / Laboratory Values</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight:</strong></td>
</tr>
<tr>
<td><strong>Height:</strong></td>
</tr>
<tr>
<td><strong>Body Mass Index:</strong></td>
</tr>
</tbody>
</table>

| **Diabetes Clinical Outcomes**           |
| **HbA1C:**                               |
| **Blood glucose serum level:**           |

| **Blood Pressure**                      |
| **Systolic:**                            |
| **Diastolic:**                           |
S. U. G. A. R. DIABETES

Start Understanding your Glucose and Appetite to reduce Risks

GROUP EDUCATIONAL SESSIONS

SELF-CARE BEHAVIOR TECHNIQUES

Are you interested in learning how to better manage diabetes?

Researchers from Old Dominion University will be on site to determine if you are eligible to participate in a research study about Diabetes Education and Self-Care Management.

*Patients aged 65 years and older, patients with gestational diabetes at the time of the study, Spanish-only speaking patients, current enrollment in another intervention, and patients not having had a provider visit within the past 12 months will be excluded.

Please contact Kevyn Goodman at (757) 627-6892
APPENDIX I

POTENTIAL PARTICIPANT LETTER

April, 2013

Dear Potential Participant:

We are researchers from Old Dominion University. The purpose of this study is to collect information that can be used to help Primary Care Specialists compare face-to-face health education in addition to providing telehealth messages focused on self-care behaviors is beneficial to you in managing your diabetes.

As a Primary Care Specialists patient, you have access to the Healthy Living Center. The Healthy Living Center, accredited by the American Association of Diabetes Educators, offers diabetes education and training, interventions, and self-management support strategies for those diagnosed and those at risk. We believe that the addition of a Telehealth component will enhance the current Health Living Center through the use of an automated voice message communication system to provide weekly educational messages on self-care behaviors.

You are being invited to take part in this study because you are a newly diagnosed patient at Primary Care Specialists with diabetes requiring medication management, or you have not been to Primary Care Specialists for treatment of diabetes in the past 12 months. We believe that you can provide a great deal of insight and information into how Primary Care Specialists can better assist patients who are receiving treatment for diabetes with health education.

We would like you to complete a questionnaire during you initial visit and on two additional separate occasions, at two months and at four months; it should take about 20 minutes each time. In addition we will need your permission to access your medical records and patient assessment that you complete for diabetes health tracking. Your information will not be shared with anyone. You will be provided assistance in completing the questionnaires.

Your participation is confidential so your name will not be attached to any of the information about you when this report is shared with Primary Care Specialists. The report will be a summary of the information from all participants. Any questions and concerns you have will be answered and addressed before you agree to participate and at any time during the 30 days. If you wish to be removed from the study at any time, let us know and your information will be removed.
We recognize the sensitive and personal nature of the medical information we are asking you to share with us, but we hope to show how important it is for Primary Care Specialists to be able to help you to better manage your diabetes as your health care provider. We appreciate you considering our request.

In the event that you have questions regarding this research project, you may contact Dr. Holly Gaff, the Responsible Project Investigator, at (757) 683-6903 or Dr. George Maihafer, the current IRB chair at 757-683-4520 at Old Dominion University, or the Old Dominion University Office of Research at 757-683-3460 who will be glad to review the matter with you.

Respectfully,

Koren S. Goodman, Lead Researcher Doctoral Candidate Old Dominion University

Dr. Holly Gaff, Associate Professor, Responsible Project Investigator Dissertation Committee Chair Old Dominion University
APPENDIX J
INFORMED CONSENT DOCUMENT
OLD DOMINION UNIVERSITY

PROJECT TITLE: Utilizing the Technology Acceptance Model to predict system use of an interactive behavior change technology to deliver virtual diabetes health education

INTRODUCTION

The purposes of this form are to give you information that may affect your decision whether to say YES or NO to participation in this research, and to record the consent of those who say YES to participating in the Utilizing the Technology Acceptance Model to predict system use of an interactive behavior change technology to deliver virtual diabetes health education, Primary Care Specialists located at 930 Majestic Avenue, Norfolk, Virginia 23504.

RESEARCHERS

The Researchers are from Old Dominion University's (ODU).

Responsible Project Investigator: Dr. Holly Gaff
College of Sciences
Department of Biological Sciences

Co-Investigators:
Dr. Elizabeth Locke
College of Health Sciences
School of Physical Therapy and Athletic Training

Dr. Ginger Watson
Darden College of Education – STEM

Koren S. Goodman, Doctoral Candidate
College of Health Sciences
Health Services Research-Dean’s Office

DESCRIPTION OF RESEARCH STUDY

Several studies have been conducted looking into the subject of the use of interactive behavior change technologies to enhance health promotion and the delivery of health care education for patients managing chronic diseases. The purpose of this study is to collect information that can be used to help determine if providing telehealth messages is
beneficial to you in managing your diabetes. You will be assigned to one of two groups which may include a routine diabetes related visit and receiving printed self-care behavior education or receiving telehealth messages on your telephone. Approximately, 150 patients receiving care at Primary Care Specialists located in Norfolk, Virginia may be participating in this study. The researcher will have a list of the arbitrary identification numbers and names on it that will be kept confidential.

We would like for you to complete a questionnaire during your initial visit and on two additional separate occasions at two months and at four months. Each survey will last for approximately 20 minutes and will ask questions about your overall self-care management of diabetes. The surveys can be completed while you are at Primary Care Specialists for your doctor's visit, via the telephone or the survey can be mailed to you for your convenience. We also want you to give us access to your medical records to collect the results from your laboratory tests the medical doctor or nurse practitioner(s) may order for you.

EXCLUSIONARY CRITERIA

If you are 65 years and over, have gestational diabetes at the time of the study, have not had a provider visit in the past 12 months, currently enrolled in another intervention, or if you are a Spanish-only speaking patient, you will not be able to participate in this study.

RISKS AND BENEFITS

RISKS: As a patient at Primary Care Specialists, the patient will have access to a Certified Diabetes Educator to explore self-care and management of diabetes complications. The patient may experience risks associated with the possibility of linking their name to survey responses. The responsible project investigator has attempted to reduce the risk by assigning an arbitrary identification number to each survey, storing the information in a locked cabinet, and only reporting results in the aggregate and not individual responses. This list will not be kept at the host primary medical care office. All information will be presented as an aggregate summary of the findings. As with any research, there is some possibility that the patient may be subjected to risks that have not yet been identified.

BENEFITS: There are no direct benefits to the patient as a result of participating in this proposed study. However, by discussing diabetes related health status, condition symptoms, medication regimens, and experienced and potential complications, the patient may have a clearer knowledge of self-care and management of the chronic condition diabetes.

COSTS AND PAYMENTS

The researchers want your decision about participating in this study to be absolutely voluntary. An incentive for your participation will be provided. A $20.00 gift card to a local retailer will be provided to you at the end of the study period.
NEW INFORMATION

If the researchers find new information during this study that would reasonably change your decision about participating, then they will give it to you.

CONFIDENTIALITY

The researchers will take reasonable steps to keep private information, such as questionnaires, medical history, and clinical laboratory findings confidential. You will not be identified in any way in any of the data collection. There will be no way to connect your name with any specific data collected in the study. Any recorded data of clinical values obtained during the course of the study in which a study participant might be recognizable will be securely erased or otherwise destroyed upon completion of the study. Upon completion of the study, your name and contact information will be shredded. The results of this study may be used in reports, presentations, and publications; but the researcher will not identify you. Of course, your records may be subpoenaed by court order or inspected by government bodies with oversight authority.

WITHDRAWAL PRIVILEGE

It is OK for you to say NO. Even if you say YES now, you are free to say NO later, and walk away or withdraw from the study -- at any time. Your decision will not affect your relationship with Old Dominion University nor Primary Care Specialists or otherwise cause a loss of benefits to which you might otherwise be entitled.

COMPENSATION FOR ILLNESS AND INJURY

If you say YES, then your consent in this document does not waive any of your legal rights. However, in the event of any harm, injury, or illness arising from this study, neither Old Dominion University nor the researchers are able to give you any money, insurance coverage, free medical care, or any other compensation for such injury. In the event that you suffer injury as a result of participation in any research project, you may contact Dr. Holly Gaff, the Responsible Project Investigator, at (757) 683-6903 or Dr. George Maihafer, the current IRB chair at 757-683-4520 at Old Dominion University, or the Old Dominion University Office of Research at 757-683-3460 who will be glad to review the matter with you.

VOLUNTARY CONSENT

By signing this form, you are saying several things. You are saying that you have read this form or have had it read to you, that you are satisfied that you understand this form, the research study, and its risks and benefits. The researchers should have answered any questions you may have had about the research. If you have any questions later on, please contact Dr. Holly Gaff, the Responsible Project Investigator, at (757) 683-6903 or Ms. Koren S. Goodman at (757) 627-6892.
If at any time you feel pressured to participate, or if you have any questions about your rights or this form, then you should call Dr. George Maihafer, the current IRB chair, at 757-683-4520, or the Old Dominion University Office of Research, at 757-683-3460.

And importantly, by signing below, you are telling the researcher YES, that you agree to participate in this study. The researcher should give you a copy of this form for your records.

| Subject's Printed Name & Signature | Date |

INVESTIGATOR'S STATEMENT

I certify that I have explained to this subject the nature and purpose of this research, including benefits, risks, costs, and any experimental procedures. I have described the rights and protections afforded to human subjects and have done nothing to pressure, coerce, or falsely entice this subject into participating. I am aware of my obligations under state and federal laws, and promise compliance. I have answered the subject's questions and have encouraged him/her to ask additional questions at any time during the course of this study. I have witnessed the above signature(s) on this consent form.

| Investigator's Printed Name & Signature | Date |
APPENDIX K

AUTHORIZATION TO DISCLOSE
ELECTRONIC MEDICAL RECORDS INFORMATION

I, ____________________________, give my consent for the Researchers at Old Dominion University to gain access to my electronic medical record with Primary Care Specialists for the purpose of evaluating my clinical outcomes regarding diabetes which may include, but is not necessarily limited to weight, height, and blood glucose levels.

- I understand that my information will not be shared with anyone else.
- I understand that I do not have to sign this authorization to get treatment.
- I understand that once my health care information is disclosed as I have authorized, it could be re-disclosed by the recipient in the form of a report, but without personal identifying information.
- I understand that signing this authorization does not cancel any rights I have under other state or federal laws.

Name: ________________________________________________________________
Address: ________________________________________________________________
City, State and Zip: _______________________________________________________
Date of Birth: ___________________________________________________________
Contact Phone: ___________________________________________________________

_________________________________________________________  ______________
Patient’s Printed Name                                          Date

_________________________________________________________
Patient’s Signature

_________________________________________________________
Witness                                          Date
APPENDIX L

RESEARCH PROPOSAL REVIEW NOTIFICATION FORM
No.: 12-179

OLD DOMINION UNIVERSITY
HUMAN SUBJECTS INSTITUTIONAL REVIEW BOARD
RESEARCH PROPOSAL REVIEW NOTIFICATION FORM

TO: Holly Gaff

Responsible Project Investigator

DATE: August 30, 2012
IRB Decision Date

Utilizing the Technology Acceptance Model to Predict Actual System use of an Interactive Behavior Change Technology to Deliver Virtual Diabetes Health Education

Name of Project

Please be informed that your research protocol has received approval by the Institutional Review Board. Your research protocol is:

Approved
Tabled/Disapproved
X Approved, contingent on making the changes below*

Contact the IRB for clarification of the terms of your research, or if you wish to make ANY change to your research protocol.

The approval expires one year from the IRB decision date. You must submit a Progress Report and seek re-approval if you wish to continue data collection or analysis beyond that date, or a Close-out report. You must report adverse events experienced by subjects to the IRB chair in a timely manner (see university policy).

* Approval of your research is CONTINGENT upon the satisfactory completion of the following changes and attestation to those changes by the chairperson of the Institutional Review Board. Research may not begin until after this attestation.

*In the Application:
- Add Koren Goodman’s name and information as a researcher. Ms. Goodman’s CITI human subjects training certificates needs to be submitted.
- Under # 7, include a sentence that describes why there is a gender disparity between men and women in the proposed study. (i.e. the gender ratio reflects the overall population of the center).
• Under 20b, all investigators who will be reviewing medical records of patients need HIPAA training line and need to initial on the line.

In the Informed Consent
• Add Dr. Elizabeth Locke's name, title as a co-investigator
• Under Description of Research Study, this section is too lengthy and wordy and could result in confusing or frustrating the subjects. In the first paragraph, reword the sentences to improve clarity by eliminating the second, third and fourth sentences. In the second paragraph, eliminate sentences five, six and seven ("The surveys will ask questions about......"). Include a sentence that describes the training and education that the participants will be receiving during the study. In general terms, the sentence should state that "you will be assigned to one of three groups which involve the training/education of....".
• Under Exclusionary Criteria, reword the sentence to state that subjects with gestational diabetes will not be included in the study, as well as people > 65 years old, and people who have been seen by their primary care specialist health care provider in the past 12 mos.
• Under Risks, remove the discussion of a chronic disease health status since it is not a risk of the study, since this discussion would take place regardless of subject participation in the research or not. Clarify the risk of confidential information in one sentence as the risk and state in a follow-up statement how the investigators intend to minimize the risk (i.e., assigning a unique identification number, storing information in a locked cabinet, only reporting results in the aggregate and not individual responses, etc.).
• Under Voluntary Consent, Dr. Gaff's name should be listed first followed by Ms. Goodman.
• Remove the witness and parent/legal guardian signature blocks.

In the Flyer
• The graphic does not clearly denote that this is a research study. Add the word "research" prior to study in the text. Include the three exclusionary criteria for participation in the study.

Attestation

As directed by the Institutional Review Board, the Responsible Project Investigator made the above changes. Research may begin.

[Signature]
IRB Chairperson's Signature

September 13, 2012
date
## APPENDIX M

### SIGN-UP SHEET # 1

<table>
<thead>
<tr>
<th>Last Name, First Name</th>
<th>Mailing Address</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>City, State Zip Code</td>
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<tr>
<td></td>
<td>Contact Phone Number</td>
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### APPENDIX N

**INTERVENTION ASSIGNMENT SHEET # 1**

<table>
<thead>
<tr>
<th>#</th>
<th>Last Name, First Name</th>
<th>Mailing Address City, State Zip Code</th>
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## APPENDIX O
### STATISTICAL ANALYSIS

<table>
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<tr>
<th><strong>Main Research Question</strong></th>
<th><strong>Measures</strong></th>
<th><strong>Statistical Test</strong></th>
</tr>
</thead>
</table>
| To what extent does the Technology Acceptance Model identify predictors of system use of telehealth messages? | Clinical Outcomes and User Characteristics  
Sum total number of messages successfully delivered and listened to  
System Usability Scale questions 1-10  
Behavior Score Instrument | Multiple Linear Regression                                                                                                                            |                           |
| Are there statistically significant differences between patients who received telehealth messages and those in a routine care group on clinical outcomes of A1C, Blood Pressure, Body Mass Index, and Weight at baseline and follow-up? | Clinical Outcomes (A1C, BP, BMI, and Weight)                                                                                                                                                              | MANOVA                    |
| Are there statistically significant differences between patients who received telehealth messages and those in a routine care group on patients’ self-care management of diabetes as measured by the Behavior Score Instrument over time? | Behavior Score Instrument                                                                                                                                                                                  | ANOVA                     |
Statistical Analysis Plan

To address research question one, five multiple linear regressions were conducted to determine if user characteristics, actual system use (total number of messages listened to), perceived usefulness of technology (SUS transformed scores), BSI scores (at baseline, two months, and follow-up), and behavioral intention to use (intention to listen to message at baseline and follow-up) effectively predict the following five clinical outcomes change scores: change scores for A1C (from baseline to follow-up), change scores for BMI (from baseline to follow-up), change scores for diastolic (from baseline to follow-up), change scores for systolic (from baseline to follow-up), and change scores for weight (from baseline to follow-up).

Prior to analysis, correlation analyses were conducted to determine which of the potential predictors are statistically significantly related to the dependent variables; only those predictors with statistically significant correlations were used the regression models. Statistical significance was determined using an alpha of .05. The categorical predictors were dummy coded as follows: marital status (1 = never married/single, \( n = 33 \) vs. 0 = other, \( n = 34 \)), insurance type (1 = government, \( n = 33 \) vs. 0 = private, \( n = 32 \); cash patient, \( n = 2 \), not included), actual system use of technology (1 = seven messages, \( n = 55 \) vs. 0 = less than seven messages, \( n = 12 \)). Race was not included because of the extreme difference in sample sizes: 63 Black participants vs. four other racial group participants. Insurance status was not included because of the extreme difference in sample sizes: 65 participants said yes vs. two participants said no. Intention to use baseline was not included because it was a constant: all experimental group participants
strongly agreed. Intention to use follow-up was not included because of the extreme difference in sample sizes: agree, \( n = 6 \) vs. strongly agree, \( n = 61 \).

To address research question two, a one-within, one-between MANOVA was conducted to determine if statistically significant differences existed on A1C, systolic and diastolic blood pressure, BMI, and weight by time (baseline vs. follow-up) and group (control vs. experimental). The within-subjects variable is baseline vs. follow-up and the between-subjects variable is control vs. experimental. Statistical significance was determined using an alpha value of .05. Prior to analysis, the assumptions of normality, absence of multicollinearity, and equality of variance/covariance were assessed. Normality was assessed with skew and kurtosis, where normality is defined as skew values between -2.00 and 2.00 and kurtosis values between -7.00 and 7.00. No values were beyond the aforementioned parameters and the assumption of normality was met. Absence of multicollinearity among the dependent variables was assessed with Pearson correlations, where multicollinearity is defined as correlation values above \( r = 0.90 \) (Tabachnick & Fidell, 2012). No correlation values were above 0.90 and thus the assumption was met. Equality of variance was assessed with Levene’s tests and results did not yield a statistically significant finding, and thus the assumption was met. Equality of covariance was assessed with Box’s M test. The result was not statistically significant, and the assumption was met. The interaction between time and group on the five scores was assessed to determine if the impact of group is statistically significantly influenced by time. The interaction between time and group did not yield statistically significant findings, \( F(5, 113) = 1.19, p = .318, \) partial \( \eta^2 = 0.05 \), indicating that distinct statistical differences can be made on the scores by time alone and by group alone.
To address research question three, a one-within, one-between ANOVA was conducted to determine if statistically significant differences existed on BSI scores by time (baseline vs. at second month vs. follow-up) and group (control vs. experimental). The within-subjects variable is baseline vs. at second month vs. follow-up. The between-subjects variable is control vs. experimental. Statistical significance was determined using an alpha value of 0.05. Prior to analysis, the assumptions of normality and equality of variance/covariance were assessed. Normality was assessed with skew and kurtosis, where normality is defined as skew values between -2.00 and 2.00 and kurtosis values between -7.00 and 7.00. No values were beyond the aforementioned parameters and the assumption of normality was met. Equality of variance was assessed with Levene’s tests and results did not indicate a statistically significant finding, and thus the assumption was met. Equality of covariance was assessed with Box’s M test and the result was statistically significant ($p < .001$), indicating the assumption was not met. Due to this violation, Pillai’s Trace approximation of $F$ was reported. The interaction between time and group on BSI scores was assessed to determine if the impact of group is statistically significantly influenced by time. Because the interaction term was found to be statistically significant, post-hoc analyses were conducted to determine where the significant differences lie.
## APPENDIX P

### MODEL CONSTRUCTS, ITEMS, AND SURVEY QUESTIONS

<table>
<thead>
<tr>
<th>Model Construct</th>
<th>Variable Scale</th>
<th>Variable Description and Survey Item</th>
<th>Response Category</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clinical Outcomes</strong></td>
<td>Ratio</td>
<td>A1C</td>
<td>Open-ended</td>
</tr>
<tr>
<td></td>
<td>Ratio</td>
<td>Systolic BP Reading</td>
<td>Open-ended</td>
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<tr>
<td></td>
<td>Ratio</td>
<td>Diastolic BP Reading</td>
<td>Open-ended</td>
</tr>
<tr>
<td></td>
<td>Ratio</td>
<td>Weight</td>
<td>Open-ended</td>
</tr>
<tr>
<td></td>
<td>Ratio</td>
<td>Height</td>
<td>Open-ended</td>
</tr>
<tr>
<td></td>
<td>Ratio</td>
<td>BMI</td>
<td>Open-ended</td>
</tr>
<tr>
<td><strong>User Characteristics</strong></td>
<td>Ratio</td>
<td>Age</td>
<td>Open-ended</td>
</tr>
<tr>
<td><strong>Nominal</strong></td>
<td>Gender</td>
<td>1) Male</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) Female</td>
<td></td>
</tr>
<tr>
<td><strong>Nominal</strong></td>
<td>Marital Status</td>
<td>1) Married</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) Never married</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3) Widowed</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4) Divorced</td>
<td></td>
</tr>
<tr>
<td><strong>Nominal</strong></td>
<td>Insurance Status</td>
<td>1) Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) No</td>
<td></td>
</tr>
<tr>
<td><strong>Nominal</strong></td>
<td>Type of Insurance</td>
<td>1) Private (non-government)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) Government-sponsored</td>
<td></td>
</tr>
<tr>
<td><strong>Nominal</strong></td>
<td>Race</td>
<td>1) White</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) Black or African American</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3) American Indian or Alaska Native</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4) Hispanic or Latino</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5) Asian</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6) Native Hawaiian or Other Pacific Islander</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7) Other</td>
<td></td>
</tr>
<tr>
<td><strong>Perceived Usefulness of Technology / System Usability Scale</strong></td>
<td>Interval</td>
<td>I think that I would like to use this system frequently.</td>
<td>Likert</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1) Strongly Disagree</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) Disagree</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3) Neutral / Not Sure</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4) Agree</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5) Strongly Agree</td>
<td></td>
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<tr>
<td>Model Construct</td>
<td>Variable Scale</td>
<td>Variable Description and Survey Item</td>
<td>Response Category</td>
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</tr>
<tr>
<td>Interval</td>
<td>Interval</td>
<td>I found the system unnecessarily complex.</td>
<td>Likert 1) Strongly Disagree 2) Disagree 3) Neutral / Not Sure 4) Agree 5) Strongly Agree</td>
</tr>
<tr>
<td>Interval</td>
<td>Interval</td>
<td>I thought the system was easy to use.</td>
<td>Likert 1) Strongly Disagree 2) Disagree 3) Neutral / Not Sure 4) Agree 5) Strongly Agree</td>
</tr>
<tr>
<td>Interval</td>
<td>Interval</td>
<td>I think that I would need the support of a technical person to be able to use this system.</td>
<td>Likert 1) Strongly Disagree 2) Disagree 3) Neutral / Not Sure 4) Agree 5) Strongly Agree</td>
</tr>
<tr>
<td>Interval</td>
<td>Interval</td>
<td>I found the various functions in this system were well integrated.</td>
<td>Likert 1) Strongly Disagree 2) Disagree 3) Neutral / Not Sure 4) Agree 5) Strongly Agree</td>
</tr>
<tr>
<td>Interval</td>
<td>Interval</td>
<td>I thought there was too much inconsistency in this system.</td>
<td>Likert 1) Strongly Disagree 2) Disagree 3) Neutral / Not Sure 4) Agree 5) Strongly Agree</td>
</tr>
<tr>
<td>Interval</td>
<td>Interval</td>
<td>I would imagine that most people would learn to use this system very quickly.</td>
<td>Likert 1) Strongly Disagree 2) Disagree 3) Neutral / Not Sure 4) Agree 5) Strongly Agree</td>
</tr>
<tr>
<td>Interval</td>
<td>Interval</td>
<td>I found the system very cumbersome to use.</td>
<td>Likert 1) Strongly Disagree 2) Disagree 3) Neutral / Not Sure 4) Agree 5) Strongly Agree</td>
</tr>
<tr>
<td>Interval</td>
<td>Interval</td>
<td>I felt very confident</td>
<td>Likert</td>
</tr>
<tr>
<td>Model Construct</td>
<td>Variable Scale</td>
<td>Variable Description and Survey Item</td>
<td>Response Category</td>
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</tbody>
</table>
|                 |                | using the system.                    | 1) Strongly Disagree  
|                 |                |                                      | 2) Disagree        
|                 |                |                                      | 3) Neutral / Not Sure  
|                 |                |                                      | 4) Agree           
|                 |                |                                      | 5) Strongly Agree   |
| Interval        |                | I needed to learn a lot of things before I could get going with this system. | Likert  
|                 |                | Overall, I would rate the user-friendliness of this product as: | 1) Worst Imaginable  
|                 |                |                                      | 2) Awful           
|                 |                |                                      | 3) Poor            
|                 |                |                                      | 4) OK              
|                 |                |                                      | 5) Good            
|                 |                |                                      | 6) Excellent       
|                 |                |                                      | 7) Best Imaginable  |
| Behavioral Intention to use | Interval | How likely are you to use these resources to help manage your diabetes care? | Likert  
|                 |                | Why or Why not?                      | Open-ended         |
| Actual System Use | Ratio | Total number of messages successfully delivered to the patient and listened to in their entirety | Open-ended         |
| Behavior Score Dashboard | Ratio / Interval | During the past week, or last 7 days, how many days were you able to follow a healthy eating plan? (circle one) | 1  
| Healthy Eating  |                |                                      | 2  
|                 |                |                                      | 3  
|                 |                |                                      | 4  
|                 |                |                                      | 5  
|                 |                |                                      | 6  
<p>|                 |                |                                      | 7  |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>an eye on and/or drinking less alcohol. It also means eating fruits, vegetables, whole grains, and beans and other foods with high fiber. Following an eating plan that is good for you may also include reaching goals for losing weight, and limiting the amount of protein and salt you eat.</td>
<td>How sure are you that you can follow an eating plan that is good for you, where 0 is not sure at all and 10 is very sure? (circle one)</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>How important is it to you to follow an eating plan that is good for you, where 0 is not important at all and 10 is very important? (circle one)</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
<tr>
<td>Ratio / Interval Being Active Being active means you are taking part in doing things such</td>
<td>During the past week, or last 7 days, how many days were you able to be active? (circle one)</td>
<td>1 2 3 4 5 6</td>
<td></td>
</tr>
<tr>
<td>Model Construct</td>
<td>Variable Scale</td>
<td>Variable Description and Survey Item</td>
<td>Response Category</td>
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<tr>
<td></td>
<td>as jogging, bicycling, golfing, gardening, or walking without stopping for at least 30 minutes most days of the week.</td>
<td>How important is it to you to be active, where 0 is not important at all and 10 is very important?</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How sure are you that you can be active, where 0 is not sure at all and 10 is very sure?</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td><strong>Ratio / Interval</strong></td>
<td><strong>Monitoring</strong> Monitoring for people with diabetes means that they regularly check blood sugar. Monitoring also includes checking your blood pressure, cholesterol, and weight. For this set of questions, we will focus on blood</td>
<td>During the past week, or last 7 days, how many days were you able to monitor your blood sugar at least once per day?</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>Model Construct</td>
<td>Variable Scale</td>
<td>Variable Description and Survey Item</td>
<td>Response Category</td>
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<tr>
<td>sugar monitoring. Monitoring the level of your blood sugar means that you use a blood sugar meter to take a blood sugar reading. Monitoring may be done on your own or with the help of a health care provider.</td>
<td>How important is it to you to monitor your blood sugar at least once per day, where 0 is not important at all and 10 is very important?</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>How sure are you that you can monitor your blood sugar at least once per day, where 0 is not sure at all and 10 is very sure?</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
<tr>
<td>Ratio / Interval</td>
<td>Taking Medication</td>
<td>Sometimes it can be a hard to remember to take all of your medicines. Over the past week, or last 7 days, how many days have you missed taking your diabetes medicines as recommended?</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>Model Construct</td>
<td>Variable Scale</td>
<td>Variable Description and Survey Item</td>
<td>Response Category</td>
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<tr>
<td>other health conditions. These may be pills, insulin, creams, or other medicines that you inject. For the next several questions, please answer for all the medicines that you take.</td>
<td>How important is it to you to take your medicines, where 0 is not important at all and 10 is very important?</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
<tr>
<td>Ratio / Interval Problem Solving Problem solving means coming up with ways to make everyday and/or challenging decisions to stay healthy with your diabetes. When you</td>
<td>How sure are you that you can take your medicines, where 0 is not sure at all and 10 is very sure?</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
<tr>
<td>Over the past week, or last 7 days, how many days have you done problem solving for everyday and/or challenging decisions?</td>
<td></td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Model Construct</td>
<td>Variable Scale</td>
<td>Variable Description and Survey Item</td>
<td>Response Category</td>
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<tr>
<td>make a decision about what to eat or how much to eat, choose which medicines to take, decide whether to take a walk, or determine how you're going to make changes to your daily routine to help your diabetes, you are problem solving. For most situations this means figuring out the problem, finding a way to deal with it and thinking about what may prevent you from solving the problem.</td>
<td>How important is being able to problem solve when being faced with everyday and/or challenging decisions, where 0 is not important at all and 10 is very important?</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
<tr>
<td>How sure are you that you can problem solve when faced with everyday and/or challenging decisions, where 0 is not sure at all and 10 is very sure?</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model Construct</td>
<td>Variable Scale</td>
<td>Variable Description and Survey Item</td>
<td>Response Category</td>
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<tr>
<td></td>
<td>Ratio / Interval</td>
<td>Over the past week, or last 7 days, how many days were you able to cope in a healthy way when you faced stress, emotional or family problems?</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td></td>
<td>Healthy Coping</td>
<td>Healthy coping is having ways to help yourself or knowing when and how to seek help when you are overwhelmed by your diabetes. Every person with diabetes has to deal with stress, strong emotions or family situations that can make it hard to manage their diabetes. How you feel and your quality of life can be affected by emotional and social problems.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>How important is it to you to either help yourself or know when and how to seek help when you are faced with stress, emotional or family problems, where 0 is not important at all and 10</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Model Construct</td>
<td>Variable Scale</td>
<td>Variable Description and Survey Item</td>
<td>Response Category</td>
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<td></td>
<td></td>
<td>is very important?</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How sure are you that you can help yourself or know when and how to seek help when faced with stress, emotional or family problems, where 0 is not sure at all and 10 is very sure?</td>
<td>1, 2, 3, 4, 5, 6, 7, 8, 9, 10</td>
</tr>
<tr>
<td>Ratio / Interval / Nominal</td>
<td>Reducing Risks</td>
<td>Check all the following things that have happened in the past year.</td>
<td>Had an eye exam (with drops in the eyes) by an eye doctor. 1) Yes 2) No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Had feet checked by a health care provider. 1) Yes 2) No</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Saw a dentist. 1) Yes 2) No</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>Had a flu and/or pneumonia vaccination. 1) Yes 2) No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Had blood pressure checked. 1) Yes 2) No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Had cholesterol and triglycerides checked. 1) Yes</td>
</tr>
<tr>
<td>Model Construct</td>
<td>Variable Scale</td>
<td>Variable Description and Survey Item</td>
<td>Response Category</td>
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<tr>
<td></td>
<td></td>
<td><strong>Got help to stop smoking (only applicable for smokers).</strong> 1) Yes 2) No</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Had an A1C test.</strong> 1) Yes 2) No</td>
<td></td>
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<tr>
<td>How important do you feel it is to do the things listed above to help prevent or reduce problems related to diabetes, where 0 is not important at all and 10 is very important?</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How sure are you that you can get the help you need to prevent or reduce problems related to diabetes, where 0 is not sure at all and 10 is very sure?</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td></td>
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</table>
APPENDIX Q

DETAILED HYPOTHESES

Research Question One: To what extent does the Technology Acceptance Model identify predictors of system use of telehealth messages?

H₀₁ₐ: There are no statistically significant predictors of change scores for A₁C (from baseline to follow-up).
H₁ₐ: There is at least one statistically significant predictor of change scores for A₁C (from baseline to follow-up).

H₀₁ₖ: There are no statistically significant predictors of change scores for BMI (from baseline to follow-up).
H₁ₖ: There is at least one statistically significant predictor of change scores for BMI (from baseline to follow-up).

H₀₁₉: There are no statistically significant predictors of change scores for blood pressure (from baseline to follow-up).
H₁₉: There is at least one statistically significant predictor of change scores for blood pressure (from baseline to follow-up).

H₀₁₆: There are no statistically significant predictors of change scores for weight (from baseline to follow-up).
H₁₆: There is at least one statistically significant predictor of change scores for weight (from baseline to follow-up).

Research Question Two: Are there statistically significant differences between patients who received telehealth messages and those in a routine care group on clinical outcomes of A₁C, blood pressure, body mass index, and weight at baseline and follow-up?

H₀₂ₐ: There are no statistically significant differences between patients who received telehealth messages and those in a routine care group on clinical outcomes of A₁C at baseline and follow-up.
H₂ₐ: There are statistically significant differences between patients who received telehealth messages and those in a routine care group on clinical outcomes of A₁C at baseline and follow-up.

H₀₂ₖ: There are no statistically significant differences between patients who received telehealth messages and those in a routine care group on clinical outcomes of blood pressure at baseline and follow-up.
H₂ₖ: There are statistically significant differences between patients who received telehealth messages and those in a routine care group on clinical outcomes of blood pressure at baseline and follow-up.
\textbf{H}_02c: There are no statistically significant differences between patients who received telehealth messages and those in a routine care group on clinical outcomes of body mass index (BMI) at baseline and follow-up.

\textbf{H}_02c: There are statistically significant differences between patients who received telehealth messages and those in a routine care group on clinical outcomes of body mass index (BMI) at baseline and follow-up.

\textbf{H}_02d: There are no statistically significant differences between patients who received telehealth messages and those in a routine care group on clinical outcomes of weight at baseline and follow-up.

\textbf{H}_02d: There are statistically significant differences between patients who received telehealth messages and those in a routine care group on clinical outcomes of weight at baseline and follow-up.

\textbf{Research Question Three:} There statically significant differences between patients who received telehealth messages and those in a routine care group on patients’ self-care management of diabetes as measured by the Behavior Score Instrument over time?

\textbf{H}_03: There are no statistically significant differences between patients who received telehealth messages and those in a routine care group on patients’ self-care management of diabetes as measured by the Behavior Score Instrument over time.

\textbf{H}_03: There are statistically significant differences between patients who received telehealth messages and those in a routine care group on patients’ self-care management of diabetes as measured by the Behavior Score Instrument over time.

\textbf{Construct Research Question One:} Is there a statistically significant relationship between change in clinical outcomes and actual system use?

\textbf{H}_01c: Change in clinical outcomes does not statistically significantly predict actual system use, as measured by the total number of messages successfully delivered.

\textbf{H}_01c: Change in clinical outcomes statistically significantly predicts actual system use, as measured by the total number of messages successfully delivered.

\textbf{Construct Research Question Two:} Is there a statistically significant relationship between user characteristics and actual system use?

\textbf{H}_02c: User characteristics do not statistically significantly predict actual system use, as measured by the total number of messages successfully delivered.

\textbf{H}_02c: User characteristics statistically significantly predict actual system use, as measured by the total number of messages successfully delivered.
Construct Research Question Three: Is there a statistically significant relationship between perceived usefulness and behavioral intention to use?

H₀₃c: There is no statistically significant relationship between perceived usefulness and behavioral intention to use.
H₁₃c: There is a statistically significant relationship between perceived usefulness and behavioral intention to use.

Construct Research Question Four: Is there a statistically significant relationship between behavioral intention to use and actual system use?

H₀₄c: There is no statistically significant relationship between behavioral intention to use and actual system use.
H₁₄c: There is a statistically significant relationship between behavioral intention to use and actual system use.

Construct Research Question Five: Is there a statistically significant relationship between perceived usefulness and actual system use?

H₀₅c: There is no statistically significant relationship between perceived usefulness and actual system use.
H₁₅c: There is a statistically significant relationship between perceived usefulness and actual system use.

Construct Research Question Six: What combination of variables contributes to changes in clinical values?

H₀₆c: None of the variables are statistically significant predictors of changes in clinical values.
H₁₆c: Two or more of the variables are statistically significant predictors of changes in clinical values.
APPENDIX R

PERMISSION TO USE THE TECHNOLOGY ACCEPTANCE MODEL

From: Fred Davis fdavis@walton.uark.edu
To: Koren Goodman KGood006@odu.edu
Date: Thu, Oct 13, 2011 at 11:44 AM
Subject: RE: Request for the Original Model-Technology Acceptance Model
Mailed-by Walton.uark.edu

Koren

Attached are two 1989 papers that introduced TAM to the literature. You have my permission to use TAM and its measures for your dissertation research. You can reproduce the diagram from the Mgt Sci paper, but you should notice that the "final model" eliminates the attitude construct.

Best wishes on your interesting and important dissertation topic about empowering people to self-manage their health.

Fred D Davis

Distinguished Professor and David Glass Chair of Information Systems
Walton College of Business, University of Arkansas, Fayetteville, Arkansas, USA
Visiting Professor of Service Systems Management and Engineering
Sogang Business School, Sogang University, Seoul, Korea

fdavis@walton.uark.edu
APPENDIX S
PERMISSION TO USE MESSAGES

Permission Request Form: Publications

Korea S. Goodman requests use of the following copyrighted AADE material:

AADE Copyrighted Publication/Project/Program Title(s)/Material(s)/Logo(s): Patient Resources AADE?

Self-Care Behaviors Handouts / Audio Files of Seven Self-Care Behaviors.

Chapter/Article Title(s): ____________________ Not Applicable (If applicable)

Page Number(s): http://www.diabeteseducator.org/DiabetesEducation/Patient_Resources/AADE7_PatientHandouts.html

Use of this material is requested for the following:

Project, Program or Publication: Dissertation-Korea S. Goodman, Old Dominion University

Type of Project, Program or Publication: Dissertation focus: Utilizing the Technology Acceptance Model to predict actual system use of an interactive behavior change technology to deliver virtual diabetes health education

Projected Date(s) Project, Program or Publication: Fall 2012- Spring 2013

Estimated number of copies to be printed or produced: 150 estimated participants for pilot/study implementation

Number of times will the product be printed or material be used within 1 year: 150 estimated participants

Do users have to pay for this project, program, or publication? No

By signing the line below, the signer understands that, if granted permission, the signer must:

• Not modify the information in any way;
• Include copyright notice originally included with the used information, and not add any additional copyright;
• Include the following credit language: “Reproduced with permission of the American Association of Diabetes Educators. All rights reserved. May not be reproduced or distributed without the written approval of AADE.”
• Notify the AADE of any attempts to reproduce this material in quantities greater than listed above

Korea S. Goodman, PhD Student, Health Services Research

Permission is granted by the AADE to use the material listed above.

Please complete and return this form to Margaret Maloney
Email: mmaloneym@aaade.org or Fax: 312.424.1427
APPENDIX T

PERMISSION TO USE BEHAVIOR SCORE INSTRUMENT

Permission Request Form: Publications

Korea S. Goodman requests use of the following copyrighted AADE material:

AADE Copyrighted Publication/Project/Program Title(s)/Material(s)/Logo(s): Behavior Score Dashboard

Chapter/Article Title(s): ___________________ Not Applicable ___________________

Page Number(s): Behavior Score Dashboard

Use of this material is requested for the following:

Project, Program or Publication: Dissertation focus: Utilizing the Technology Acceptance Model to predict actual system use of an interactive behavior change technology to deliver virtual diabetes health education

Type of Project, Program or Publication: Dissertation Research

Projected Date(s) Project, Program or Publication: Summer 2013-Fall 2013

Estimated number of copies to be printed or produced: An estimated 300 Participants / 900 copies

Number of times will the product be printed or material be used within 1 year: An estimated 300 Participants / 900 copies

Do users have to pay for this project, program, or publication? No

By signing the line below, the signer understands that, if granted permission, the signer must:

• Not modify the information in any way;
• Include copyright notice originally included with the used information, and not add any additional copyright;
• Include the following credit language: "Reproduced with permission of the American Association of Diabetes Educators. All rights reserved. May not be reproduced or distributed without the written approval of AADE;"
• Notify the AADE of any attempts to reproduce this material in quantities greater than listed above

Korea S. Goodman, Doctoral Student, Health Services Research

Signature: ____________________________

Date: 3/18/2013

Margaret Maloney, Publications Manager, AADE

Date: ____________________________

Printed Name and Title: ____________________________

Telephone Number/Email: ____________________________

Permission is granted by the AADE to use the material listed above.

Please complete and return this form to Margaret Maloney
Email: mmaloney@aadener.org or Fax: 312.424.3427
SCRIPT FOR INITIAL VISIT

Hello. My name is ______________________. I am a researcher from Old Dominion University.

You are being invited to take part in this study because we believe that you can provide a great deal of insight and information into how your primary care provider can better assist patients who are receiving treatment for diabetes with health education.

We would like you to complete a questionnaire today, and on two additional separate occasions, at two months and at four months; it should take about 20 minutes each time.

In addition, we will need your permission to access your medical records and patient assessment that you complete today. Your information will not be shared with anyone. You will be provided assistance in completing the questionnaires. Your participation is confidential so your name will not be attached to any of the information about you when this report is shared.

Any questions and concerns you have will be answered and addressed before you agree to participate and at any time during the 30 days. If you wish to be removed from the study at any time, let us know and your information will be removed.

Do I have your permission to proceed?

If “NO”: Thank you for your time.

If “YES”: I will now ask you a series of questions about how you manage diabetes. These questions will focus on behaviors in the past 7 days or past week. I will also ask you about your behaviors in the past 12 months. Finally, I will ask you about your intentions to utilize the resources provided to you.

ACTION ITEM: Proceed with administering the Behavior Score Instrument.

If “CONTROL GROUP PARTICIPANT”: I would like to provide you with some handouts from the American Association of Diabetes Educators focused on healthy eating, being active, monitoring, taking medication, problem solving, reducing risks, and healthy coping.

If “EXPERIMENTAL GROUP PARTICIPANT”: An automated voice message communication system will contact you over the next seven weeks. The phone number that will appear will be ____-____-_____. You will receive one phone call, each week for seven weeks, at the same time. You will receive the messages in the following order:
healthy eating, being active, monitoring, taking medication, problem solving, reducing risks, and healthy coping. The message time will vary each week. There will be four parts to the entire call.

When the system connects, you will hear my voice. I will say:

1. Hello.
2. Are you a patient at ____________________? If yes, press 1. If no, press 2.
3. You will now hear a message focused on
   a. Healthy eating.
   b. Being active.
   c. Monitoring.
   d. Taking medication.
   e. Problem solving.
   f. Reducing risks.
   g. Healthy coping.
4. Thank you for listening to the message on
   a. Healthy eating.
   b. Being active.
   c. Monitoring.
   d. Taking medication.
   e. Problem solving.
   f. Reducing risks.
   g. Healthy coping.

If you do not pick up the phone, the system will try to reach you again.

ACTION ITEM: Proceed with administering the Behavioral Intention to use questionnaire.
SCRIPT FOR TWO MONTH FOLLOW-UP

Hello. My name is ______________________. I am a researcher from Old Dominion University.

Remember you were participating in this study because we believe that you can provide a great deal of insight and information into how your primary care provider can better assist patients who are receiving treatment for diabetes with health education.

We would like you to complete the second questionnaire today and it should take about 20 minutes.

Remember, your information will not be shared with anyone. You will be provided assistance in completing the questionnaires. Your participation is confidential so your name will not be attached to any of the information about you when this report is shared. Any questions and concerns you have will be answered and addressed before you agree to participate and at any time during the 30 days. If you wish to be removed from the study at any time, let us know and your information will be removed.

Do I have your permission to proceed?

If “NO”: Thank you for your time.

If “YES”: I will now ask you a series of questions about how you manage diabetes. These questions will focus on behaviors in the past 7 days or past week. I will also ask you about your behaviors in the past 12 months. Finally, I will ask you about your intentions to utilize the resources provided to you.

ACTION ITEM: Proceed with administering the Behavior Score Instrument.

If “EXPERIMENTAL GROUP PARTICIPANT”: Thank you again for listening to the seven messages. I would like to ask you some questions about what you thought about the system.

ACTION ITEM: Proceed with administering the System Usability Scale.
SCRIPT FOR THREE-FOUR-MONTH FOLLOW-UP

Hello. My name is ______________________. I am a researcher from Old Dominion University.

Remember you were participating in this study because we believe that you can provide a great deal of insight and information into how your primary care provider can better assist patients who are receiving treatment for diabetes with health education.

We would like you to complete the final questionnaire today and it should take about 20 minutes.

Remember, your information will not be shared with anyone. You will be provided assistance in completing the questionnaires. Your participation is confidential so your name will not be attached to any of the information about you when this report is shared. Any questions and concerns you have will be answered and addressed before you agree to participate and at any time during the 30 days. If you wish to be removed from the study at any time, let us know and your information will be removed.

Do I have your permission to proceed?

If “NO”: Thank you for your time.

If “YES”: I will now ask you a series of questions about how you manage diabetes. These questions will focus on behaviors in the past 7 days or past week. I will also ask you about your behaviors in the past 12 months. Finally, I will ask you about your intentions to utilize the resources provided to you.

ACTION ITEM: Proceed with administering the Behavior Score Instrument.

ACTION ITEM: Proceed with administering the Behavioral Intention to use questionnaire.
SCRIPT FOR RESEARCH PROTOCOL COMPENSATION

Hello. My name is ______________________. I am a researcher from Old Dominion University.

Remember you were participating in this study because we believe that you can provide a
great deal of insight and information into how your primary care provider can better assist patients who are receiving treatment for diabetes with health education.

I would like to thank you for your participation by providing you with a $20.00 gift card to a local retailer.

I will be at the ___________________ on _______________ from _______ to _______.
Please stop by to pick up your gift card on this day and time.
APPENDIX V

RESEARCH COMPENSATION FORM

RESEARCH PARTICIPATION COMPENSATION
FOR RESEARCH PROTOCOL 12-179

I, the undersigned, acknowledge receipt of an incentive in the amount of a **$20.00 Wal-Mart Gift card** for my time as a participant in the above research study.

<table>
<thead>
<tr>
<th>Subject’s Printed Name and Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

INVESTIGATOR’S STATEMENT

I certify that I have provided a $20.00 Wal-Mart Gift card to the above subject as an incentive for participating in Research Protocol 12-179.

<table>
<thead>
<tr>
<th>Investigator’s Printed Name and Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX W

PILOT STUDY

Purpose

A pilot study was conducted to test the logistics, the automated voice message communication system, and the survey administration among 10 patients diagnosed with type 2 diabetes at the host data collection site. The purpose of the pilot study was to determine the feasibility in logistics, changes needed in the administration of the telehealth messages, and survey administration prior to the full study. Results of the pilot study did not warrant amendments to survey instruments, but rather modifications to the electronic data collection variables. Blood glucose serum levels, employment, educational, and income status were eliminated prior to the full study. Additionally, telehealth messages were streamlined, using a patient preferred time slot of morning, afternoon or evening. Following the pilot study, the full implementation of the study began June 2013, after committee approval.

This research study was approved August 30, 2012 by the Old Dominion University's Institutional Review Board. The pilot study took place May 2013 at the host data collection site. Potential participants were recruited over a one week period during scheduled, diabetes-related visits at the host data collection site. The AADE self-care behaviors utilized for the pilot study focused on healthy eating and being active. Control group participants received two AADE educational handouts following the diabetes-related visit. Participants in the experimental group received two telehealth messages delivered by the automated voice message communication utilizing a female voice. The telehealth message on healthy eating was delivered the first week, followed by the
message focused on being active the subsequent week. Pilot study participants did not receive an incentive for their participation.

The researcher orally confirmed eligibility with each potential participant for formal enrollment. Following the diabetes-related visit, potential participants were randomized to either the control group or experimental group to receive the two telehealth messages. Participants completed the informed consent document and the electronic medical record authorization form. The behavioral intention to use questionnaire and the Behavior Score Instrument were orally administered by the researcher for each participant. Total time to complete both questionnaires was approximately 10 minutes. Participants in the experimental group received the schedule indicating the date and time of the delivery of the two messages, instructions on how to interact with the system, and the area code the system would be using to deliver the message. An electronic medical record review was conducted to extract practitioner-recorded clinical outcome values and user characteristics at baseline. Recorded outcome values were the most current laboratory tests appropriate to diabetes management and tracking to include weight, height, BMI, A1C level, blood glucose, systolic and diastolic blood pressure readings. User characteristics included the patient's age, gender, marital status, race, insurance status, type of insurance, and employment status.

The system made three attempts to reach potential participants in the event of a busy line signal, hang-up, voicemail or answering machine. The system required that a person answer the telephone and listen to the message in its entirety to be recorded as a successful call. The automated voice message communication system recorded the total number of messages successfully delivered, partial messages, failed or incomplete calls
due to voicemail status, and call error status because of a non-servicing number or tower interruption of service. A web-based program tracked data derived from the automated voice message communication system. All contact between the researcher and potential participant was documented using an electronic file.

Population

Participants were majority female (n=7; 70%), married (n=6; 60%), Black (n=9; 90%), with a mean age of 55.6 years. The gender ratio reflects the overall population of the center. More than half (n=6; 60%) were residents of Norfolk, Virginia. Patients having participated in a shared medical appointment at the host data collection site accounted for more than half (n=6; 60%). The majority of patients had either commercial or government-sponsored insurance (n=8). Two of the participating patients were self-pay patients. Characteristics of pilot study participants are listed in Table 1.

Among clinical outcomes, pilot program participants had an average blood pressure reading of 140/70 mmHg. The average weight and BMI were 211.70 pounds and 34.40, respectively. The mean BMI of participants indicated an obesity status. The most recent practitioner recorded HbA1C level had a mean value of 7.3%. The average blood glucose reading was 135 mg/dL, which may have included a fasting blood sugar, 2-hour postprandial blood sugar or a random blood sugar level.

Response Rate

The pilot study response rate was 90%. Messages were on average five minutes and 4 seconds in length. Of the experimental group participants (n=5), two telehealth messages were successfully delivered and listened to by four patients.
Table 1

Characteristics of Pilot Study Participants

<table>
<thead>
<tr>
<th>Demographic Characteristic</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>7</td>
<td>70</td>
</tr>
<tr>
<td>Male</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never married/single</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Married</td>
<td>6</td>
<td>60</td>
</tr>
<tr>
<td>Divorced</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Legally separated</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td><strong>Insurance type</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optima</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>Medicaid</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Anthem Blue Cross / RBCBS</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>Optima/Family Care</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Healthkeepers Plus</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Blue Cross / Blue Shield</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Self-Pay</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Black</td>
<td>9</td>
<td>90</td>
</tr>
</tbody>
</table>

*Note.* Percentages may not total 100 due to rounding error.

Results

**Behavioral intention to use.** A researcher-developed one item scale was generated on the behavioral intention to use construct of the TAM prior to the intervention using a five point Likert scale with anchors that ranged from 1 (strongly disagree) to 5 (strongly agree). All participants (n=10) strongly agreed with the intention to use the resources provided. To satisfy a qualitative component to this Likert scale item, participants were then asked to provide reasoning in the form of an open ended item, “why or why not”. Patterns were categorized from this qualitative component into four themes:
Weight Control/Weight Management

1. Always looking for ways to help me take care of diabetes; I am getting older and I have to watch how much I eat, when I eat, and what I eat.

2. I really need to lose weight.

Healthier Eating Choices

1. I need to eat better.

2. New things come up in the field of diabetes all the time. This will be helpful for me because I am always traveling on the road, so to hear an encouraging message will be good.

3. I definitely need information on what to eat when eating out.

Improve Self-Care Behaviors

1. My daughter wants me to be better at checking my blood sugar levels.

2. I am looking for new ways to help me with diabetes.

3. It may be some helpful information for my daughter.

Increasing Physical Activity

1. Daughter wants me to start walking with her. Reading the material will show me how to come up with my own plan for working out with her.

2. I know I need to be more active; I need to exercise more.

Behavior Score Instrument

The Behavior Score Instrument is a 21-item questionnaire that was used to assess patient reported self-care behavior management of diabetes. Patients were asked seven questions to describe self-care behaviors occurring in the prior seven days. When asked about following a healthy eating plan the previous week or last seven days, 70% of
patients responded with seven days. Patients were physically active on average 6 days per week. More than half (60%) reported some type of physical activity each day and having monitored blood sugar levels. Of the total participants, six patients used problem solving for everyday and/or challenging decisions regarding the self-care management of diabetes. Eighty percent of patients reported being able to cope in a healthy way when faced with stress, emotional or family problems. Table 2 details the patient reported behaviors to reduce risk for diabetes-related complications.

Table 2

<table>
<thead>
<tr>
<th>Patient Reported Self-Care Behavior Management</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eye Examination with an Optometrist</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>Yes</td>
<td>6</td>
<td>60</td>
</tr>
<tr>
<td><strong>Foot Examination by Health Care Provider</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>Yes</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td><strong>Saw a Dentist</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>Yes</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td><strong>Had a flu and/or pneumonia vaccination</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>6</td>
<td>60</td>
</tr>
<tr>
<td>Yes</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td><strong>Received help to stop smoking</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Not a Smoker</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td><strong>Had an A1C Test</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td><strong>Had blood pressure checked</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td><strong>Had cholesterol and triglycerides checked</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>10</td>
<td>100</td>
</tr>
</tbody>
</table>

*Note.* Percentages may not total 100 due to rounding error.
Preliminary findings from the study suggest that the Behavior Score Dashboard does not provide a true overall behavior score for patients.

**Summary of Pilot Study**

The pilot study was conducted to examine the feasibility in logistics, determine changes needed in the administration of the telehealth messages, and survey administration prior to the full study to identify predictors of system use among patients managing diabetes in a primary care setting. The majority of patients were receptive of the automated voice message communication system and commented the system was very helpful. Some patients provided future insights for the system’s usability.

Three attempts were made to contact the patient. The system had the ability to detect voicemails. A final attempt by the researcher included a patient preferred time to listen to the message. Oral survey administration by the researcher increased the response rate of the Behavior Intention to Use questionnaire and the Behavior Score Instrument. The System Usability Scale was orally administered the day following the last telehealth message. Oral administration of all surveys is the preferred method of survey administration for the full implementation of the study.

**User characteristics.** Blood glucose serum levels may need to be eliminated, as the practitioner-recorded level may include a fasting blood sugar, 2-hour postprandial blood sugar or a random blood sugar level. This method of collection inconsistent across patients. The practitioner-recorded HbA1C level provided the most accurate method of average blood glucose for the past two to three months.

Employment, educational, and income status was either limited or unavailable in the electronic medical record. Employment status was limited to the type for some
patients, but did not include the status. The inclusion of educational, employment, and income status may provide an overview of the demographics of the sample population to determine links to self-care behavior management among those patients managing diabetes for future studies. The following questions are proposed:

**What is the highest grade or year of school you completed?**

a) Never attended school  
b) 8th grade or less (Elementary)  
c) Grades 9 through 11 (Some high school)  
d) High School Diploma or GED (High school graduate)  
e) Some College or Technical School (College 1 year to 3 years)  
f) College Graduate (College 4 years or more)

**What of the choices below best describes your employment status?**

a) Employed for wages (Full-Time)  
b) Employed for wages (Part-time)  
c) Self-employed  
d) Out of work for more than 1 year  
e) Out of work for less than 1 year  
f) A Homemaker  
g) A Student  
h) Retired  
i) Unable to Work / Disabled

**Which of the following choices best describes your household total income?**

a) Less than $10,000  
b) $10,000 - $14,999  
c) $15,000 - $19,999  
d) $20,000 - $24,999  
e) $25,000 - $34,999  
f) $25,000 - $49,999  
g) $50,000 - $74,999  
h) $75,000 or more
Telehealth message delivery. Preliminary findings suggest offering additional time options for patients that would include a morning, afternoon, and evening opportunity to listen to the message. The delivery of the initial telehealth message will be streamlined and should begin the following day, using a patient preferred time slot of morning, afternoon or evening. Patients will be informed of the exact phone number from which the system would be calling from.
VITA

Koren Sher’Keyer Goodman
Old Dominion University Norfolk, Virginia

EDUCATION:

Master of Science in Education May 2005
Cognate Area: Higher Education Administration

Bachelor of Science in Human Services Counseling May 2003
Minor: Sociology

United States Air Force
Traffic Management San Antonio, Texas May 1998

AWARDS:
College of Health Sciences-Graduate Fellowship-2007-2010; 2011-2013
Modeling and Simulation Steering –Graduate Assistantship, 2010-2011

RESEARCH PUBLICATION:

TEACHING:
Adjunct Teaching Faculty, Old Dominion University November 2005-August 2007

CERTIFICATES:
Certificate in Preparing Future Faculty December 2013
Old Dominion University

Certificate in College Teaching November 2013
Virginia Tidewater Consortium for Higher Education

Certificate in Modeling & Simulation, Health Sciences May 2010
Old Dominion University

PROFESSIONAL AFFILIATIONS / ASSOCIATIONS / SERVICE

- Physicians For Peace, Medical Operations Committee
  - November 2013-present
- American Association of Diabetes Educators
  - April 2013-present
- College of Health Sciences Dean’s Student Advisory Committee
  - October 2011-present
- American Public Health Association (APHA), November 2006-present
  - 2012, 2013 Junior Colleague / Student Abstract Reviewer
- National Academic Advising Association (NACADA)
  - March 2005-August 2007 2007 Mid Atlantic Regional Volunteer Chair