Spring 5-19-2014

Impact of Text Messaging on Diabetic Foot Self-Care Behaviors Using a Single-Case Design

Stephanie Charese Hills

IMPACT OF TEXT MESSAGING ON DIABETIC FOOT SELF-CARE BEHAVIORS USING A SINGLE-CASE DESIGN

by

STEPHANIE CHARESE HILLS

A dissertation submitted in partial fulfillment
of the requirements for the degree of

Doctor of Philosophy
Department of Nursing

K. Lynn Wieck, Ph.D., Committee Chair

College of Nursing and Health Sciences

The University of Texas at Tyler
May 2014

The University of Texas at Tyler
Tyler, Texas

This is to certify that the Doctoral Dissertation of

STEPHANIE C. HILLS

has been approved for the dissertation requirement on
April 22, 2014
for the degree of Doctor of Philosophy in Nursing.

Approvals:

K. Lynn Wieck
Dissertation Chair: K. Lynn Wieck, Ph.D.

Beth M. Smith
Member: Beth Mastel Smith, Ph.D.

Jenifer M. Chilton
Member: Jenifer Chilton, Ph.D.

Kevin P. Gosselin
Member: Kevin Gosselin, Ph.D.

Barbara K. Haas
Chair, Department of Nursing

Pam Martin
Dean, College of Nursing and Health Sciences

Acknowledgments

"But they that wait upon the LORD shall renew their strength; they shall mount up with wings as eagles, they shall run and not be weary, and they shall walk and not faint" Isiah 40:31. I first thank God for giving me the strength and courage to keep pressing on. I thank my sons Stephen and Nicholas who were the wind beneath my wings that sustained me even when I didn't think I had the energy to keep flying. I want to express sincere gratitude to all of my family and friends who have been so supportive throughout this journey. Special acknowledgement to my mother Betty, sister Heidi, brothers Michael and Robin and my nieces Brianna, Khori, Mikana and nephew Michael. A special thanks to my dissertation committee and especially my chair Dr. Lynn Wieck for her belief in me and guidance through each step. I am honored to have had your wealth of knowledge, experience and wit, and I will be forever grateful to you for all you have done to bring me to this point. I will never be able to thank you enough. I also want to say a special thank you to Dr. Kevin Gosselin who presented me with the initial idea of using the single-case design in this study. This dissertation is dedicated to my maternal grandmother Nancy Beautyland Adkins. She taught me what it means to work hard, persevere and never give up. May you rest in peace. I hope you are proud of me. Lastly, I would like to acknowledge two ladies who were the reason I chose to focus my first study on diabetic foot care: Mary Waddles, my paternal grandmother, and Annie Mae Chase who both had diabetic related amputations.

Table of Contents

List of Tables

List of Figures

Abstract

IMPACT OF TEXT MESSAGING ON DIABETIC FOOT SELF-CARE BEHAVIORS USING A SINGLE-CASE DESIGN

Stephanie Charese Hills

Dissertation Chair: K. Lynn Wieck, Ph.D.

The University of Texas at Tyler
April 2014

Diabetes is a debilitating chronic disease that affects millions of people worldwide and is responsible for billions of dollars in healthcare expenditures. Diabetic-related amputations are the most costly complication of the disease. Patient education targeted at enhanced self-care behaviors is seen as one means to improve outcomes. The purpose of this research study was to examine the use of text messaging as an approach to provide diabetic foot-care education and to evaluate the impact on the discrete patient using a single-case design. This methodology has been successfully used by other disciplines and provides a valid means to study the impact of nursing interventions using few resources and when the use of multiple participants is not feasible. Two articles provide the context and outcomes of this original research study. One article provides an overview of single-case design focusing on its feasibility in nursing research. The second article is a report of two single-case design studies conducted simultaneously to test the impact of a texting intervention to improve the foot care practices of two people with

diabetes. The findings support text messaging as a way to improve foot care and the use of single-case design as a sound research design option for professional nursing.

Chapter One

Overview of the Research Study

Overall Purpose of the Study

The number of persons with diabetes is rising globally with approximately 347 million currently diagnosed worldwide (World Health Organization, 2014). It is predicted that by the year 2030, diabetes will be the seventh leading cause of death in the world with the toll projected to rise more than 50% over the next 10 years. Approximately 90% of those diagnosed worldwide have Type 2 diabetes which is caused by the body's resistance to insulin and insufficient production. The estimated total cost in 2012 of diagnosed diabetes in the United States was $245 billion with $176 billion directly related to medical costs and $69 billion attributed to lost productivity (American Diabetes Association, 2014a). Minority populations in the United States comprise 25% of adults with Type 2 diabetes and the majority of children and adolescents with the disease (U. S. Department of Health & Human Services, 2013a). These large numbers are due in part to the prevalence of obesity and lack of physical activity despite a plethora of information focused on prevention through diet and weight control. "Rates for type 2 diabetes rise sharply with age for both men and women and for members of all racial and ethnic groups" (Centers for Disease Control, 2012). Diabetes that is poorly managed can lead to "serious complications including heart disease, stroke, blindness, kidney disease and amputations leading to disability and premature mortality" (Scott, 2013). During

2005-2007, for every 1000 persons diagnosed with diabetes, 3.5 required a lower extremity amputation (U. S. Department of Health & Human Services, 2013a).

Healthcare providers have struggled to develop uniform self-care recommendations. Nevertheless, a third of diabetic patients are unaware of the potential risk of amputations (Turns, 2012). In addition, preventing diabetic foot complications requires vigilant daily foot care activities; however, there is currently no valid or reliable tool to measure these behaviors (Chin & Huang, 2013). One of the Healthy People 2020 goals is to "reduce the disease and economic burden of diabetes and improve the quality of life for all persons who have, or are at risk for developing the disease" (U. S. Department of Health & Human Services, 2013b). This objective is to be met through increasing patient self-management behaviors with population-based interventions and patient education.

Ongoing self-care education is a crucial tool used to sustain progress and improve the health of diabetic patients through enhanced decision-making, problem-solving, and self-care behaviors all of which ultimately impact outcomes and quality of life (American Diabetes Association, 2008). Diabetes control and management require healthcare providers to support patients as they deal with life barriers that may impact their ability to adhere to treatment protocol (Harwood, Bunn, Caton & Simmons, 2013). Nursing strives to assist patients in the management of diabetes through theory-based interventions targeted at improving self-care behaviors (Jang & Yoo, 2012). Persons with diabetes often require frequent diet and medication adjustments and rely heavily on self-care to control acute or chronic complications (Wilkinson, Whitehead, & Ritchie, 2014).

This study examined how text messaging used to provide diabetic foot-care education impacts patient self-care behaviors and clinical outcomes using the Theory of Self-Care of Chronic Illness (Riegel, Jaarsma, & Strömberg, 2012). An original study was conducted using the single-case study design to evaluate the impact on the discrete patient in order to frame further discussion on the use of this design in nursing research.

Introduction of Articles Appended

Two articles are included to report the findings of this topic of research. The first manuscript, Single-Case Design: An Option for Nursing Research, presents the single-case design methodology as a viable option to build evidence-based interventions that are more patient-centered, individualized, and easily transferable into practice in a fiscally-constrained and time-conscious research environment. Nursing research is facing an unnerving challenge for national relevance in a healthcare system in flux. Repeated emphasis on the benefits and need for evidence-based practice has made hospitals clamor for ways to make it happen. But getting evidence into the hands of staff nurses as a consumable product which can be applied to the clinical practice setting has been difficult. Part of the problem lies in the research itself. The outcome of most research is not in a format that can be easily understood and applied by the bedside nurse. Opening our minds to the potential contribution of more non-traditional research designs and putting the research into practical terminology will go a long way toward a truly evidence-based environment. This paper describes a methodology that is common in education and sports research but which has not been readily embraced by professional nursing. The single-case design research method holds potential to be one way to truly translate research into practice.

The second manuscript, Impact of Text Messaging on Diabetic Foot Self-Care Behaviors Using a Single-Case Design, reports findings of the use of a text messaging intervention as a method to provide diabetic foot-care education and the impact on self-care behaviors and clinical outcomes. The Theory of Self-Care of Chronic Illness was used as the framework to guide this study. The key concepts of the theory (*self-care maintenance, self-care monitoring, and self-care management)* were evaluated during the study along with the results of daily blood glucose monitoring and weekly weights. A computerized survey was sent out via email to the participants. The survey included five instruments to measure various aspects of diabetic self-care based on the three key concepts of the model. The Self-efficacy for Diabetes Scale (SDS) developed by the Stanford Patient Education Research Center (n.d.) consists of an 8-item questionnaire that measures a patient's confidence level (1= *not at all confident* to 10 = *total confidence*) in performing behaviors that are not directly related to diabetes, but they help the patient maintain the best health possible (McCleary-Jones, 2011). The Foot Care Behaviors Scale (FCBS) is a five point Likert scale based on the American Diabetes Association (2014a) guidelines aimed at avoiding diabetic foot complications. The Summary of Diabetes Self-Care Activities (SDCSA) is a self-completion questionnaire that measures behaviors over several domains of the diabetic regimen: blood sugar testing, medications, diet, foot care, exercise and smoking (Toobert, Hampson, & Glascow, 2000). It assesses the level of care and the frequency of specific behaviors as opposed to adherence. For the purpose of this study, only the blood sugar and foot care subscales were used. The Diabetic Self-Management Questionnaire (DSMQ) was the first German instrument developed to target diabetic self-care behaviors involving metabolic control for both

Type 1 and Type 2 adult patients (Schmitt et al., 2013). The 16-item questionnaire uses four subscales (glucose management, dietary control, physical activity and health care use) along with a sum scale as a global measure to evaluate self-care behaviors (Schmitt et al., 2013).

This manuscript describes the findings from two single-case intervention studies which ran simultaneously but were managed separately. Findings revealed that text messaging to provide targeted patient education to persons with chronic diseases can have a positive impact on self-care behaviors and may impact clinical outcomes. Confidence levels increased for both participants in the area of self-care maintenance which involved behaviors such as following a prescribed diet, choosing appropriate foods, knowing what to do when blood sugars went higher or lower, and exercising to maintain health. Self-care management activities, for instance keeping doctor's appointments, avoiding foods high in sugar or carbohydrates, and engaging in regular physical activity, also improved during the intervention and after the rest period. The impact of the intervention on self-care monitoring activities varied between participants. These activities include blood sugar testing, checking the feet for diabetic related problems, and wearing slippers. Though there were some periods of increased compliance, the frequency of these activities for one participant did not improve as much due to mitigating factors such as a lack of necessary supplies and some confusion regarding the survey questions. At the exit interview, both participants agreed that the text messages were an effective means to provide new or reinforced patient education, and each requested to continue receiving the text messages even after the study ended.

Finding answers to the debilitating effects of chronic diseases like diabetes will continue to be a priority into the foreseeable future. Openness to new research designs and implementing innovative technology interventions may hold promise for progress in improving health outcomes for chronically-ill persons. The following articles report an effort to use innovative designs and interventions to impact the self-care of diabetic persons which might help them have longer, happier, and healthier lives.

Chapter Two

*S*ingle-Case Design: An Option for Nursing Research

Abstract

There are sweeping changes ahead in the delivery of healthcare due to the passage of the Affordable Care Act with an increase in patient-centered care, a potential rise in patients living longer with chronic diseases, and an anticipated critical shortage of health providers. Nurses must be poised to become frontline leaders in this movement. These comprehensive changes will require nurses come better prepared through higher levels of education and enhanced research methodologies. This paper presents the single-case design (SCD) methodology as a viable option to create evidence-based interventions that are more patient-centered, individualized, and easily transferable to meet the coming challenges. An overview of the scope, process, and utility of the SCD research methodology will be presented along with examples of how it has been used in nursing research and other disciplines. Limitations and possible recommendations for use in future nursing studies will also be discussed.

Keywords: nursing research, single-case design, ABA withdrawal, multiple baseline, alternating treatments

Single-Case Design: An Option for Nursing Research

Nursing research is facing an unnerving challenge for national relevance in a healthcare system in flux. Repeated emphasis on the benefits of and need for evidence-based practice has made hospitals clamor for ways to make it happen. However, getting evidence into the hands of staff nurses as a consumable product that can be applied to the clinical practice setting has been difficult. Part of the problem lies in the research itself. The outcomes of most research studies are not in a format that can be easily understood and applied by the bedside nurse. Opening minds to the potential contribution of more non-traditional research designs and putting the research into practical terminology will go a long way toward a truly evidence-based environment. This paper describes a methodology that is common in education and sports research but which has not been readily embraced by professional nursing. The single-case design research method holds potential to be one way to truly translate research into practice.

Significance of Opportunity for New Research Ideas

The passage of the Affordable Care Act in 2010 promised sweeping changes in the United States healthcare system. This new frontier necessitates adjustments in the way nursing students are educated to meet increasing demands, and it portends changes in the way patient care is delivered. Healthcare is shifting to a more patient-centered, individualized paradigm with greater emphasis on shared decision making and patient engagement throughout the continuum of care. This represents a major change from the traditional passive patient and provider relationship (Berryman, Palmer, Kohl & Parham, 2013). Improvements in treatment and diagnostics will continue to extend life expectancy for patients dealing with chronic diseases (Smidth, Christensen, Olesen &

Vedsted, 2013) necessitating more focus on patient self-management instead of acute care.

The 2010 Institute of Medicine (IOM) report, *The Future of Nursing: Leading Change and Advancing Health*, identified nursing as a critical element and frontline leader in the healthcare system of the future. A major priority is to double the number of nurses with doctoral degrees by the year 2020. This recommendation was embraced by the American Association of College of Nurses (2010) in a news release that applauded the IOM's suggested transformational changes in nursing education. A 2008 national survey of registered nurses (RNs) revealed only 0.93% of all RNs in the United States held either the clinically focused Doctor of Nursing Practice (DNP) or the research focused Doctor of Philosophy (PhD) degree (U. S. Department of Health & Human Services, 2010). An essential aspect of increasing the number of nurses with doctoral degrees is a renewed focus on the science being generated by aspiring and neophyte nurse scientists. The type of research, accessibility of findings, and general applicability to the clinical setting are essential elements of planning for the future of doctoral nursing education. Into this dynamic healthcare environment, nursing research brings the potential to lead the way with creative ideas and plausible solutions. These solutions should be based on evidence and must be easily translatable into the clinical practice setting. The notion of new research designs is fully consistent with the goal to double the number of doctoral nurse graduates by 2020 and provides a new openness to generating science that is rigorous, focused, and meaningful. Small-study designs meet the current needs of neophyte and seasoned nurse researchers as a way to explore scientific bases,

test interventions, and advise methods in a fiscally-constrained and time-conscious research environment.

Single-case Design: Description and Relevance

Potential for Contribution of Small Sample Studies to Nursing

Nursing research, like that of most disciplines, has sought rigor in high numbers of participants. Specific calculations project the minimum number needed for large population studies based on the impact the intervention is likely to have, previous study findings using the same or similar variables, and trust level of the researcher in how much of the findings can be left to chance. However, there are cases where decisions about appropriate interventions can logically be made by using single subject research. The impact of single observations can be illustrated by this example: A young man walking down the street steps off the curb into the pathway of a fast-moving bus. The ensuing impact results in his untimely and decisive demise. How many times would one have to witness this situation to be convinced that walking in front of a moving bus is not a desirable behavior? If the intervention and outcome are crystal clear, as in the bus situation, a sample size of one is probably adequate to change behavior. Most studies do not have such clear parameters, but the use of single-case studies as a nursing research method can have the benefits of testing methods in real-life settings in anticipation of larger studies (Byiers, Reichle & Symons, 2012), clearly articulating a workable intervention design, and helping to develop *a priori* research hypotheses based on experiential findings.

Single subject research design refers to a research study where there is a sample size of one or where a number of individuals are considered to be one group (Wasson,

2005). These designs typically allow the researcher to make inferences about behavior change as the result of some treatment or series of treatment variations. It is akin to a time-series design where subjects serve as their own controls and are measured prior to treatment, during treatment, and after treatment (Gay & Airasian, 2003). This clear design, with the ability to do rigorous field work with a single individual seeking some change in behavior, seems particularly suited to nursing where strict laboratory conditions for control of subjects is seldom available, practical, or ethical.

Much of nursing practice has relied heavily on tradition, custom, or intuition instead of sound clinical evidence (Polit & Beck, 2008). This system makes it difficult to determine what treatment actually caused an observed outcome since the statistics used rely heavily on the law of averages in which researchers must make broad sweeping generalizations that may not be relevant in predicting individual patient responses (Portney & Watkins, 2009). Another limitation of large-group research is that the timing of measurements (before and after the study) makes it difficult to determine what intervention actually caused the observed response (Portney & Watkins, 2009). Traditional study designs are very time consuming and may not be appropriate for disciplines with immature or absent theoretical models (Barnett et al, 2012). Although one might argue that nursing has led the way in mid-range theory development with relevance to everyday clinical practice, testing these models using sound research methods remains a goal. While large, multi-site studies with complex interventions are promoted in nursing research circles, they are costly and labor-intensive which further limits their usefulness as a research option, especially for doctoral students and beginning researchers.

Moving into the future, nurse scientists must look at other research design options that may be better suited to understanding the individual patient response as a precursor to more relevant larger studies. New frameworks will increase understanding of the impact of interventions on chronically ill patients allowing them to better manage lifelong complications and treatment. With a rise in the number of Doctor of Nursing Practice programs, most of which require some sort of original research-based project resulting in findings applicable to the practice arena, small sample studies make sense. The single-case design (SCD) is a research methodology that can fill the need for research competency and evidence-based practice alternatives. It is highly suited for investigators whose primary goal is to understand individual patient behavior and outcomes using a small sample size where a larger control group is difficult or impossible to obtain (Barnett et al, 2012; Wasson, 2005). Using this model, nursing research can evolve into a web of evidence-based interventions built around an increasingly individualized health delivery system that can be easily transferred to the clinical practice setting. The single-case design provides a means to initiate research based on some evidence of potential successful interventions and methods which can help reduce wasted time, effort, and resources.

The Process of Single-Case Design Research

In single-case design (SCD) research, a case is defined as "an individual affected by disease, illness, or disability characterized in terms of the outcome of interest" (Barnett et al, 2012, p. 177). A single-subject study is conducted using one participant under controlled conditions which provides the flexibility to observe patient behavior and make thoughtful and documented changes accordingly throughout the treatment phase

(Portney & Watkins, 2009). SCD studies focus on the individual instead of group differences (Rassafiani & Sahaf, 2010). The individual participant or the single group acts as their own control (Portney & Watkins, 2009; Wasson, 2005; Wolery, Dunlap & Ledford, 2011) through an observation period prior to the introduction of a single or series of interventions.

Repeated measurements in single case design are used to observe individual trends and patterns which allow for individualized modifications of interventions rendering more meaningful results. A simple example would be an athlete in training whose running speed is measured during baseline, a new exercise is initiated at two week intervals over a period of eight weeks (n = 4 interventions), and running speed improvements are monitored throughout the entire eight weeks and for two additional weeks after cessation of introduction of new exercises. Through external measurements and subject feedback, the effectiveness of each new intervention on overall performance can be assessed. These types of studies are considered the most scientifically valid method for disciplines such as education and psychology (Wasson, 2005) and are often used when the intent is to examine multiple interventions, amounts, or forces to resolve a unique behavioral problem (Brossart, Meythaler, Parker, McNamara & Elliott, 2008). This conceptual goal is consistent with many of the problems in healthcare for which nurses seek solutions. SCD represents a flexible means to systematically study a patient while at the same time manipulate variables, tailor interventions, and gather data for analysis (Tate et al, 2008). They are especially suitable for research in the clinical setting where the focus is on the individual client (Byiers, Reichle & Symons, 2012). Since it is possible to draw causal inferences about the relationship between independent variables

and behavior from experimental SCD studies (Worlery, Dunlap & Ledford, 2011), nurses could use this method to determine the effectiveness of their interventions on patient behaviors and draw conclusions from the outcomes. Single-case design involves observing and measuring a single person or single group through a series of actions (interventions) toward a final goal. The following five characteristics are the core of single-case design (McMillan, 2004):

1. Reliable measure: consistent measurement to improve rigor.
2. Repeated measurement: to establish a clear pattern over time
3. Description of conditions: clear, detailed descriptions strengthen internal and external validity
4. Baseline and treatment conditions: baseline = dependent variable; treatment=experimental manipulation
5. Single-variable rule: only one variable changed from baseline to treatment conditions

The U.S. Government-sponsored What Works Clearinghouse, under the auspices of the U.S. Department of Education, has developed pilot standards for single-case designs: 1) an individual "case" is the unit of intervention and data analysis; 2) the case provides its own control for purposes of comparison; and 3) the outcome variable is measured *repeatedly* within and across *different* conditions or levels of the independent variable (What Works Clearinghouse, 2011). SCDs are proposed as a means to provide a rigorous experimental evaluation of intervention effects (Kratochwill & Levin, 1992; Shadish, Cook, & Campbell, 2002). SCDs are reported to "provide a strong basis for establishing causal inference" and have been widely applied to the disciplines of psychology and

education (What Works Clearinghouse, 2011, p. 61). The goal of SCDs is to determine if a causal relationship exists between a manipulated variable introduced by the researcher and change in a measured dependent variable (What Works Clearinghouse, 2011). Although there are many variants of the SCD form, it is important to note that there must be precision in the objectives and questions which drive the study.

Types of Single-Case Design and Examples

The three most common types of SCD are: *ABA Withdrawal, Multiple-Baseline, and Alternating Treatments* (Wasson, 2005), and they typically contain two identifiable measurement periods (baseline and intervention). Baseline represents the period of no intervention or the natural state and is equal to the control in traditional research (Portney & Watkins, 2009; Wasson, 2005). The baseline period must be long enough to allow the researcher to gather data that will be used to estimate the patient's level of stability or state of health prior to implementation of the treatment phase. Once the intervention is introduced, changes from baseline are compared to evaluate any cause-and-effect relationships. Phases of the study, or results, are plotted using a line graph along an X- and Y-axis (Portney & Watkins, 2009). *ABA Withdrawal* design typically includes a baseline measurement period (the dependent variable), introduction of an intervention (the independent variable), and then withdrawal or reversal of the intervention. It is used in clinical research to answer questions that attempt to understand the effect of a single intervention, i.e. the independent variable (Byiers, Reichle & Symons, 2012). *Alternating Treatment SCD* involves an iterative manipulation of the intervention across different observational phases. Estimates of the trending and changes are measured within specific conditions or manipulated interventions across several phases of the study

with measurement taken during each phase. *Multiple Baseline SCD* is a time-based study with staggered introduction of the intervention across different points in time (What Works Clearinghouse, 2011, p. 62). In multiple base studies, the timing of introduction and withdrawal of specific interventions are staggered with comparisons made between the series of data as well as within each data series set. Different replications of the intervention vary in length and timing of change. Variations of these three basic methods are available. The purpose of SCD is to answer the following kinds of research questions: does the introduction of an intervention change the baseline state; does adding additional components to an intervention cause more or different change in baseline; does the addition of two alternating interventions cause a change in the baseline (What Works Clearinghouse, 2011).

ABA Withdrawal Design.

The standard single-case model is the ABA withdrawal or reversal design where the "A" phases represent periods of non-treatment or observation and the "B" phase represents the treatment or intervention (Skjutar, Müllersdorf & Schult, 2012). In this design, "A1" is the initial baseline non-treatment observational or control period that precedes the treatment phase. During this period, a range of stable data points are identified and collected which helps to establish a predictable benchmark that will be later compared to the patient's behavior during the intervention phase "B". During the intervention, some type of designated activity or treatment is introduced with frequent data collection (often daily) and possible modification of treatment which is carefully documented. The "B" treatment period is followed by the "A2" phase which is the follow-up non-treatment observational or control period when the intervention undergoes

a “withdrawal” or “reversal” that allows for a return to baseline. This series of steps may be followed by a reintroduction of the same or a modified intervention or “B2” phase, along with subsequent measurements to evaluate the degree of change. Some studies also include an additional AB phase to rule out unrelated factors that may impact results. An example of this type of study is the A-B1-B2-B3-A model where B1, B2, and B3 represent different types of treatment levels with multiple data collection points in each phase. Basically, the ABA design can be used to compare or predict behavior under various conditions (Barnett et al., 2012) with the goal being to identify a causal relationship (Rassafiani & Sahaf, 2010). Behavior is measured during all phases, and all results are compared. ABA withdrawal research is conducted using a single subject, behavior, and setting (Wasson, 2005) with study phases varying from days, week, or months depending on the study plan and variables (Rassafiani & Sahaf, 2010). This design has strong internal validity because the researcher can “demonstrate experimental control by turning the target behavior on and off like a light switch” (Wong, 2010, p. 254).

O’Malley, et al. (2013) used the ABAB variation of this design to introduce iPad®-based math skill applications into a curriculum for middle-school students with disabilities to try to increase basic math fluency. The ten (10) students served as a single group. The single-case reversal design was used to provide and withdraw the iPad® use at four-week intervals. The within-subjects comparisons allowed each subject to serve as their own control. Visual inspection of time series line graphs contributed to an understanding of effect based on data patterns. Further, dependent t-tests showed an increase in ability to answer basic math problems correctly per minute from baseline (A

phase) with a mean of 5.75 (SD=3.41) to the intervention period (B phase) where the mean increased to 17.56 (SD=6.65); $t(9)$=-.8.66, p<001. The design allowed the researchers to find that the use of the technology indicated an average of a 12 point increase in the number of correct problems per minute while also allowing them to study advantages and barriers in this type of intervention. This type of focused, time-limited observation, intervention, and measurement has tremendous potential for nursing studies of health behaviors.

Bédard et al. (2011) used the ABA design to study the use of targeted interventions (comfort measures, social interactions and sensory stimuli) administered by mental health therapists and their effect on verbal agitation (VA) in nursing home residents with dementia. The study was conducted in four phases: baseline (T1), intervention or treatment phase (T2), withdrawal of the intervention (T3), and follow-up (T4). The researchers used single-group repeated measures to evaluate behaviors such as screams or repetitive vocalizations using a computer-assisted device for direct observation before, during, and after the intervention. Throughout phases T2 and T4, all interventions were applied six times, for 30 minutes, to 26 participants who served as the treatment group. The observations were conducted on different days over a two week period. Results revealed a statistically significant reduction in the duration of VA during the period that the intervention was being applied with 54% of the patients having a 50% reduction in symptoms, especially higher functioning patients. A multiple regression analysis revealed a significant association with $R^2 = 0.57$ and (F (1, 21) = 27.33, $p < 0.01$) which explained 57% of the variance between those patients with higher cognitive levels and the treatment response. Limitations cited include the possibility of extraneous factors

responsible for the decrease in VA, observer bias, and the fact that all participants continued receiving usual care throughout the study period.

Alternating-Treatment Design

Patients studied using an *Alternating-Treatment* design were exposed to two randomly selected and alternating treatments during each experimental phase (Wasson, 2005). Data collection begins in the baseline phase, but random assignment occurs during subsequent phases in which "baseline sessions rapidly alternate between two or more treatment conditions" (Wong, 2010, p. 256). This randomization is necessary to ensure that any difference in performance noted can be attributed to the intervention or treatment instead of extraneous factors such as the setting or researcher bias (Wong, 2010). For example, if attempting to control the study from potential influences such as time and order, one intervention can be introduced on days 1,3,5,7 and another on days 2,4,6,8, etc. (Matson, Turygin, Beighley, & Matson, 2012). One of the strongest rationales for the use of this design is that it can be used to determine if the effect(s) of one treatment works better than another (Byiers, Reichle & Symons, 2012; Matson, Turygin, Beighley, & Matson, 2012).

Taber-Doughty, Shurr, Brewer, and Kubik (2010) used an alternating treatment design to measure community-dwelling adults with cognitive disabilities regarding the differences between having prompts for guidance in daily care activities provided by standard on-site care staff alternating with the prompts arising from a remote telecare provider. The prompts were verbal including how to do things like fold a sheet or address an envelope and were given alternately by on-site provider and telecare provider. The prompts provided by the remote telecare provider did increase task independence

slightly and decreased the number of prompts for task completion. Researchers did caution about the small sample size noting that findings indicate that further study of this type of distance prompting should be studied with larger samples. The ability to test the feasibility of an intervention using a single subject or a single group is one of the benefits of single-case design. No nursing studies were found using the alternating treatment SCD in nursing.

Multiple Baseline Design

The *Multiple Baseline* design is similar to the *Alternating-Treatment* model in that it can also be used to evaluate the effects of a single intervention across three or more variables (Byiers, Reichle & Symons, 2012). In a M*ultiple-Baseline* study, one parameter is varied (subject, behavior or setting) throughout the intervention period while the other two parameters remain constant. This design does not remove the intervention, as in the ABA withdrawal, thus it is seen as a more ethical option while being the most practical for evaluating new interventions and techniques (Rassafiani & Sahaf, 2010). One of the key features of this design is that the baseline can be of varying lengths, followed by a treatment phase, and it can be utilized to evaluate various behaviors within the same patient. Also, establishing the baseline is more flexible in this design since it can be created by observing multiple, separate behaviors of a single client; the single behavior of one client in a variety of settings; or, by evaluating the same behavior of multiple clients, which is the most common (Matson, Turygin, Beighley, & Matson; Wong, 2010). Experimental control is maintained only if improvements are observed when the intervention is applied after each baseline.

Cushing, Jensen, and Steele (2011) used a multiple baseline design to evaluate the effect of personal electronic devices (PED) on adherence to self-monitoring behaviors of overweight adolescents tasked to record both dietary intake and physical activity. During baseline, each participant used a paper-and-pencil method to record behavior. This was later replaced by an Apple iPod Touch™ loaded with software used to record and store data. The use of the PED increased adherence which was sustained and stabilized at 75-100% for two of the participants, but for the third, the increase was more variable (M=55.1%), yet remained above baseline (M=25.3%). Further research to investigate the use of PEDs as a weight management intervention was recommended. Undertaking this type of research using a large-group methodology would not be cost effective or feasible due to limited resources.

No recent multiple baseline studies in nursing were located. A multiple baseline study in nursing was done with depressed inpatients in a 1994 study of the benefits of movement therapy (Stewart, McMullen & Rubin, 1994). Researchers conducted a single-case design study with 12 replications to control for multiple treatments by randomizing between treatment and non-treatment days. They found a significant reduction in depressed mood on the intervention days ($p < .05$). They reported that the single case experiment offered several advantages when doing research in the clinical setting, i.e. ability to separate the treatment effect from coexisting variables, cost containment, and utility to clinicians.

Conclusion

SCDs have been used successfully by many disciplines to evaluate the patient response to treatment modalities. It is the recommendation of this author that nursing adopt this research design as a legitimate means to generate evidence-based nursing practice. This recommendation is based on three conclusions regarding SCD: It is a useful method for staff nurses to "try out" new ideas and provides a practical structure to evaluate new interventions by helping to identify initial causal relationships between the treatment and the patients' response, although the design must still follow IRB protocol before implementation in the clinical setting. Additionally, the simplicity of the model and its rapid applicability to the clinical setting provide an added imperative for nurses to consider a means to evaluate proposed changes to their practice. And lastly, it is the epitome of evidence-based practice.

The SCD methodology also has the potential to greatly impact the novice nurse researcher by providing an ideal means to test out causal relationships and the feasibility of conducting larger studies. Most DNP programs require the completion of a project that impacts or promotes change in the clinical setting. MSN students are also involved in clinical change projects while the PhD student needs data and findings to initiate a funded research career. This design can move the novice nurse researcher toward an understanding of how an intervention might impact an individual patient and sets the tone for further exploration.

Limited funding and lack of supporting resources will continue to curtail the ability to conduct meaningful large-population studies, but nurses cannot let science and evidence-based practice lapse or suffer because of external challenges. SCD provides a

mechanism to continue to explore changes in practice geared toward improvement of patient outcomes and an enlightened practice discipline.

References

American Association of Colleges of Nurses. (2010). AACN applauds the new institute of medicine report calling for transformational change in nursing education and practice. Retrieved from http://www.aacn.nche.edu/government-affairs/AACN_Support_ of_IOM_ Future_of_Nursing_Report_10-8-2012.pdf

Barnett, S. D., Heinemann, A. W., Libin, A., Houts, A. C., Gassaway, J., Sen-Gupta, S., Brossart, D. F. (2012). Small N designs for rehabilitation research. *Journal of Rehabilitation Research & Development, 49*(1), 175-186.

Bédard, A., Landreville, P., Voyer, P., Verreault, R., & Vézina, J. (2011). Reducing verbal agitation in people with dementia: Evaluation of an intervention based on the satisfaction of basic needs. *Aging & Mental Health, 15*(7), 855-865. doi:10.1080/13607863.2011.569480

Berryman, S., N., Palmer, S., P., Kohl, J., E., & Parham, J., S. (2013). Medical home model of patient-centered health care. *MEDSURG Nursing, 22*(3), 166-196.

Brossart, D.F., Meythaler, J. M., Parker, R. I., McNamara, J., Elliott, T.R. (2008). Advanced regression methods for single-case designs: Studying propranolol in the treatment for agitation associated with traumatic brain injury. *Rehabilitation Psychology*, 53(3), 357–69. http://dx.doi.org/10.1037/a0012973

Byiers, B. J., Reichle, J., & Symons, F. J. (2012). Single-subject experimental design for evidence-based practice. *American Journal of Speech-Language Pathology, 21*(4), 397-414. doi:10.1044/1058-0360(2012/11-0036)

Cushing, C. C., Jensen, C. D., & Steele, R. G. (2011). An evaluation of a personal electronic device to enhance self-monitoring adherence in a pediatric weight management program using a multiple baseline design. *Journal of Pediatric Psychology*, *36*(3), 301-307. doi:10.1093/jpepsy/jsq074

Gay, L. R., & Airasian, P. (2003). *Educational research: Competencies for analysis and application*. Columbus, OH: Merrill Prentice Hall.

Institute of Medicine. (2010). *The future of nursing: Leading change, advancing health.* Retrieved from http://www.nap.edu/catalog.php?record_id=12956

Kratochwill, T.R., & Levin, J.R. (1992). *Single-case research design and analysis: New directions for psychology and education.* Hillsdale, NJ: Erlbaum.

Matson, J. L., Turygin, N. C., Beighley, J., & Matson, M. L. (2012). Status of single-case research designs for evidence-based practice. *Research in Autism Spectrum Disorders*, 931-938.

McMillan, J.H. (2004). *Educational research: Fundamentals for the consumer (*4th ed.). Boston: Allyn and Bacon.

O'Malley, P., Jenkins, S., Wesley, B., Conehower, C., Rabuck, D., & Lewis, M.E.B. (2013). *Effectiveness of using iPads to build math fluency.* Baltimore, MD: Kennedy Krieger Institute. Retrieved from http://eric.ed.gov/?id=ED541158

Polit, D.E., & Beck, C. T. (2008). *Nursing research: Generating and assessing evidence for nursing practice.* (8th ed.). Philadelphia: Lippincott Williams & Wilkins.

Portney, L., & Watkins, M. (2009). *Foundations of clinical research: Applications to practice (3rd edition).* New Jersey: Prentice Hall.

Rassafiani, M., & Sahaf, R. (2010). Single case experimental design: An overview. *International Journal of Therapy & Rehabilitation, 17*(6), 285-289.

Shadish, W.R., Cook, T.D., & Campbell, D.T. (2002) *Experimental and quasi-experimental designs for generalized causal inference.* Boston: Houghton Mifflin.

Skjutar, Å., Müllersdorf, M., & Schult, M. (2012). Repeated measures design: A methodological issue of conducting research on patients with chronic pain. *Musculoskeletal Care,10*(2), 119-123. doi:10.1002/msc.1009

Smidth, M., Christensen, M. B., Olesen, F., & Vedsted, P. (2013). Developing an active implementation model for a chronic disease management program. *International Journal of Integrated Care, 13,* 1-16.

Stewart, N., McMullen, L., & Rubin, L. (1994). Movement therapy with depressed inpatients: A randomized multiple single case design. *Archives of Psychiatric Nursing*, *8*(1), 22-29.

Taber-Doughty, T., Shurr, J., Brewer, J., & Kubik, S. (2010). Standard care and telecare services: Comparing the effectiveness of two service systems with consumers with intellectual disabilities. *Journal of Intellectual Disability Research*, *54*(9), 843-859. doi: 10.0000/j.1365-2788.2010.01314.x

Tate, R. L., Mcdonald, S., Perdices, M., Togher, L., Schultz, R., & Savage, S. (2008). Rating the methodological quality of single-subject designs and n-of-1 trials: Introducing the single-case experimental design (SCED) scale. *Neuropsychological Rehabilitation, 18*(4), 385-401.

U. S. Department of Health and Human Services. (2010). The registered nurse population. Retrieved from http://bhpr.hrsa.gov/healthworkforce/rnsurveys/rnsurveyinitial2008.pdf

Wasson, J. (2005). Single subject design. *Practicalpress.net*. Retrieved from http://www.practicalpress.net/updatenov05/SingleSubject.html

What Works Clearinghouse. (2011). *Procedures and standards handbook, v 2.1*. Washington DC: Department of Education. Retrieved from http://ies.ed.gov/ncee/wwc/pdf/reference_resources/wwc_procedures_v2_1_standards_handbook.pdf

Wolery, M., Dunlap, G. & Ledford, J.R. (2011). Single-case experimental methods: Suggestions for reporting. *Journal of Early Intervention, 33(103), 103*-109. doi:10.1177/1053815111418235

Wong, S. E. (2010). Single-case evaluation designs for practitioners. *Journal of Social Service Research, 36*(3), 248-259. doi:10.1080/01488371003707654

Chapter Three

Impact of Text Messaging on Diabetic Foot Self-Care Behaviors Using a Single-Case Design

Abstract

Problem: The absence of diabetic foot self-care is one of the major reasons for the approximately 60,000 avoidable lower extremity amputations annually in the U.S. Providers have limited time during clinic visits to educate their patients and increase awareness. Innovative strategies beyond the clinical setting are necessary to reinforce self-care behaviors.

Objective: The purpose of this study was to use an innovative design method to examine the impact of providing diabetic foot care education to patients via text messaging and to assess the effect on patient self-care behaviors and clinical outcomes.

Methods: Quantitative research using a single case study design.

Findings: Targeted text messages improved diabetic foot self-care behaviors in both participants and resulted in a change of potentially harmful behavior. One participant increased activity as a result of the study. A lack of diabetic supplies and some confusion regarding the survey created inconclusive results for the other. Both expressed satisfaction with the use of text messaging.

Implications for Nursing: Texting patients to help patients adopt new self-care behaviors is an effective nursing intervention and provides an opportunity to reinforce education, improve clinical outcomes, and ultimately affect quality of care. Single case

design offered the opportunity for an initial assessment of causal relationships between nursing interventions and patient response on a manageable level. Using single cases to test interventions could change the rate at which nursing science transitions ideas into evidence-based practice leading to improved processes and enhanced quality of care.

Keywords: diabetes foot care, text messages, self-care behaviors, outcomes

Impact of Text Messaging on Diabetic Foot Self-Care Behaviors Using a Single-Case Design

Worldwide approximately 246 million people are affected by diabetes. The destructive side effects of diabetes make it one of the most dreaded chronic diseases. For instance, there are 20 to 30 million people with diabetes at risk for developing neuropathy which most often affects the feet and can lead to life threatening ulcerations and amputation (Pluijms et al., 2011). The disease affects approximately 25.8 million Americans or 8.3% of the population with 1.9 million new cases diagnosed each year in persons 20 years of age or older (Centers for Disease Control, 2012). It is projected that 33 percent of the U.S. population will have diabetes by the year 2050, and another third will have pre-diabetes (Boyle, Thompson, Gregg, Barker, & Williamson, 2010).

The estimated cost of diabetes in 2007 was $174 billion of which $116 billion was directly related to medical costs and $58 billion to lost work, activity restriction, and diabetic related disability (Center for Disease Control, 2012). Adding to the challenge and frustration of health providers seeking to improve health outcomes for persons with diabetes is the fact that "Type 2 diabetes, which accounts for 90% to 95% of all diagnosed cases of diabetes, can be prevented or controlled through proper self-management" (Saxe-Custack &Weatherspoon, 2012, p. 213). One of the Healthy People 2020 objectives for diabetes is to reduce the incidence of lower extremity amputations using population-based interventions through self-management behaviors and patient education (U. S. Department of Health & Human Services, 2012). Educating diabetic patients about foot care is critical (Sheridan, 2012). A missing element in the efforts to

educate people about their chronic diseases is the enhanced utilization of new technology available with the proliferation of cell phones and personal electronic devices.

Texting

Text messaging or "texting" involves sending brief messages [short messaging service; (SMS)] between mobile phones and is used by approximately 72 million U.S. subscribers (Ceccucci, Peslak & Sendall, 2010). It is the most far-reaching telecommunication method in the United States with 87% of African Americans and Latinos and 80% of Whites owning a cell phone in 2010 (Aguilera & Muñoz, 2011). Because of the relatively low cost of texting, the fact that it is less time consuming than telephone follow-up, and its limitless reach, texting is a viable option for patient education in the current healthcare environment notable for a shortage of professionals (Zolfaghari, Mousavifar, & Pedram, 2009). In addition, text messages can be sent to any mobile phone user regardless of model or service provider (Aguilera & Muñoz, 2011). Free et al. (2013) noted in a meta-analysis that technology-based interventions demonstrated a small statistically significant effect and were of borderline clinical importance; yet, they stressed the need for additional high-quality controlled studies.

Purpose

The purpose of this study was to examine the use of text messages as a diabetic foot-care education method and to assess the impact on patient self-care and clinical outcomes using the Theory of Self-Care of Chronic Illness (Riegel, Jaarsma, & Strömberg, 2012). The American Diabetes Association (2013) recommends ongoing self-care education in order to sustain progress in improving the health of people with diabetes. Informed decision-making, increased self-care behaviors, problem-solving,

collaboration, improved outcomes, and quality of life are also recommended. "Skills for diabetes self-care require the ability to gather information, self-monitor blood glucose levels, and adjust food intake related to activity, stress, and illness" (McCleary-Jones, 2011, p. 25). An important goal of nursing in the care of patients with chronic conditions is to increase their self-care behaviors by developing and providing effective culturally-sensitive theory-based interventions (Jang & Yoo, 2012). However, approximately a third of diabetic patients are unaware of their risk for lower-limb amputations partly due to the fact that healthcare providers have struggled to develop unanimity on the recommended self-management behaviors (Turns, 2012). Daily foot care activities are essential to prevent ulcers; however, currently a reliable and valid tool to measure these activities is lacking (Chin & Huang, 2013). In addition, office visits are limited and do not provide adequate time to properly educate, encourage, or support patients' self-care behaviors (Free et al., 2013). Nursing shortages have also contributed to a decrease in staff availability to actively engage in health promotion activities.

Background and Significance

According to Gebel (2010), diseases of the nerves, known as neuropathies, affect an estimated 60 to 70 percent of people with diabetes. The American Orthopaedic Foot and Ankle Society (2010) reports diabetic foot conditions are responsible for more hospital admissions than any other aspect of the disease. People with diabetes have at least a tenfold greater risk of developing foot infections that can lead to hospitalizations than people without the disease (Kosinski & Lipsky, 2010). Of those with diabetic foot problems, more than 80% complain of numbness, diminished sensation, burning, and tingling (Pluijms et al., 2011). This loss of sensation can lead to injuries that have the

potential to develop into rampant infections due to poor healing. The subsequent risk is the formation of foot ulcers, a potential risk for amputation in diabetic people. Sheridan (2012, p. 398) identified five stages of foot ulcers:

Stage 1 – A normal foot: Absence of neuropathy, ischemia, and deformity.

Stage 2 – A high-risk foot: Presence of neuropathy, ischemia, and deformity.

Stage 3 – An ulcerated foot: Neuropathic ulcer on plantar surface.

Stage 4 – An infected foot: Local ulcer infected cellulitis.

Stage 5 – A necrotic foot: Neuropathic foot with necrosis and ischemia.

The lack of proper diabetic foot self-management is a major cause of the approximately 60,000 avoidable lower extremity amputations annually in the U.S. (American Orthopaedic Foot & Ankle Society, 2010; Sheridan, 2012). "Foot care education of diabetic patients is a long-established practice that is at the heart of the prevention and management of diabetic foot disease" (Turns, 2012, p. 430). Methods to improve the quality of diabetic foot care should focus on increasing education, removing barriers, and targeting the patient's attention to the problem (Sheridan, 2012). Efforts to decrease lower extremity damage have become an economic imperative for the US healthcare system.

Xu, Pan, and Liu (2010) found participants adhered to medication schedules but were less likely to engage in self-monitoring behaviors relative to their diet, physical activity, blood glucose, and foot care. A meta-analysis of randomized control trials conducted between 2000 and 2009 compared diabetic self-monitoring to no intervention. Farmer et al. (2013) concluded patients who monitored blood glucose under clinical management had a reduction in a critical indicator of blood glucose levels over time, the

glycated hemoglobin (HbA1c). Other researchers (Muller et al., 2012) compared HbA1c levels in patients who self-monitored both blood (BGSM) and urine glucose (UGSM) at 24 months and discovered 36.5% preferred urine monitoring over glucose monitoring (23.5%) with no significant difference in glucose control (HbA1c UGSM 7.03 versus BGSM 6.97%; $p = 0.807$).

Kate Lorig conducted numerous studies using the Internet as a means to provide patient education to enhance self-management (Gilkey & Garcia, 2010; Lorig et al., 2010; Lorig et al., 2013; Yank, Laurent, Plant & Lorig, 2013). She is credited for developing an internet-based patient education offering called *Internet Chronic Disease Self-Management Program (ICDSMP)* for English and Spanish-speaking people with chronic conditions, grounded in Bandura's self-efficacy theory (Gilkey & Garcia, 2010). She was one of the principal investigators who studied the effect of an online diabetes self-management program for American Indians and Alaska Natives with type 2 diabetes (Lorig et al., 2010). She also evaluated the effectiveness of an online chronic disease self-management program for South Australia residents that found significant improvements ($p < .05$) six months post intervention for four health status measures (self-rated health, role function, fatigue, and health distress), health behaviors, self-efficacy, and visits to emergency departments (Lorig et al., 2013). Yank et al. (2013) piloted a study to evaluate webinar-based training for health professionals. The method was determined to not only be feasible, but it potentially could impact provider beliefs and confidence regarding the support of patient self-management.

A few studies examined the use of texting in general diabetic education. One such study noted patients who received diabetic education via text messaging had

perceived improved social support, increased self-efficacy, and modified health beliefs (Nundy, Dick, Solomon, & Peek, 2012). The researchers concluded that mobile technology is a potential mechanism to affect self-management in African-Americans with diabetes, noting the participants viewed the text messaging as coming from a peer and as an enhancement to their health care system. They acknowledged few studies were conducted that validated hypothetical relationships between mobile technology and their effects on behavioral responses to chronic disease management.

Internationally, researchers have sought to understand the correlation between texting and diabetic education. In Iran, researchers used text messages to evaluate patient knowledge of diabetes care by measuring their responses to 20 multiple choice questions (Fatehi, Malekzadeh, Akhavimirab, Rashidi, & Afkhami-Ardekani, 2010). The results revealed the mean of correct answers improved significantly from 7.92 to 11.51 ($p <$ .001) in the intervention group after 45 days with no significant difference found in the control group. In addition, the mean of incorrect answers decreased from 8.00 to 7.00 in the intervention group, but increased from 8.90 to 9.45 in the control group. The change in the mean score was also noted to be significantly different between the two groups ($p <$ .001) before and after the intervention. The researchers suggested future studies assess the relationship between knowledge and attitudes towards self-care behaviors, which was not within their scope.

Diabetic patients enrolled in a Medicaid managed care plan demonstrated a higher rate of self-care behaviors after receiving monthly educational text messages and appointment reminders (Agency for Healthcare Research and Quality, 2018). Schmidt, Mayer and Panfil (2008) noted patients at risk for diabetic foot ulcers who received text

messages increased self-care behaviors but required more professional support for daily activities to prevent complications. In an enhanced texting study, another group of researchers discovered HbA1c levels improved when using text messages along with telephone follow up (Kim & Jeong, 2007; Nundy et al., 2012; Zolfaghari et al., 2009).

These studies lay a sound foundation for the adoption of technology into the historical efforts to promote healthy outcomes for diabetic persons. Large studies of chronically-ill people have offered some insight into the acceptance of online education and texting for disease management. However, a conceptual basis for technology-based interventions remains vague. Riley et al. (2011) conducted a meta-analysis of texting research conducted through June 2010 and identified only one of 16 which used a theoretical framework (Social Cognitive Theory) to support diabetes behavior interventions. It is time for a theory-based study to explore the potential causal effect of a texting intervention in a small-sample controlled study of self-care management in a chronic illness like diabetes.

Conceptual Framework

The Theory of Self-Care of Chronic Illness (Figure 1) is a middle range theory that evolved from the clinical care of heart failure patients and was influenced by Dorethea Orem's grand theory focused on promoting the individual's self-care (Riegel, Jaarsma, & Strömberg, 2012). The developers assert that more tailored interventions will help providers better understand the patient's struggle in performing self-care behaviors (Riegel et al., 2012). The theory is offered as a foundation to help researchers speed the application of study results into practice, measure self-care in chronic illnesses, and develop interventions from various approaches (Riegel et al., 2012).

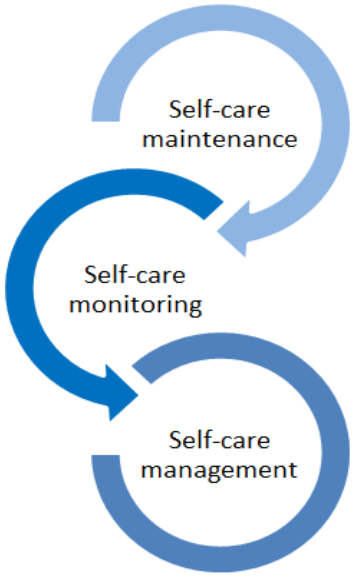

Figure 1. Theory of Self-Care of Chronic Illness.

Note. Self-care maintenance, self-care monitoring, and self-care management are the three core elements of the Self-care of chronic illness theory. The model demonstrates that although unique elements, the elements function in a synchronous method that allows the patient to maintain health and manage illness through conscientious monitoring of diabetic status. (Riegel et al., 2012)

The key concepts of the Theory of Self-Care of Chronic Illness are *self-care maintenance, self-care monitoring, and self-care management. Self-care maintenance* indicates the actions taken by an individual to manage a medical condition based upon provider recommendations or one's lifestyle. It includes activities such as smoking cessation, healthy eating, or medication adherence. *Self-care monitoring* involves vigilance and surveillance of symptoms. "The goal of self-care monitoring is to recognize that a change has occurred" (Riegel et al., 2012, p. 196). In diabetic patients, self-care monitoring provides information to evaluate how diet, behavior, and medications impact blood sugar levels and diabetic-related complications (American Association of Diabetic Educators, 2013). *Self-care management* requires an analysis and evaluation of signs and symptoms to determine if treatment is needed or a

consultation warranted. It requires an assessment of the effectiveness of a treatment to determine if it should be repeated in the future (Riegel et al., 2012). *Self-care monitoring* is the bridge between *self-care maintenance* and *self-care management*. All three are unique elements that function together to maintain health and manage chronic disease but are heavily influenced by decision making, reflection, experience and skill, motivation, and cultural beliefs and values (Riegel et al., 2012).

Design and Methods

Design

A single-case study design using the range-bound changing criteria (A-B1-B2-B3-A) approach was used for this study. In this methodology, baseline data was collected and a pre-established range of behavior/ performance targeted for each intervention phase. The "A" represents the no-treatment or baseline phase and "B1, B2, and B3" represent different types of treatment levels with multiple data collection points within each phase.

A control group in traditional research includes those participants who do not receive the experimental treatment/intervention and their results serve as a baseline for comparison with the experimental group to measure the treatment's effect (Polit & Beck, 2008). In the SCD, control is created when the individual participant's behavior/performance consistently meets or exceeds the target during the intervention phase and continues to show improvement at each subsequent intervention period while the target goal becomes increasingly rigorous (McDougall, 2013). Baseline and subsequent data were collected using Qualtrics® software and from the participant's self-report of blood glucose and weight.

In traditional group research, behavior is measured before and after treatment, and researchers must make generalizations based on group averages which may not be relevant in predicting individual performance. Another limitation of group research is that measurements are taken before and after the study ends, making it difficult to determine what intervention actually causes an observed change (Portney & Watkins, 2009). In single-case studies, there are at least two testing periods (baseline and intervention), and behavior is measured repeatedly during both. Baseline represents the period of no intervention or the natural state and is equal to the control in traditional research (Portney & Watkins, 2009). During the baseline period, the researcher captures data relative to the stability of the patient's response and notes any trends which may reflect a change in behavior. Once the intervention is introduced, changes from baseline are compared to evaluate the possibility of a cause-and-effect relationship. Phases of the study are plotted using a line graph along an X-Y axis (Portney & Watkins, 2009).

Methods

Two individuals with diabetes at risk for foot problems were recruited by word of mouth. Both expressed at least average knowledge of receiving and sending text messages. Two separate SCD studies were conducted simultaneously using the A1-B1-B2-B3-A2 method. Baseline data were collected using Qualtrics® software and from the participant's self-report of daily blood glucose results from the previous month which is stored in glucose monitoring devices. The individual's current weight was also obtained during the initial meeting.

Two meetings were held with each participant for a total of four meetings. The first was conducted face-to-face the weekend prior to beginning the study (A1) and the

second was a telephone interview, per the participants' request, conducted at the end of the four week rest period (A2) to obtain feedback about the study and the use of text messaging. Phone calls were made in advance to schedule all meetings. A content analysis was conducted of the final interview for words and phrases which relate to the constructs: *self-care maintenance, self-care monitoring, or self-care management*. This involves "breaking down data into smaller units, coding and naming the units according to the content they represent, and grouping coded material based on shared concepts" (Polit & Beck, 2008). This method allows for a greater understanding of the data collected and helps the researcher draw possible inferences from the results.

Phases B1, B2, and B3 represented the intervention periods when targeted text messages were sent to the patient. Each intervention phase was two weeks in duration. During phase B1, one text message was sent each day. During phase B2, two messages were sent, and at phase B3 three messages were sent daily. The participants self-reported their daily blood glucose results and weekly weights via text and email during the six week intervention period. A weekly Qualtrics® survey was sent to each participant during the intervention period to collect data regarding diabetic self-care behaviors.

To analyze such data, researchers often compare regression lines across phases or standard pre-post measures in which data points are aggregated from each intervention phase. This method requires a large number of observations, and they often violate homogeneity of variance due to the use of data obtained from a single individual. In this study, data were collected daily via text from each participant within each intervention phase as well as pre-, post-, and during intervention periods conducted to establish

multiple data collection points. The numbers of texts sent and received were also reviewed but they were not analyzed in this study.

Research Questions

1. What is the effect of an intermittent intensive text messaging intervention on the reported self-care behaviors of a diabetic adult related to care of the feet?

2. Does an intermittent intensive text messaging intervention increase the self-care maintenance and self-care management behaviors of a diabetic adult?

3. What are the benefits and challenges of using a text message intervention to improve diabetic foot care self-management as reported by a diabetic adult?

Sample

The University of Texas at Tyler IRB reviewed and approved the study (see Appendix A). Two persons who met the inclusion criteria were invited to participate. Inclusion criteria were: (a) adults over 18 years of age with a diagnosis of either non-insulin dependent diabetes mellitus (NIDDM) or insulin-dependent diabetes mellitus (IDDM) within the last two years, (b) body mass index (BMI) > 30, (c) cell phone owner who demonstrates average proficiency in receiving and responding to text messages without assistance, and (d) able to provide blood sugar results for the previous month and daily during the intervention period. Patients who have undergone bilateral lower extremity amputations were excluded.

Prior to beginning, each participant was provided information regarding the benefits and risks associated with the study along with a form used to obtain informed consent authorizing participation (see Appendix B). The participant was also advised that confidentiality and privacy would be protected through an encrypted laptop that the

principal investigator used to send diabetic foot care text messages to the study participant's cell phone via email message. This was accomplished by entering the participant's 10-digit cell phone number as an email address using the carrier information (i.e. number@txt.att.net). This method allows for faster and more accurate key strokes and better tracking of messages sent or received. In addition, all communication from the participant was protected from potential breaches by the encrypted laptop. Each participant's name and participation was kept confidential.

An initial face-to-face meeting was held to obtain informed consent and explain the study. The participant was provided a hard copy of the Qualtrics® questionnaire at this initial meeting to allow questions or to receive any additional clarification.

Instruments

Self-care maintenance is related more to a patient's feeling of confidence in their ability to maintain the best health possible by following healthcare provider recommendations and making any necessary lifestyle changes. For this study, it was measured pre- and post-intervention using the Self-efficacy for Diabetes Scale (SDS) which consists of an 8-item questionnaire (McCleary-Jones, 2011). The instrument measures a patient's confidence level (0 = *not at all confident* to 10 = *total confidence*) in performing behaviors that are not directly related to diabetes, but helps the patient maintain the best health possible (see Appendix C). The questionnaire was created by the Stanford Patient Education Research Center (n.d.) and has an internal consistency reliability coefficient of 0.828. The mean score of the eight items are calculated with a higher score representing greater self-efficacy. Questions on the SDS include, "*How confident are you that you can control your diabetes so that it doesn't interfere with the*

things you want to do?" and "*How confident do you feel that you can do something to prevent your blood sugar levels from dropping when you exercise*?"

The Foot Care Behaviors Scale (FCBS) was used to evaluate diabetic foot *self-care monitoring* (see Appendix D). It was administered pre- and post-intervention and weekly using a five point Likert scale and was based on the 2014 American Diabetes Association's (ADA) recommendations to prevent diabetic foot complications (see Appendix E). There is no reliability for the FBCS instrument, but confidence is encouraged by its endorsement by the ADA. The Summary of Diabetes Self-Care Activities (SDCSA) was also used to measure *self-care monitoring* behaviors (see Appendix F). The SDSCA (Toobert, Hampson, & Glascow, 2000) is a set of self-completion questions that assess behaviors over several domains of the diabetic regimen (blood sugar testing, medications, diet, foot care, exercise and smoking). The self-completion questionnaire assesses the level of care, as opposed to adherence, and the frequency of specific behaviors. The mean and standard deviation are scored for each subscale which is used for comparative analysis. The higher the percentage, the better self-care for all scales. According to Toobert et al. (2000), the questionnaire has an acceptable internal consistency (M = .47), based on average inter-item correlations, but the specific diet scale is consistently unreliable (r = .07 - .23). For the purpose of this study, only the blood sugar and foot care subscales were used.

A modified version of the Diabetes Self-Management Questionnaire (DSMQ) was used to measure self-care management pre- and post-intervention (see Appendix G). Written permission was obtained from Schmitt et al., (2013) via email (see Appendix H). The DSMQ was the first German instrument developed to target diabetic self-care

behaviors involving metabolic control for both Type 1 and Type 2 adult patients (Schmitt et al., 2013). The 16-item questionnaire uses four subscales (glucose management, dietary control, physical activity and health care use) along with a sum scale as a global measure to evaluate self-care behaviors. The questionnaire is scored by reversing items that are negatively worded so that the higher the score the more effective the self-care behaviors. "Seven of these items are formulated positively and nine inversely with regard to what is considered effective self-care" (Schmitt et al., 2013, p. 3). Items are summed and changed to a score from 0 to 10 while the four subscales are estimated. For this study, only the Blood Sugar Testing and Foot Care subscales were used. The instrument has an internal consistency of 0.84 (Schmitt et al., 2013).

Table 1 contains a list of all instruments used in the study to further clarify permissions, reliability, timing, and method of administration.

Table 1
Study Instruments

	Self-efficacy for Diabetes Scale (SDS)	***Foot Care Behavior Scale* (FCBS)**	**Summary of Diabetes Self-Care Activities (SDCSA)**	**Diabetes Self-Management Questionnaire (DSMQ)**
Theoretical Concept	*Self-care Maintenance*	*Self-care Monitoring*	*Self-care Monitoring*	*Self-care Management*
Instrument description	8-item questionnaire; measures patient confidence in self-care behaviors	10-item 5 point Likert scale	8-item self-completion questionnaire; blood sugar and foot care subscales only	16-item questionnaire uses four subscales
Reliability	Internal consistency 0.828	Based on the ADA guidelines for diabetic foot care	Internal consistency (*M* =.47); based on average inter-item correlations	Internal consistency 0.84
Permissions	public domain	public domain	public domain	granted
Administration Frequency	Baseline and after Rest Period	Baseline, after Rest Period and Weekly	Baseline and after Rest Period	Baseline and after Rest Period
Means of Administration	Qualtrics® software	Qualtrics® software	Qualtrics® software	Qualtrics® software

Data Collection Procedures

An initial meeting was scheduled to discuss the study with the participant. At this meeting, the informed consent was reviewed and signed by the participant. A demographic survey was completed that included questions such as age, sex, ethnicity, weight and educational level (see Appendix I). The participant was asked to provide glucometer readings from the previous month, current weight, and self-reported most recent Glycated Hemoglobin (HbA1c) level. Instructions were also given to the participant to provide daily blood glucose results and weekly weights via email or text during the intervention period. The participants were informed of the goals for each intervention period (Table 2).

Table 2
Intervention Goals

Intervention Goals
Intervention Period B1
• Maintain average Fasting Blood Sugars (if baseline within normal limits), or demonstrate a 1-2% decrease if above normal limits at baseline. • Add 1-2 new foot care self-management behaviors during the first intervention period.
Intervention Period B2
• Maintain average Fasting Blood Sugars (if first intervention period within normal limits), or demonstrate a 2-3% decrease if above normal limits during the first intervention period. • Add 2-3 new foot care self-management behaviors by the end of the second intervention period. • Add 1-2 new activities to increase daily exercise by the end of the second intervention period.
Intervention Period B3
• Maintain average Fasting Blood Sugars (if second intervention period within normal limits), or demonstrate a 3-5% decrease if average was above normal limits at the end of the second intervention period. • Add 3-4 new foot care self-management behaviors by the end of the third intervention period. • Add 2-3 new activities to increase daily exercise by the end of the third intervention period.

The preliminary surveys (SDA, SDSCA, DSMQ and FCBS) were sent to the participants via Qualtrics® software after the initial meeting to obtain baseline self-care behavior data and also weekly during the six week intervention period. A post-intervention interview was conducted by telephone at the end of the intervention period to provide closure for the participants, allow the participants to discuss their perception of the use of text messages, discuss what they learned as a result of the study, provide suggestions for improvements, and to share their plan for continued self-management and health promotion.

Interventions

Text messages providing diabetic foot care education derived from the ADA recommendations were sent to the participants using a pre-determined schedule as seen in Table 2. The participants were informed that the number of text messages sent daily would increase every two weeks according to the schedule.

Table 3
Text Messaging Schedule

Month 1		Month 2		Month 3
2 weeks	**2 weeks**	**2 weeks**	**2 weeks**	**2 weeks**
Texting **1x/day**	**Texting** **2x/day**	**Texting** **3x/day**	**Rest** **No Texts**	**Rest** **No Texts**

The SDS, SDSCA, DSMQ and FCBS were administered weekly via Qualtrics® and the results used to determine the specific text messages to be sent to the participant (see Appendix J). Areas identified as "insufficient" were matched with a targeted text message for the next week.

A single text message containing diabetic foot care education was sent every day for the first two weeks. During the second two weeks, two different texts were sent each day. For the final two week period, the participants received three text messages a day. The text messages included such tips as, "*Look at your feet every day to check for problems*," "*If you cannot bend, check your feet with a mirror*," "*Do not put lotion between your toes*," "*Wash your feet in warm water every day*," "*Make sure the water is not too hot*," "*Test the water temperature with your elbow*."

After the intervention period, there was a four week withdrawal period of rest or control where there were no text messages or surveys sent to the participants, and the participants did not report their blood sugars or weights. At the end of the rest period, all questionnaires were re-administered via Qualtrics® and final data collected to include reports of any blood sugars collected during the rest period and the current weight. Verbal feedback on the participant's perceptions of the experience was also collected through a telephone conversation.

Results

Data were analyzed using graphs to visually depict any changes in clinical indicators, fasting blood sugars and weights. The results of the survey were visually graphed based on the means of the survey scores which measured the variables *self-care maintenance*, *self-care monitoring*, and *self-care maintenance*.

Sample

Two diabetic patients were selected to participate in the study. Participant #1 was a college educated, married, Caucasian female in her 50's with a history of more than five years with diabetes. She reported to be very confident in sending and receiving text

messages. Participant #2 was an unmarried, African American male in his late 40s, who had some college education. He also had been diagnosed with diabetes more than five years ago and reported a high degree of confidence in sending and receiving text messages. A test of their ability to use text messaging was performed face-to-face prior to beginning the study. At the end of the study, both participants received a thank you note and a $100 gift certificate.

Data Analysis

Both participants were asked to provide fasting blood sugars from the month prior to starting the study in order to establish baseline, and after the rest period. Participant #1 provided the requested information but Participant #2 did not have a record of all results. The baseline data and subsequent reported blood sugar results were reviewed to determine the percent of change compared to the previous intervention phase and how they related to the normal range of fasting blood sugars, between 70–130mg/dl (American Diabetic Association, 2014b).

Participant #1 had a mean blood sugar of $M = 141$ at baseline which was 11 points higher than the normal range (see Figure 2). During the first intervention period, this participant did not meet the target goal of a 1-2% decrease (138-139mg/dl) from baseline. A 13% increase above the prior mean of 141 was reported which represents a mean blood sugar of 159 over the B1 phase.

The goal established for the second intervention phase was met at $M = 139$. During this time, there was a 14% decrease from the first phase which was well below the target range of 2-3%. A 14% decrease was also seen in the third intervention phase ($M = 121$) when compared with the phase two results. In fact, Participant #1 continued to

report a decrease in blood sugars even after the rest period resulting in M = 120, or 21 points lower than the initial baseline, a 15% decrease.

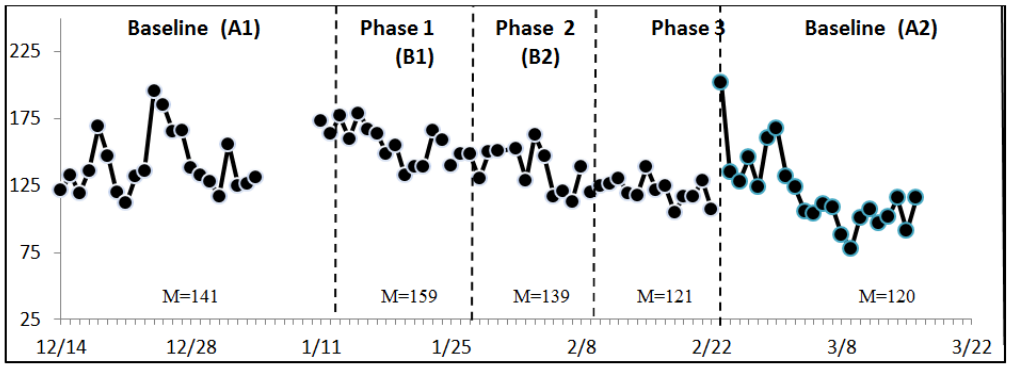

Figure 2. Fasting Blood Sugars – Participant # 1

Participant #2 began the study providing only four days of data to include in the initial baseline. He acknowledged that prior to the study he was not taking his blood sugars frequently and only began to take them a few days before the start of the study since he knew it would be a requirement for participation.

A mean score was calculated from the limited data to establish a baseline M = 183 (see Figure 3). He met the target goal for the first intervention period by decreasing his blood sugars by 7% (M = 171) but realized only a 0.6% decrease in the second phase (M = 172) and experienced a 3% (M = 178) increase in the final intervention phase. This participant reported that he did not measure his blood sugars during the rest period but has since begun to do so again. He expressed that the text messages helped him to monitor his blood sugars more frequently, but that the cost of the test strips was the main factor for his noncompliance during the rest period.

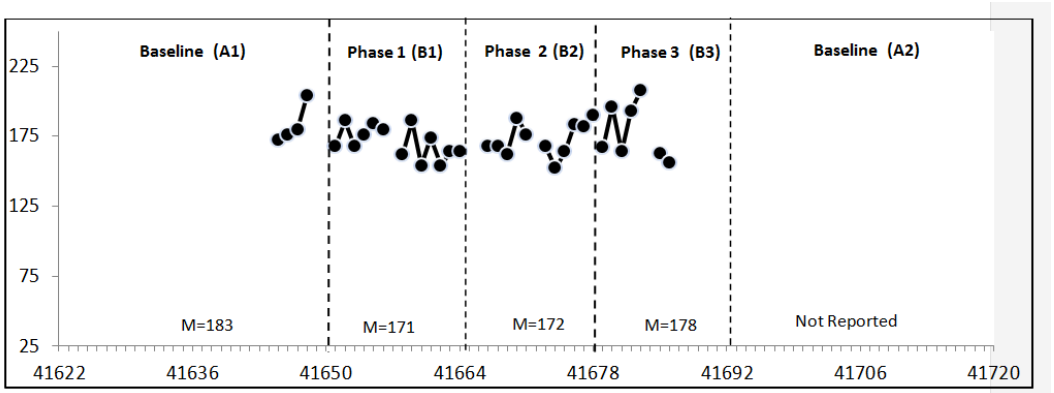

Figure 3. Fasting Blood Sugars – Participant #2

Neither participant demonstrated a significant change in weight from baseline during the study. Participant #1 began the study at 189 lbs. Her weight only changed by 1 to 2 pounds from the initial baseline. At the end of the rest period, her weight had dropped to 188 lbs. Participant #2 reported his weight remained at 208 lbs. throughout the study.

Self-Care Maintenance

The Self-efficacy for Diabetes Scale (SDS) was used to evaluate each participant's level of confidence in maintaining the best health possible. The higher the mean score the greater the self-efficacy or confidence level. Confidence was ranked using a 10-point scale with zero representing "*not at all confident*" and 10 "*totally confident*." This study did not have an internal consistency, but the internal consistency for the SDS for this study was 0.828.

Participant #1 demonstrated a 4% increase (M = 9.63) in confidence from initial baseline to the end of the rest period (M = 10.00). Figure 4 shows this participant's progress. She rated herself as "*totally confident*" in all surveys completed in the ability to "*eat meals every 4 to 5 hours every day*", "*follow her diet when having to prepare or*

share food with other people without diabetes" and, in her "*ability to do something to prevent blood sugar levels from dropping when exercising*." She responded that she was also totally confident, except during the first intervention phase, in "*choosing the appropriate foods to eat when hungry (for example, snacks)*", "*knowing what to do when blood sugar level goes higher or lower*", "*judging when a change in illness means you should visit the doctor*" and, "*in controlling diabetes so that it does not interfere with the things you want to do*." The most significant increase in confidence involved the participant's ability to perform exercise. When asked "*How confident do you feel that you can exercise 15 to 30 minutes, 4 to 5 times a week*" the participant ranked her confidence level at "7" during the first intervention period but expressed total confidence after the rest period at the end of the study.

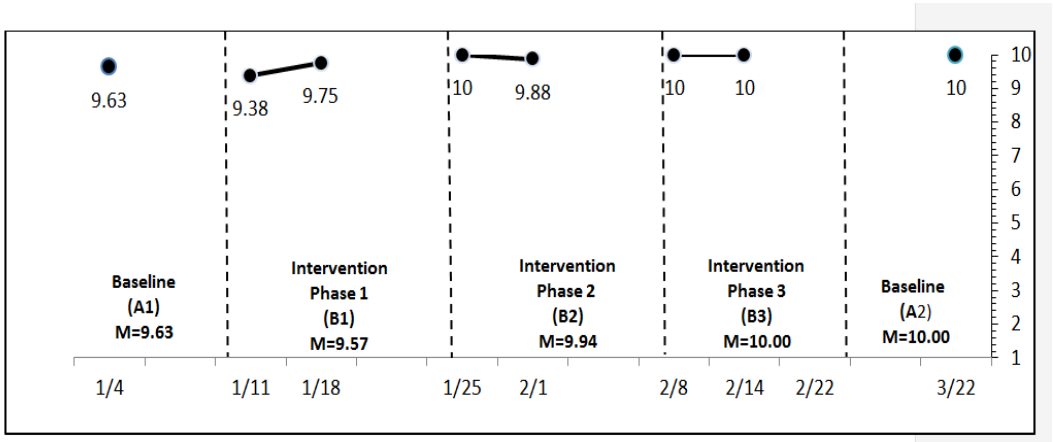

Figure 4. Self-Efficacy for Diabetes Scale (SDS) – Participant #1

Participant #2 had a mean confidence level of *M* = 8.75 at the initial baseline survey (see Figure 5). At this time, he reported total confidence only in the ability to "*eat meals every 4 to 5 hours every day, including breakfast*." When it came to some other behaviors, he rated his confidence at 9 out of 10 for "*choosing the appropriate foods to eat when hungry (for example, snacks)*", "*exercising 15 to 30 minutes, 4 to 5 times a week*" and "*preventing blood sugar level from dropping when exercising*." His lowest

level of confidence was in his ability to "*feel that he can control his diabetes so that it does not interfere with the things he wants to do*." He rated this at 7 out of 10.

The participant's confidence level increased to *M* = 9.57 during phase 1 to a high of *M* = 10.0 at the end of phase 3. These results dropped significantly (36%) after the rest period to *M* = 6.38. He attributed this to the fact that he was no longer receiving the daily text messages that had become a reminder to him about his illness in general. According to the participant:

> "When I stopped getting the notifications I started to just forget about doing certain things. It wasn't just about my feet either. The text messages helped me to think about the fact that I needed to check my blood sugars. I never checked them as much as when I did this study. When I received a text message I thought…hey, I need to check my blood sugar so that I can send them to her. I wish you could start sending them to me again."

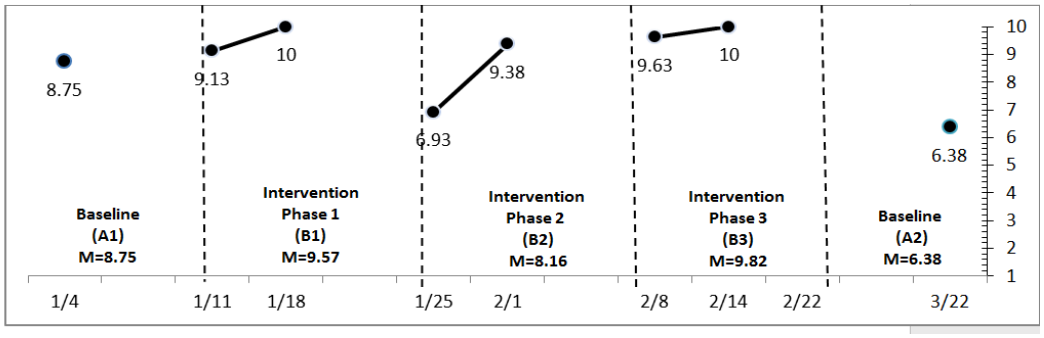

Figure 5. Self-Efficacy for Diabetes Scale (SDS) – Participant #2

Self-Care Monitoring

Two instruments were used to evaluate self-care monitoring. The Foot Care Behaviors Scale (FCBS) and the Summary of Diabetes Self-Care Activities (SDCSA). The FCBS ranks the responses "*Never, Rarely, Sometimes, Often, and Always*" on a scale

from 1 to 5 based on the American Diabetic Association's recommendations for foot care. Reversed scoring was applied to the question "*Do you put lotion between your toes*?" since the correct answer should be "*never*". The mean score results were reviewed to evaluate the frequency of performing diabetic foot care activities.

The Summary of Diabetes Self-Care Activities (SDCSA) was used to evaluate the care and frequency of blood sugar testing and foot care by obtaining the number of days during the week self-monitoring behaviors are performed from 1-7 days. The higher the score the more frequent the self-care monitoring behaviors occur.

Participant #1 had a baseline FCBS score of 3.50 (see Figure 6). She reported to always "*wear slippers to protect her feet from injury*", "*washing her feet in warm water daily*", "*drying between her toes*", "*checking daily for blisters, redness, calluses or other problems*", and "*bending over or pulling up her feet to check them*." She also noted to sometimes "*file corns or calluses after bathing*" but that she rarely "*checks the inside of her shoes for sharp edges, use a mirror to check her feet, or put lotion between her toes*." Regarding seeking help from others to perform self-care activities, she never "*asks anyone else to check her feet*."

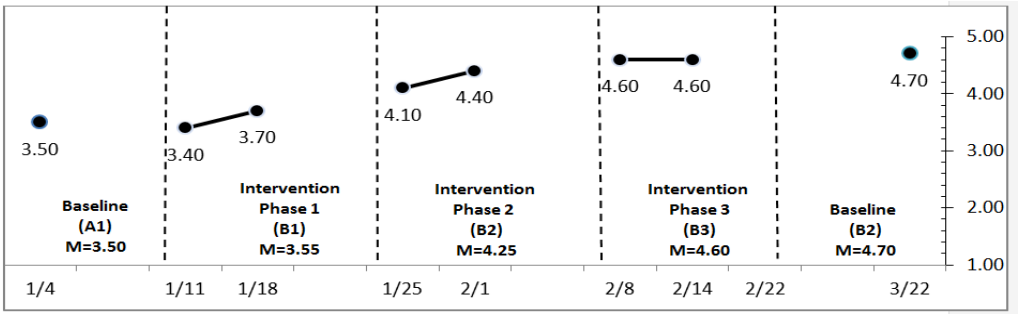

Figure 6. Foot Care Behaviors Scale (FCBS) – Participant #1

Participant #1 demonstrated a 1% increase in mean score (M = 3.55) during the first phase, when compared to baseline. During phase two, she began to practice even

more foot care behaviors as evidenced by a 19% increase (*M* = 4.25) in the score from the first intervention period. This score increased in the third phase by another 8% (*M* = 4.60) and after the rest period by 2% (*M* = 4.70).

At the end of the study, this participant was able to answer "*always*" to eight of the ten questions except "*filing corns and /calluses after bathing"* which she stated was done "*often*". She further reported to "*never*" use lotion between the toes which is the appropriate answer since diabetic patients have a high risk of infection from performing this task. The response on the initial survey was "*rarely*", so this represents a positive change from a potential negative behavior based on information provided to the participant via text message.

A review of the second participant's scores revealed a similar pattern of positive change (see Figure 7). The baseline mean of 3.60 increased to 3.80 (6%) during the first intervention period. This participant also initially reported "*always*" to executing five of the ten self-monitoring behaviors "*washing the feet in warm water everyday*", "*drying them well, especially between the toes*", "*looking at the feet every day to check for cuts, sores, blister, etc.*", "*bending over or pulling the feet to check them*" and, "*wearing slippers or shoes to protect the feet from injury*." And, initially he responded "*never*" to using a mirror to check the bottom of his feet. By the end of the rest period, he had increased the number of self-care behaviors to seven. He was now using a mirror and also no longer putting lotion between his toes, something he reported "*always*" doing until the third phase when he began to respond "*never*" to performing this behavior.

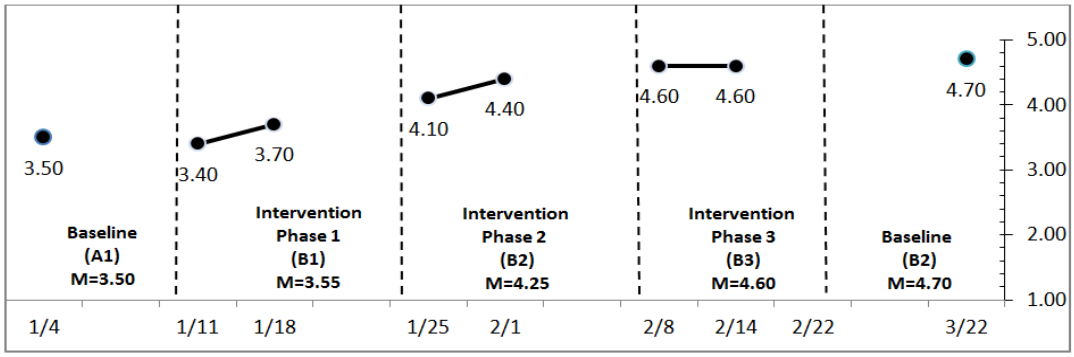

Figure 7. Foot Care Behaviors Scale (FCBS) – Participant #2

Responses to the SDCSA continued to demonstrate an increase in self-monitoring behaviors from baseline for both participants. Participant #1 had a mean of 5.00 at baseline with five of the seven behaviors being performed seven days a week to include "*blood sugar testing per health care provider recommendation*", "*checking of the feet*", along with "*washing and drying between the toes*" (see Figure 8). When asked "*On how many of the last seven days did you inspect the inside of your shoes*?" and "*How many of the last seven days did you soak your feet?*" the response at initial baseline was zero.

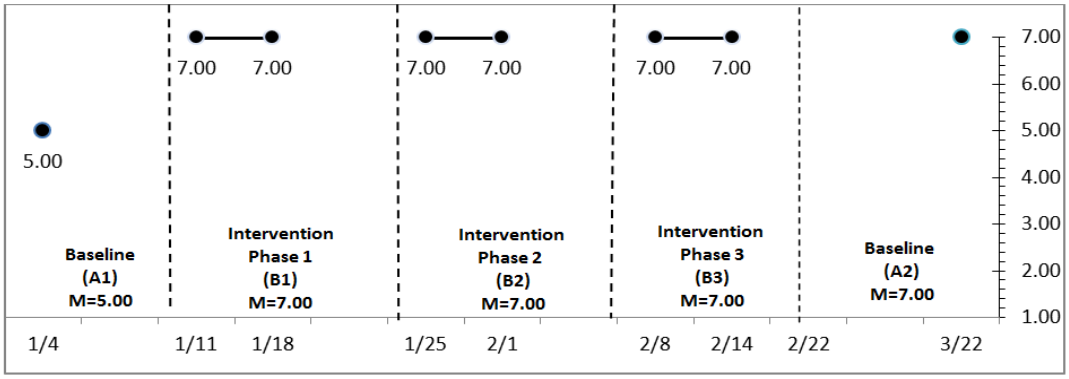

Figure 8. Summary of Diabetes Self-Care Activities (SDSCA) – Participant #1

After the first intervention period, Participant 1# began to respond that all listed behaviors were being performed seven days a week. This remained constant throughout the study even after the rest period and represented an overall increase of self-monitoring

behaviors from initial baseline to study completion of 40% (*M* = 7.00).

The second participant began the initial baseline with an *M* = 5.71 (see Figure 9). Five of the seven behaviors were also being performed seven days a week with only one behavior "*soaking the feet*" not being performed at all; and it was reported that blood sugar monitoring was only being performed five days a week. During the first intervention period, the mean scores increased by 13% to *M* = 6.43 but this decreased in all three subsequent phases from 2% (*M* = 6.29) in the second phase, 11% (*M* = 5.57) in the third, and 18% (*M* = 4.57) after the rest period.

Participant #2 reported the lowest frequency and the greatest variability in blood sugar monitoring throughout the study. He reported monitoring his blood sugars at times only twice a week to seven days a week. In response to the question "*On how many of the last SEVEN DAYS did you test your blood sugar?*" the average response was 5.1 days. When asked "*On how many of the last SEVEN DAYS did you test your blood sugar the number of times recommended by my health care provider?*" the average response was 5.5 days. It is important to note that this participant expressed concern about the cost of glucose test strips during the final interview which contributed to his reluctance to measure glucose frequently.

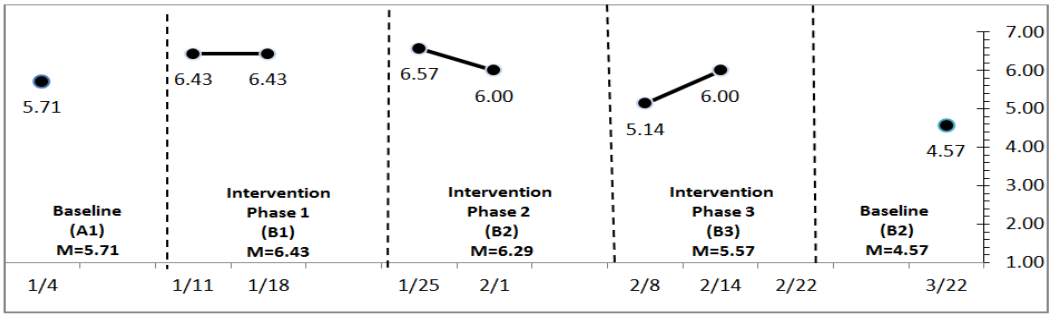

Figure 9. Summary of Diabetes Self-Care Activities (SDSCA) – Participant #2

Self-Care Management

The blood sugar testing and foot care subscales of the Diabetes Self-Management Questionnaire (DSMQ) were used to evaluate the patient's self-care management behaviors. Answers are scored, "1= *Does not apply to me*", "2 = *Applies to me to some degree*", "3 = *Applies to me to a considerable degree*", and "4 = *Applies to me very much.*" This instrument is designed so that scoring includes the reversal of negatively worded items in order to produce a higher score which corresponds to better self-care management (Schmitt et al., 2013).

Initial baseline results for Participant #1 revealed a mean of 2.56 (see Figure 10). This increased by 11% (M = 2.85) during phase 1 and to 7% (M = 2.66) during phase 2. There was an 8% decrease in mean behaviors during phase 3 (M = 2.44) but this was followed by a 10% increase (M = 2.69) after the rest period. During phase one, this participant reported that "*avoiding diabetes-related doctor appointments*" and "*having poor diabetic self-care*" did not apply to her at that time. She further responded that taking her diabetes medication, keeping recommended doctor's appointments, and checking her blood sugar levels did apply to her "*very much*." Yet, she reported that to "*some degree*" she occasionally ate lots of sweets or other foods rich in carbohydrates. In addition, she only performed "*regular physical activity to achieve optimal blood sugar levels*" to some degree and instead "*avoided physical activity, although it would improve her diabetes*", and "*skipped planned physical activity*."

By study end, her responses revealed positive changes in self-care behaviors relative to exercising. She reportedly no longer avoided or skipped physical activity and to a "*considerable degree*" she performed regular physical activity to achieve optimal

sugar levels. Also, she reported to no longer eating lots of sweets or foods high in carbohydrates.

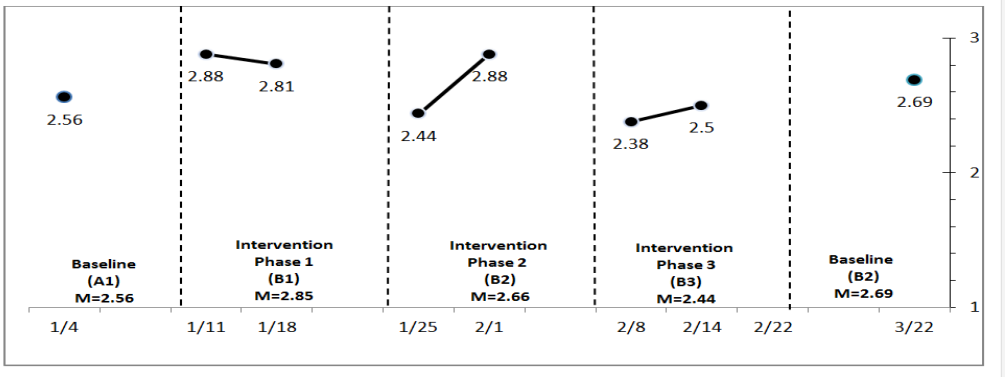

Figure 10. Diabetes Self-Management Questionnaire (DSMQ) – Participant #1

Participant #2 demonstrated variable self-management behaviors throughout the study as evidenced by the results of the DSMQ (see Figure 11). At initial baseline, his mean score was 2.31. Survey responses received from this participant were at times inconsistent, and it is unclear if this was a result of the confusion he expressed at the final interview regarding the survey. For example, he professed to be involved in "*regular physical activity to achieve optimal blood sugar levels*" but later acknowledged that to some degree, he was "*avoiding physical activity, although it would improve his diabetes*." Also, he selected "*does not apply to me*" to the statement "*I tend to avoid diabetes-related doctors' appointments*" and answered "*applies to me very much*" to the statement "*I keep all doctors' appointments recommended for my diabetes treatment*" despite responding positively to the idea that he "*should see his medical practitioner(s) more often*." These responses reveal some lack of clarity regarding his behaviors related to his health provider.

Regardless of these inconsistencies, there were some small improvements noted in self-care management during the study along with a few setbacks. His mean score

improved during the first two intervention periods by 3% (*M* = 2.38) and 4% (*M* = 2.47) respectively, but decreased in the third period by 8% to *M* = 2.28. The score after the rest period also revealed another decrease by 1% (*M* = 2.25). This represented an overall decrease of 3% from initial baseline to the final survey. And, despite the small positive changes noted, there existed continued areas of needed improvement for this participant.

For instance, in the final survey he selected "*does not apply to me*" to the statement "*I tend to avoid diabetes-related doctors' appointments*" and was "*to a considerable degree*" now keeping all recommended diabetes doctors' appointments as well as taking his medications as prescribed. Yet, he professed to a "*considerable degree*" to avoiding physical activity and failing to check his blood sugars frequently enough to provide adequate control. He further responded "*does not apply to me*" when asked if he recorded his blood sugars regularly or analyzed the value chart with his blood glucose meter which was consistent with his other responses, yet showed opportunities for improvement still exist. It is unclear if he simply did not understand the question, as he later stated in the exit interview, or if he did not consider avoidance an option that applied to him because he kept his appointments.

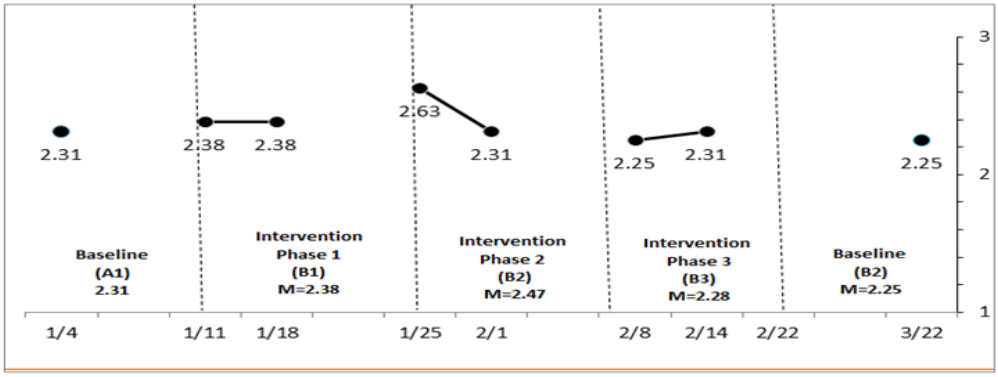

Figure 11. Diabetes Self-Management Questionnaire (DSMQ) – Participant #2

Post-Intervention Interview

A telephone interview was conducted separately with both participants at the end of the four week rest period to allow for feedback and evaluation of the study. A content analysis found several words and phrases which related to the constructs: *self-care maintenance, self-care monitoring, or self-care management.*

Both participants reported that the study increased their overall self-care behaviors in all three constructs. They expressed the establishment of self-care monitoring routines that were not performed prior to the study. Participant #1 stated, "*I started using the mirror to check the bottom of my feet daily which I was not doing before the study*" and "*I now do not lotion between my toes daily which I did do before.*" "*I now soak my feet for 15 minutes each night before I go to bed, even during the rest period.*" The study was noted to have had a positive impact on self-care monitoring by affecting overall health related behaviors. Participant #1 started the study not performing any exercise activity, "*Now, I walk 4-5 times a week in a large store when I am out shopping. I just walk around, not stopping to look at things, several times before I stop. I increased my level of exercise because I knew I had to report my weight.*" Participant #2 reported to have started a new job during the first intervention period which required more walking daily. Because of this, the amount of exercise had also increased for this participant, but not as a result of the study. Both stated the texts alone served as reminders to check their feet "*for any bruising or injury that I would have overlooked from a prior bump or injury*" and they "*simply helped me to remember to take my blood sugars even though sometimes I ran out of strips and was unable to take them.*" This

participant also reported that additional test strips had been purchased, and blood sugar checks had resumed.

Each also stated they enjoyed receiving the messages with one preferring to receive them in the morning while the other favored having them scattered throughout the day. Neither expressed concern regarding the quantity of messages stating, "*The number sent was not a problem for me*" with one stating "*There was no problem if there were all sent together or scattered throughout the day*."

When asked what aspects of the study, if any, they would change, one participant stated she would not change anything and suggested that healthcare providers use the method as a reminder to their patients to reinforce education and self-care behaviors "s*ince most of the time they are just too busy in the office*." The other participant expressed concern about the surveys only stating it was confusing and recommended using the same scale for all questions "*So that I can rank them all from 1-10*."

Each expressed having a very positive overall experience with the study and reported to have increased their feeling of confidence or self-care maintenance, "*In the past I have never checked my blood sugars this often, and it really made me focus on my foot care a lot more than in the past, too*." In addition, they both said that they learned something new about diabetic foot care and felt the study "*enlightened me to things I didn't know*." Each asked if they could continue receiving the text messages even though the study had ended stating "*it provided me with a level of information that helped me to take better care of my diabetes*." One participant even reported that the study influenced her diabetic family and friends to improve their self-care behaviors through the sharing of

information. This participant stated that a family member, after noticing improvements in condition of her feet, requested information about diabetic foot care.

Discussion

The results of this study indicate a text messaging intervention has the potential to positively impact self-care behaviors of diabetic patients. Confidence levels increased in the area of self-care maintenance which included behaviors such as following a prescribed diet, choosing appropriate foods, knowing what to do when blood sugars went higher or lower, and exercising to maintain health. One participant reported a decrease in these behaviors during the rest period when the text messages were not being sent because they served as an overall reminder. There was also an increase in self-care monitoring from baseline. Behaviors evaluated included the frequency of blood sugar testing and the degree the patients monitored their feet for diabetic foot problems or engaged in behaviors aimed at preventing problems, such as wearing slippers and checking the inside of shoes for sharp edges. The frequency of blood sugar monitoring for one participant did not increase as a result of the intervention, but the contributing factor was a lack of diabetic supplies. Improvements were also seen in diabetic self-care management activities such as keeping doctor's appointments, avoiding foods high in sugar or carbohydrates, and engaging in regular physical activity to achieve optimal blood sugar levels. The post-study interview confirmed the fact that behaviors were positively affected through the participants' acknowledgment of performing new self-care activities that were not a part of their daily routines prior to the study. Both requested to have the text messages re-started because they felt they served as overall reminders to remain diligent regarding their own self-care behaviors.

The results of this study provide evidence that text messaging can be used effectively as a nursing intervention to enhance patient self-care behaviors. Today's tech savvy patient is ready to be introduced to this concept and already has the capabilities literally in hand with most subscribing to unlimited text messaging. In addition, texting is an effective tool that can be used to educate multiple patients over limitless geographic areas. This can be important for the patient that resides several miles away from a healthcare provider or who is unable to come into the office due to physical limitations or transportation constraints. Also, many patients forget education provided in the clinical setting (Markle, 2011) and require additional reinforcement far beyond what is possible in a normal nursing workday. Texting is convenient, low cost, and versatile enough to incorporate into a nurse's daily routine. Also, the use of emails to submit the text message allows for ease in tracking of messages sent and responses. The only caution is in ensuring that Health Insurance Portability and Accountability Act (HIPPA) privacy guidelines are practiced, but this can be overcome through the use of secure messaging and encryption. With the current state of technology, cell phones and text messaging are powerful tools that nursing should embrace to enhance and reinforce patient education with the goal of improving self-management and improve quality of care.

Limitations

Some may consider the single case study a limitation due to the small sample size, but this can be overcome through setting goals and consistently measuring the participant's performance against the criteria to determine if improvements are occurring as goals steadily increase (McDougall, 2013). Portney and Watkins (2009) suggest strengthening single case designs by replication of effects or through alternating or

withdrawing interventions and reinstating treatment or baseline conditions. Replication was accomplished by having a second case occurring simultaneously. This researcher attempted to ensure tight control through the use of a withdrawal (rest) period to assess if the target behavior only occurs in the presence of the intervention. The strength of the study lies in the fact that there have been few, if any, prior studies that explored the relationship between text messaging and self-care behaviors using a single-case study design. However, it is acknowledged that a limitation of any small-population study is the engagement and veracity of the participant.

Implications for Research

The research findings from this study suggest that text messages could be effectively used to provide targeted patient information and that texting has the potential to change self-care behaviors which can ultimately lead to better clinical outcomes. Further research is needed to replicate this study in order to determine if these results can be generalized to a larger population. Additional research using the SCD methodology should also be considered as a means to build upon the body of nursing science. Further research using this methodology can demonstrate its practical use as an initial method of inquiry for novice nurses or as a means to direct individualized patient care in clinical practice. Recommendations are for nurses to consider the adoption of the SCD into practice as a means to assess targeted interventions while using a simple approach to understanding causal relationships between the patient, clinical indicators, and treatment modalities. The use of visual graphs should also be promoted as a clear and practical method to analyze data without the use of complex statistical formulas or software

making it more easily transferable to the clinical setting. Training in the use of the SCD in nursing and its analysis is encouraged.

The SCD could change the rate at which nursing interventions transition from idea to evidence-based practice. What is considered a highly effective process to evaluate the response to treatment in other disciplines, the SCD can also be used by nursing as an impetus to spark inquiry with the potential to positively change the way we interact with our patients. The methodology can provide greater detail about individual patient preferences, moving healthcare delivery forward from the macro to the micro level.

Conclusion

Diabetes affects patients worldwide in alarming numbers. Neuropathic complications from the disease can be debilitating and life threatening resulting in countless unnecessary amputations yearly. These complications also contribute significantly to the financial burden of the disease and impact quality of life. Patient self-management is crucial. Text messaging has previously been explored as a means to improve disease management, but there currently exists a gap in the literature relative to its use as an intervention in diabetic self-management. This study also adds to the literature by suggesting nurses undertake future research using the single-case study design. It is easily transferable to the practice setting, more cost effective, and allows for the evaluation of individualized results.

References

Agency for Healthcare Research and Quality. (2008). *Monthly text messages increase compliance with recommended blood glucose testing in medicaid managed care enrollees with diabetes.* Retrieved from http://www.innovations.ahrq.gov/content.aspx?id=2395

Aguilera, A., & Muñoz, R. F. (2011). Text messaging as an adjunct to CBT in low-income populations: A usability and feasibility pilot study. *Professional Psychology: Research and Practice, 42*(6), 472-478. doi: 10.1037/a0025499

American Association of Diabetic Educators. (2013). *AADE7 Self-Care Behaviors.* Retrieved from http://www.diabeteseducator.org/ProfessionalResources/AADE7/

American Diabetes Association. (2014a). Foot care. Retrieved from http://www.diabetes.org/living-with-diabetes/complications/foot-complications/foot-care.html

American Diabetic Association. (2014b). Checking your blood glucose. Retrieved from http://www.diabetes.org/living-with-diabetes/treatment-and-care/blood-glucose-control/checking-your-blood-glucose.html

American Diabetes Association. (2013). Position statement: Standards of medical care in diabetes – 2013. *Diabetes Care*, 36(Suppl.1). Retrieved from http://care.diabetesjournals.org/content/36/Supplement_1/S11.full.pdf+html?sid=9f2e4f4d-36f0-46cb-8b89-9bd6d6c30ae7

American Orthopaedic Foot & Ankle Society . (2010). *Orthopaedic foot & ankle surgeons provide patient education guide to diabetic foot care*. Retrieved from http://www.disabled-world.com/health/diabetes/feet-care.php

Boyle, J.P., Thompson, T.J., Gregg, E.W., Barker, L.E., & Williamson, D. F. (2010). Projection of the year 2050 burden of diabetes in the US adult population: dynamic modeling of incidence, mortality, and prediabetes prevalence. *Population Health Metrics*. 8(29). Retrieved from http://www.pophealthmetrics.com/content/8/1/29

Ceccucci, W., Peslak, A. & Sendall, P. (2010). An emperical study of behavioral factors influencing text messaging intention. *Journal of Information Technolgoy Management. 21*(*1*), 16-34.

Centers for Disease Control. (2012). *Diabetes Resource and Statistics*. Retrieved from Diabetes Public Health Resource: http://www.cdc.gov/diabetes/consumer/research.htm

Chin, Y.-F., & Huang, T.-T. (2013, March). Development and Validation of a Diabetes Foot Self-Care Behavior Scale. *Journal of Nursing Research*, pp. 19-25. Retrieved from http://www3.med.unipmn.it/papers/2013/LWW_Journals/2013-04-15_lww/Development_and_Validation_of_a_Diabetes_Foot.5.pdf

Farmer, A. J., Perera, R., Ward, A., Heneghan, C., Oke, J. B., Davidson, M. B., et al. (2013). *Meta-analysis of individual patient data in randomised trials of self monitoring of blood glucose in people with non-insulin treated type 2 diabetes.* Retrieved from http://www.bmj.com/content/344/bmj.e486.pdf%2Bhtml

Fatehi, F., Malekzadeh, G., Akhavimirab, A., Rashidi, M., & Afkhami-Ardekani, M. (2010). The effect of short message service on knowledge with patients with diabetes in Yazd, Iran. *Iranian Journal of Diabetes and Obesity*, pp. 27-31.

Free, C., Phillips, G., Galli, L., Watson, L., Felix, L., Edwards, P., . . . Haines, A. (2013). The effectiveness of mobile-health technology-based health behavior change or disease management interventions for health care consumers: A systematic review. *PloS Medicine, 10*(1), 1-45. doi:10.1371/journal.pmed.1001362

Gebel, E. (2010). *The Basics of Neuropathy*. Retrieved from Diabetes Forecast: http://forecast.diabetes.org/magazine/diabetes-101/basics-neuropathy?utm_source=WWW&utm_medium=ContentPage&utm_content=NeuropathyBasics&utm_campaign=DF

Gilkey, M., & Garcia, C. (2010). What do you think of when you think of patient education? An interview with Kate Lorig. *Health Promotion Practice, 11*(2), 169-172. doi:10.1177/1524839909359150

Jang, Y., & Yoo, H. (2012). Self-management programs based on the social cognitive theory for Iranians with chronic disease: A systematic review. *Contemporary Nurse: A Journal for the Australian Nursing Profession, 40*(2), 147-159.

Kim, H.S. & Jeong, H.S. (2007). A nurse short message service by cellular phone in type-2 diabetic patients for six months. *Journal of Clinical Nursing, 16*(6), 1082-1087. doi: 10.1111/j.1365-2702.2007.01698.x

Kosinski, M. A., Lipsky, B. A. (2010) Current medical management of diabetic foot infections. *Expert Review of Anti-Infective Therapy, 8*(11): 1293–305.

Lorig, K., Ritter, P. L., Laurent, D. D., Plant, K., Green, M., Jernigan, V., & Case, S. (2010). Online diabetes self-management program: A randomized study. *Diabetes Care*, *33*(6), 1275-81. doi:10.2337/dc09-2153

Lorig, K., Ritter, P. L., Plant, K., Laurent, D. D., Kelly, P., & Rowe, S. (2013). The south australia health chronic disease self-management internet trial. *Health Education & Behavior, 40*(1), 67-77. doi:10.1177/1090198112436969

Markle (2011). Many doctors and patients perceive gaps in their communications. *Markle Health in a Networked Life*. Retrieved from http://www.markle.org/publications/1438-many-doctors-and-patients-perceive-gaps-their-communications

McCleary-Jones, V. (2011). Health literacy and its association with diabetes knowledge, self-efficacy and disease self-management among african americans with diabetes mellitus. *Association of Black Nursing Faculty Journal*, *22*(2), 25-32.

McDougall, D. (2013). Applying single-case design innovations to research in sport and exercise psychology. *Journal of Applied Sport Psychology, 25,* 33-45.

Muller, N., Stengel, D., Kloos, C., Ristow, M., Wolf, G., & Muller, U. A. (2012). Improvement of HbA1c and stable weight loss 2 years after an outpatient treatment and teaching program for patients with type 2 diabetes without insulin therapy based on urine glucose self-monitoring. *International Journal of General Medicine, (2),* 241-247. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3325012/pdf/ijgm-5-241.pdf

Nundy, S., Dick, J. J., Solomon, M. C., & Peek, M. E. (2013). Developing a behavioral model for mobile phone-based diabetes interventions. *Patient Education & Counseling, 90*(1), 125-132. doi:10.1016/j.pec.2012.09.008

Pluijms, W., Huygen, F., Cheng, J., Mekhail, N., van Kleef, M., Van Zundert, J., & Van Dongen, R. (2011). Painful diabetic polyneuropathy. *Pain Practice, 11*(2), 191-198. doi:10.1111/j.1533-2500.2010.00435.x

Polit & Beck. (2008). *Nursing research: Generating and assessing evidence for nursing practice* (8th ed.). Philadelphia: Lippincott.

Portney, L., & Watkins, M. (2009). *Foundations of clinical research: Applications to practice* (3rd ed.). New Jersey: Prentice Hall.

Riegel, B., Jaarsma, T., & Strömberg, A. (2012). A middle-range theory of self-care of chronic illness. *Advances in Nursing Science, 35*(3), 194-204.

Riley, W. T., Rivera, D. E., Atienza, A. A., Nilson, W., Allison, S. M., & Mermelstein, R. (2011). Health behavior models in the age of mobile interventions: Are our theories up to the task? *Translational Behavior Medicine.* Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3142960/pdf/nihms309810.pdf

Saxe-Custack, A., & Weatherspoon, L. (2012). A patient-centered approach using community-based paraprofessionals to improve self-management of type 2 diabetes. *American Journal of Health Education,* 44, 213-220.

Schmidt, S., Mayer, H., & Panfil, E. (2008). Diabetes foot self-care practices in the German population. *Journal of Clinical Nursing, 17*(21), 2920-2926. doi:10.1111/j.1365-2702.2008.02352.x

Schmitt, A., Gahr, A., Hermanns, N., Kulzer, B., Huber, J. ö., & Haak, T. (2013). The diabetes self-management questionnaire (DSMQ): Development and evaluation of an instrument to assess diabetes self-care activities associated with glycaemic control. *Health & Quality of Life Outcomes, 11*(1), 1-14. doi:10.1186/1477-7525-11-138

Sheridan, S. (2012). The need for a comprehensive foot care model. *Nephrology Nursing Journal, 39*(5), 397-400.

Stanford Patient Education Research Center. (n.d.). *Self-efficacy for diabetes scale.* Retrieved from http://patienteducation.stanford.edu/research/sediabetes.html

Toobert, D. J., Hampson, S. E., & Glascow, R. E. (2000). The Summary of Diabetes Self-Care Activitites Measure. *Diabetes Care, 23(7),*943-950. Retrieved from http://care.diabetesjournals.org/content/23/7/943.full.pdf

Turns, M. (2012). The diabetic foot: An overview for community nurses. *British Journal of Community Nursing, 17*(9), 422-430.

U. S. Department of Health and Human Services. (2012). *Diabetes*. Retrieved from Healthy People.gov:http://www.healthypeople.gov/2020/ topicsobjectives2020/objectiveslist. Aspx?topicId=8

Xu, Y., Pan, W., & Liu, H. (2010). Self-management practices of Chinese Americans with type 2 diabetes. *Nursing & Health Sciences, 12*(2), 228-234. doi:10.1111/j.1442-2018.2010.00524.x

Yank, V., Laurent, D., Plant, K., & Lorig, K. (2013). Web-based self-management support training for health professionals: A pilot study. *Patient Education and Counseling, 90*(1), 29-37. doi:10.1016/j.pec.2012.09.003

Zolfaghari, M., Mousavifar, S. A., & Pedram, S. (2009). Mobile phone text messaging and telephone follow-up in type 2 diabetic patients for 3 months: A comparative study. *Iranian Journal of Diabetes & Obesity, 1*(1), 45-51.

Chapter Four

Evaluation of the Project

The goal of this study was to determine the effect of an intermittent intensive text messaging intervention on reported self-care behaviors of a diabetic adult related to the care of the feet. The study was designed to determine whether the intervention would increase the patient's self-care maintenance and self-care management behaviors. In addition, the researcher wished to understand the benefits and challenges of using a text message intervention to improve diabetic foot care self-management. Self-care maintenance was measured using the Self-Efficacy for Diabetes Scale created by the Stanford Education Research Center (n.d.) to evaluate a patient's level of confidence in maintaining the best health possible. An evaluation of a patient's self-care monitoring behaviors was accomplished through the use of the Foot Care Behaviors Scale (based on the American Diabetes Association's self-management of diabetes feet guidelines) and the Summary of Diabetes Self-Care Activities developed by Toobert, Hampson & Glascow (2000). The Diabetes Self-Management Questionnaire (DSMQ), developed by Schmitt et al. (2013), was used to measure self-management behaviors. The mean scores of the instruments were visually graphed and evaluated. A telephone interview was conducted at the end of the study to assess the participant's perceived benefits and challenges of the study.

It was clear from the graphs for Participant #1 that the texting intervention improved her compliance with diabetic foot care behaviors and prompted her to become

more physically active. In addition, she changed a potential negative behavior (putting lotion between her toes) as a direct result of the study. The follow up interview supported the findings when she commented about the helpful nature of the texts and her desire for them to continue. The data for Participant #2 provided less clear conclusions. His participation was more erratic and his understanding of the goals of the intervention and his adherence were more unclear. He had several life events, getting a new job and being unable to financially afford the test strips, which interfered with his adherence with data collection. However, he also requested to continue to receive the text messages as he saw them as strong reminders to perform some self-care behaviors that he had not been practicing before. And, although he did not show as much improvement in his self-care behaviors as Participant #1, a review of his data showed improvement in self-management behaviors. He began to use a mirror to check underneath his feet and he also stopped using lotion between his toes.

It is clear that having two separate single case design studies simultaneously helped this researcher to get a more dynamic and comprehensive view of the challenges of changing behaviors in the management of a chronic disease. The results of this study demonstrated that the process of sending text messages via email is a very feasible and practical way to provide new patient education information or reinforce what was previously provided in the clinical setting. Once the targeted educational information was identified, the process of sending the messages daily was simple even when the number increased during the final intervention phase to three a day. During that period, the messages were sent at alternating times and in varying numbers. Another important feature is that the educational information can be easily stored as a database of text

messages that can be effortlessly transferred to an email for transmission. A benefit of sending text messages via email is the blind carbon copy "bcc" feature that allows the sender to email the same message to multiple recipients without divulging their identity.

In addition to the text messaging, the use of the single-case design is equally plausible for nursing practice. Data collection is straightforward and easy to analyze using visual graphs. The ability to look at the results from a visual standpoint helped to convey an initial impression of causal relationships between the intervention and the patients' response. Once the graphs were created, the calculation of mean scores helped to further assess the impact. The visual graphs and scores together aided this researcher to draw conclusions which were presented in a narrative format and validated through participant interviews.

The results of this study contributed to the body of science in the use of text messages as a nursing intervention to provide or reinforce patient education and its impact on patient self-care behaviors and clinical outcomes. In addition, the study presents a practical approach to developing nursing research aimed at understanding the causal relationship between interventions and the individual patient using a single-case study design.

Recommendations Based on Findings

Based on the study, a case can be made for the use of text messages to improve patient self-care behaviors, especially amongst those with chronic illnesses. The use of text messaging presents a low cost method to reach multiple patients who are often left to make critical choices after they leave the health care setting, choices which are based on limited information or a lack of clear understanding. HIPPA requirements would need to

be followed to ensure patient privacy and confidentiality. Yet, it can be an essential tool to manage chronic illnesses, which are by their very nature slow progressing and often long in duration with the potential to adversely affect quality of life (Institute Of Medicine, 2009). The annual financial burden of chronic illnesses in the U.S. is estimated at $2 trillion dollars or 75% of overall healthcare expenditures (Institute of Medicine, 2009). Moving into the future, healthcare's focus has shifted to more individualized, high quality care, yet with the same limitations on resources. Also, with the advent of technology, patients are demanding more innovative and flexible alternatives to the way they are being educated and treated. Sending text messages is a way to enhance patient education, improve the frequency and accuracy of self-care behaviors, and impact quality of life in areas where access may be a concern.

Relative to the use of the SCD, any nurse can easily adopt this design as a tool to promote the initial assessment of a nursing intervention. The single case design is recommended as a positive way for nurses to test new interventions in a way that conserves resources and time but still provides a good causal basis for making decisions about future care. Results can be easily analyzed and evaluated by any nurse from the novice to the more experienced without the need for advanced statistical calculations. The SCD can be easily incorporated into the nursing care plan as a method to further individualize care and evaluate patient responses. Once specific goals are identified, the SCD model can be used to determine if goals are being met or if another intervention should be used.

Lastly, it is recommended that the SCD be considered as a new model in care coordination as a means to identify and understand the discrete confounding issues that may impact the patient's ability to manage chronic condition at home. If such issues are recognized early, it may lead to a decrease in unnecessary emergency room visits or repeat hospitalizations. This methodology offers great promise for nurses, and it provides the tools to take greater control of the discipline and to ensure quality of care for patients now and in the future.

References

American Diabetes Association. (2008). National standards for diabetes self-management education. *Diabetes Care*, *31*(Suppl. 1). S97-S104. Retrieved from http://care.diabetesjournals.org/content/31/Supplement_1/S97.full.pdf+html

American Diabetes Association. (2014a). Statistics about diabetes. Retrieved from http://www.diabetes.org/diabetes-basics/statistics/

American Diabetes Association. (2014b). Foot care. Retrieved from http://www.diabetes.org/living-with-diabetes/complications/foot-complications/foot-care.html

Centers for Disease Control. (2012). *Diabetes Resource and Statistics*. Retrieved from http://www.cdc.gov/diabetes/consumer/research.htm

Chin, Y.-F., & Huang, T.-T. (2013). Development and validation of a diabetes foot self-care behavior scale. *Journal of Nursing Research, 21*(1), 19-25. Retrieved from http://www3.med.unipmn.it/papers/2013/LWW_Journals/2013-04-15_lww/Development_and_Validation_of_a_Diabetes_Foot.5.pdf

Harwood, E., Bunn, C., Caton, S., & Simmons, D. (2013). Addressing barriers to diabetes care and self-care in general practice: A new framework for practice nurses. *Journal of Diabetes Nursing, 17*(5), 186-191.

Institute of Medicine. (2009). *Living well with chronic illness: A call for public health action*. Retrieved from: http://www.iom.edu/~/media/Files/Report%20Files/2012/Living-Well-with-Chronic-Illness/livingwell_chronicillness_reportbrief.pdf

Jang, Y., & Yoo, H. (2012). Self-management programs based on the social cognitive theory for koreans with chronic disease: A systematic review. *Contemporary Nurse: A Journal for the Australian Nursing Profession, 40*(2), 147-159.

McCleary-Jones, V. (2011). Health literacy and its association with diabetes knowledge, self-efficacy and disease self-management among african americans with diabetes mellitus. *ABNF Journal, 22*(2), 25-32.

Riegel, B., Jaarsma, T., & Strömberg, A. (2012). A middle-range theory of self-care of chronic illness. *Advances in Nursing Science, 35*(3), 194-204.

Schmidt, S., Mayer, H., & Panfil, E. (2008). Diabetes foot self-care practices in the German population. *Journal of Clinical Nursing, 17*(21), 2920-2926. doi:10.1111/j.1365-2702.2008.02352.x

Schmitt, A., Gahr, A., Hermanns, N., Kulzer, B., Huber, J. ö., & Haak, T. (2013). The diabetes self-management questionnaire (DSMQ): Development and evaluation of an instrument to assess diabetes self-care activities associated with glycaemic control. *Health & Quality of Life Outcomes, 11*(1), 1-14. doi:10.1186/1477-7525-11-138

Scott, C. (2013). Care planning-supporting self-management in diabetes care. *Practice Nurse, 43*(10), 28-30.

Stanford Patient Education Research Center. (n.d.). Diabetes self-efficacy scale. Retrieved from http://patienteducation.stanford.edu/research/sediabetes.html

Toobert, D. J., Hampson, S. E., & Glascow, R. E. (2000). The Summary of Diabetes Self-Care Activitites Measure. *Diabetes Care, 23(7),*943-950. Retrieved from http://care.diabetesjournals.org/content/23/7/943.full.pdf

Turns, M. (2012). The diabetic foot: An overview for community nurses. *British Journal of Community Nursing, 17*(9), 422-430.

U. S. Department of Health and Human Services. (2013a). *Diabetes*. Retrieved from http://healthypeople.gov/2020/Data/SearchResult.aspx?topicid=8&topic=Diabetes&objective=D-4&anchor=347

U. S. Department of Health and Human Services. (2013b). *Diabetes-Objectives*. Retrieved from http://healthypeople.gov/2020/topicsobjectives2020/TechSpecs.aspx?hp2020id=D-4

Wilkinson, A., Whitehead, L., & Ritchie, L. (2014). Factors influencing the ability to self-manage diabetes for adults living with type 1 or 2 diabetes. *International Journal of Nursing Studies, 51*(1), 111-122. doi:10.1016/j.ijnurstu.2013.01.006

World Health Organization. (2014). 10 facts about diabetes. Retrieved from http://www.who.int/features/factfiles/diabetes/en/

The University of Texas at Tyler
Institutional Review Board

December 6, 2013

Dear Ms. Hills,

Your request to conduct the study: *Impact of Text Messaging on Diabetic Foot Self-Care Behaviors Using a Single Case Design,* IRB #F2013-47 has been approved by The University of Texas at Tyler Institutional Review Board under expedited review. This approval includes the written informed consent and HIPAA consents that are attached to this letter, and your assurance of participant knowledge of the following prior to study participation: this is a research study; participation is completely voluntary with no obligations to continue participating, with no adverse consequences for non-participation; and assurance of confidentiality of their data. In addition, please ensure that any research assistants are knowledgeable about research ethics and confidentiality, and any co-investigators have completed human protection training within the past three years, and have forwarded their certificates to the IRB office (G. Duke).

Please review the UT Tyler IRB Principal Investigator Responsibilities, and acknowledge your understanding of these responsibilities and the following through return of this email to the IRB Chair within one week after receipt of this approval letter:

- This approval is for one year, as of the date of the approval letter
- Request for Continuing Review must be completed for projects extending past one year
- Prompt reporting to the UT Tyler IRB of any proposed changes to this research activity
- **Prompt reporting to the UT Tyler IRB and academic department administration will be done of any unanticipated problems involving risks to subjects or others**
- Suspension or termination of approval may be done if there is evidence of any serious or continuing noncompliance with Federal Regulations or any aberrations in original proposal.
- Any change in proposal procedures must be promptly reported to the IRB prior to implementing any changes except when necessary to eliminate apparent immediate hazards to the subject.

Best of luck in your research, and do not hesitate to contact me if you need any further assistance.

Sincerely,

Gloria Duke, PhD, RN

Gloria Duke, PhD, RN
Chair, UT Tyler IRB

Appendix B: Informed Consent

THE UNIVERSITY OF TEXAS AT TYLER

Informed Consent to Participate in Research
Institutional Review Board # F2013-47

Approval Date: December 6, 2013

1. **Project Title**: Impact of Text Messaging on Diabetic Foot Self-Care Behaviors Using a Single Case Design

2. **Principal Investigator:** Stephanie Hills, MSN, RN, PhD(c)

3. **Participant's Name:**

To the Participant:

You are being asked to take part in this study at The University of Texas at Tyler (UT Tyler). This permission form explains:

- Why this research study is being done.
- What you will be doing if you take part in the study.
- Any risks and benefits you can expect if you take part in this study.

After talking with the person who asks you to take part in the study, you should be able to:

- Understand what the study is about.
- Choose to take part in this study because you understand what will happen

4. Description of Project

The purpose of this study is to learn how text messages that provide diabetic foot care can help persons with diabetes take care of their feet and manage their diabetes. The study will also help providers learn how patients feel about the use of text messages in patient education.

5. Research Procedures

If you agree to be in this study, we will ask you to do the following things:

- You will be asked to set up and attend three meetings/telephone calls with the researcher to talk about how you care for your feet and manage your diabetes. You may be asked to meet again if more information is needed. During these meetings/telephone calls the principal investigator will ask you questions to complete questionnaires. These meetings/telephone calls will occur at the beginning of the study, at the end of the six week intervention, and at the end of a four week rest period. It will take approximately 45 minutes to complete these questionnaires.
- You will be sent text messages to your phone that provide diabetic foot-care education every day for six weeks. During the first two weeks you will receive one text message a day. During the second two weeks you will receive two text messages daily, and during the last two weeks, you will receive three text messages daily. You will not need to respond back to these educational text messages.

- You will also be sent two additional text messages each day, during the six week intervention period that you will be requested to respond by return text message. These messages will ask you clinical questions such as "What is your blood sugar?" "How much do you weigh?" You will also be asked to rate on a scale from 1-10 with 1= poor and 10=excellent the following questions, "How did your feet feel last night?" and "How well did you stick to your diabetic diet yesterday?" It will take less than 5 minutes for you to text your response daily.

- The principal investigator will administer a questionnaire weekly during the six week intervention period to identify which educational texts should be sent each week. The questionnaire should take no more than 15 minutes to complete.

6. Side Effects/Risks

Questionnaires may contain questions that are sensitive in nature. You may refuse to answer any question that makes you feel uncomfortable. If you have concerns after completing the questionnaires, we encourage you to inform the principal investigator during the meeting or at any time during the study (contact information will be at the end of this consent form).

There are only minimal risks associated with participation in this research in the possibility of someone else, other you and the researcher, seeing the text messages on your phone. This risk can be reduced if you agree to a set time to receive the texts and you delete them shortly afterwards.

7. Potential Benefits

Nurses and doctors can help other persons with diabetes learn how to better care for their feet and prevent diabetic foot problems.

Understanding of Participants

8. I have been given a chance to ask any questions about this research study. The researcher has answered my questions.

9. If I sign this consent form I know it means that:

- I am taking part in this study because I want to. I chose to take part in this study after having been told about the study and how it will affect me.
- I know that I am free to not be in this study. If I choose to not take part in the study, then nothing will happen to me as a result of my choice.
- I know that I have been told that if I choose to be in the study, then I can stop at any time. I know that if I do stop being a part of the study, then nothing will happen to me.
- I will be told about any new information that may affect my wanting to continue to be part of this study.
- The study may be changed or stopped at any time by the researcher or by The University of Texas at Tyler.
- The researcher will get my written permission for any changes that may affect me.

10. I have been promised that that my name will not be in any reports about this study unless I give my permission.

11. I also understand that any information collected during this study may be shared as long as no identifying information such as my name, address, or other contact information is provided). This information can include health information. Information may be shared with:

- Organization giving money to be able to conduct this study
- Other researchers interested in putting together your information with information from other studies
- Information shared through presentations or publications

12. I understand The UT Tyler Institutional Review Board (the group that makes sure that research is done correctly and that procedures are in place to protect the safety of research participants) may look at the research documents. These documents may have information that identifies me on them. This is a part of their monitoring procedure. I also understand that my personal information will not be shared with anyone.

13. I have been told about any possible risks that can happen with my taking part in this research project.

14. I also understand that I will not be given money for any patents or discoveries that may result from my taking part in this research.

15. If I have any questions concerning my participation in this project, I will contact the principal researcher: Stephanie Hills at 214-901-2861 or email shills@patriots.uttyler.edu.

16. If I have any questions concerning my rights as a research subject, I will contact Dr. Gloria Duke, Chair of the IRB, at (903) 566-7023, gduke@uttyler.edu,
or the University's Office of Sponsored Research:

The University of Texas at Tyler
c/o Office of Sponsored Research
3900 University Blvd
Tyler, TX 75799

I understand that I may contact Dr. Duke with questions about research-related injuries.

17. **CONSENT/PERMISSION FOR PARTICIPATION IN THIS RESEARCH STUDY**

I have read and understood what has been explained to me. I give my permission to take part in this study as it is explained to me. I give the study researcher permission to register me in this study. I have received a signed copy of this consent form.

Signature of Participant _____ Date _____

_____ _____

Signature of Person Responsible (e.g., legal guardian) Relationship to Participant

_____

Witness to Signature

18. I have discussed this project with the participant, using language that is understandable and appropriate. I believe that I have fully informed this participant of the nature of this study and its possible benefits and risks. I believe the participant understood this explanation.

_____ _____

Researcher/Principal Investigator Date

Appendix C: Self-Efficacy for Diabetes Scale (SDS)

STANFORD
PATIENT EDUCATION
RESEARCH CENTER

Self-Efficacy for Diabetes

We would like to know how confident you are in doing certain activities. For each of the following questions, please choose the number that corresponds to your confidence that you can do the tasks regularly at the present time.

	not at all confident	1	2	3	4	5	6	7	8	9	10	totally confident
1. How confident do you feel that you can eat your meals every 4 to 5 hours every day, including breakfast every day?	not at all confident	1	2	3	4	5	6	7	8	9	10	totally confident
2. How confident do you feel that you can follow your diet when you have to prepare or share food with other people who do not have diabetes?	not at all confident	1	2	3	4	5	6	7	8	9	10	totally confident
3. How confident do you feel that you can choose the appropriate foods to eat when you are hungry (for example, snacks)?	not at all confident	1	2	3	4	5	6	7	8	9	10	totally confident
4. How confident do you feel that you can exercise 15 to 30 minutes, 4 to 5 times a week?	not at all confident	1	2	3	4	5	6	7	8	9	10	totally confident
5. How confident do you feel that you can do something to prevent your blood sugar level from dropping when you exercise?	not at all confident	1	2	3	4	5	6	7	8	9	10	totally confident
6. How confident do you feel that you know what to do when your blood sugar level goes higher or lower than it should be?	not at all confident	1	2	3	4	5	6	7	8	9	10	totally confident
7. How confident do you feel that you can judge when the changes in your illness mean you should visit the doctor?	not at all confident	1	2	3	4	5	6	7	8	9	10	totally confident
8. How confident do you feel that you can control your diabetes so that it does not interfere with the things you want to do?	not at all confident	1	2	3	4	5	6	7	8	9	10	totally confident

(Stanford Patient Education Research Center, (n.d.)

Appendix D: Foot Care Behaviors Scale (FCBS)

1. Do you wash your feet in warm water every day? Never ……. Rarely …….. Sometimes…….Often……. Always
2. Do you dry your feet well, especially between your toes. Never ……. Rarely …….. Sometimes…….Often……. Always
3. Do you look at your feet every day to check for cuts, sores, blisters, redness, calluses, or other problems? Never ……. Rarely …….. Sometimes…….Often……. Always
4. Do you bend over or pull your feet up to check them? Never ……. Rarely …….. Sometimes…….Often……. Always
5. Do you use a mirror to check your feet? Never ……. Rarely …….. Sometimes…….Often……. Always
6. Do you ever ask someone else to check your feet? Never ……. Rarely …….. Sometimes…….Often……. Always
7. Do you put lotion between your toes? Never ……. Rarely …….. Sometimes…….Often……. Always
8. Do you file your corns and calluses after your bath or shower? Never ……. Rarely …….. Sometimes…….Often……. Always
9. Do wear slippers or shoes to protect your feet from injuries? Never ……. Rarely …….. Sometimes…….Often……. Always
10. Before putting your shoes on do you feel the insides to make sure they have no sharp edges or objects that might injure your feet? Never ……. Rarely …….. Sometimes…….Often……. Always

Appendix E: ADA Recommendations for Diabetic Foot Care

1. Wash your feet in warm water every day. Make sure the water is not too hot by testing the temperature with your elbow. Do not soak your feet. Dry your feet well, especially between your toes.
2. Look at your feet every day to check for cuts, sores, blisters, redness, calluses, or other problems. Checking every day is even more important if you have nerve damage or poor blood flow. If you cannot bend over or pull your feet up to check them, use a mirror. If you cannot see well, ask someone else to check your feet.
3. If your skin is dry, rub lotion on your feet after you wash and dry them. Do not put lotion between your toes.
4. File corns and calluses gently with an emery board or pumice stone. Do this after your bath or shower.
5. Cut your toenails once a week or when needed. Cut toenails when they are soft from washing. Cut them to the shape of the toe and not too short. File the edges with an emery board.
6. Always wear slippers or shoes to protect your feet from injuries.
7. Always wear socks or stockings to avoid blisters. Do not wear socks or knee-high stockings that are too tight below your knee.
8. Wear shoes that fit well. Shop for shoes at the end of the day when your feet are bigger. Break in shoes slowly. Wear them 1 to 2 hours each day for the first few weeks.

9. Before putting your shoes on, feel the insides to make sure they have no sharp edges or objects that might injure your feet.

(American Diabetes Association, 2014)

Appendix F: The Summary of Diabetes Self-Care Activities (SDSCA) – modified version

The questions below ask you about your diabetes self-care activities during the past 7 days. If you were sick during the past 7 days, please think back to the last 7 days that you were not sick.

Blood Sugar Testing
On how many of the last SEVEN DAYS did you test your blood sugar?
0 1 2 3 4 5 6 7

On how many of the last SEVEN DAYS did you test your blood sugar the number of times recommended by your health care provider?
0 1 2 3 4 5 6 7

Foot Care
On how many of the last SEVEN DAYS did you check your feet?
0 1 2 3 4 5 6 7

On how many of the last SEVEN DAYS did you inspect the inside of your shoes?
0 1 2 3 4 5 6 7

Foot Care
9A. On how many of the last SEVEN DAYS did you wash your feet?
0 1 2 3 4 5 6 7

10A. On how many of the last SEVEN DAYS did you soak your feet?
0 1 2 3 4 5 6 7

11A. On how many of the last SEVEN DAYS did you dry between your toes after washing?
0 1 2 3 4 5 6 7

Scoring Instructions for the Summary of Diabetes Self-Care Activities
Scores are calculated for each of the five regimen areas assessed by the SDSCA: Diet, Exercise, Blood-Glucose Testing, Foot-Care, and Smoking Status.

Step 1:
For items 1–10, use the number of days per week on a scale of 0–7. Note that this response scale will not allow for direct comparison with the percentages provided in Table 1.

Step 2: Scoring Scales
General Diet = Mean number of days for items 1 and 2.
Specific Diet = Mean number of days for items 3, and 4, reversing item 4

(0=7, 1=6, 2= 5, 3=4, 4=3, 5=2, 6=1, 7=0).

Given the *low inter-item correlations for this scale*, using the individual items is recommended.
Exercise = Mean number of days for items 5 and 6.
Blood-Glucose Testing = Mean number of days for items 7 and 8.
Foot-Care = Mean number of days for items 9 and 10.
Smoking Status = Item 11 (0 = nonsmoker, 1 = smoker), and number of cigarettes smoked per day.

Scoring for Additional Items
Recommended regimen = Items 1A - 4A, and items 12A - 14A, no scoring required.
Diet = Use total number of days for item 5A.
Medications = Use item 6A - OR - 7A AND 8A, use total number of days for item 6A, use mean number of days if both 7A and 8A are applicable.
Foot-Care = Mean number of days for items 9A - 11A, after reversing 10A and including items 9 and 10 from the brief version.

(Toobert, Hampson, & Glascow, 2000)

Appendix G: Diabetes Self-Management Questionnaire (DSMQ)

	The following statements describe self-care activities related to your diabetes. Thinking about your self-care over the last 8 weeks, please specify the extent to which each statement applies to you.	Applies to me very much	Applies to me to a consider-able degree	Applies to me to some degree	Does not apply to me
1.	**I check my blood sugar levels with care and attention.** ☐ *Blood sugar measurement is not required as a part of my treatment.*	☐3	☐2	☐1	☐0
2.	**The food I choose to eat makes it easy to achieve optimal blood sugar levels.**	☐3	☐2	☐1	☐0
3.	**I keep all doctors' appointments recommended for my diabetes treatment.**	☐3	☐2	☐1	☐0
4.	**I take my diabetes medication (e. g. insulin, tablets) as prescribed.** ☐ *Diabetes medication / insulin is not required as a part of my treatment.*	☐3	☐2	☐1	☐0
5.	**Occasionally I eat lots of sweets or other foods rich in carbohydrates.**	☐3	☐2	☐1	☐0
6.	**I record my blood sugar levels regularly (or analyze the value chart with my blood glucose meter).** ☐ *Blood sugar measurement is not required as a part of my treatment.*	☐3	☐2	☐1	☐0
7.	**I tend to avoid diabetes-related doctors' appointments.**	☐3	☐2	☐1	☐0
8.	**I do regular physical activity to achieve optimal blood sugar levels.**	☐3	☐2	☐1	☐0
9.	**I strictly follow the dietary recommendations given by my doctor or diabetes specialist.**	☐3	☐2	☐1	☐0

10.	**I do not check my blood sugar levels frequently enough as would be required for achieving good blood glucose control.** ☐ *Blood sugar measurement is not required as a part of my treatment.*	☐3	☐2	☐1	☐0
11.	**I avoid physical activity, although it would improve my diabetes.**	☐3	☐2	☐1	☐0
12.	**I tend to forget to take or skip my diabetes medication (e. g. insulin, tablets).** ☐ *Diabetes medication / insulin is not required as a part of my treatment.*	☐3	☐2	☐1	☐0
13.	**Sometimes I have real 'food binges' (not triggered by hypoglycaemia).**	☐3	☐2	☐1	☐0
14.	**Regarding my diabetes care, I should see my medical practitioner(s) more often.**	☐3	☐2	☐1	☐0
15.	**I tend to skip planned physical activity.**	☐3	☐2	☐1	☐0
16.	**My diabetes self-care is poor.**	☐3	☐2	☐1	☐0

(Schmitt et al., 2013)

Appendix H: Written Permission

AW: Permission to use tool
Schmitt Andreas <schmitt@diabetes-zentrum.de> Stephanie Hills;
Dear Miss Hills,

thank you for your kind request. I appreciate your interest in the questionnaire and feel glad that if I can help you with your PhD research this way. You may of course use the DSMQ for your work. If I can help you with any problem or question please don't hesitate to ask.

Kind regards from Germany,
Andreas Schmitt

Andreas Schmitt, Dipl.-Psychologe

FIDAM
Forschungsinstitut der Diabetes Akademie Bad Mergentheim e.V.
Theodor-Klotzbücher-Str. 12
97980 Bad Mergentheim

Tel.: 07931/594411
Fax: 07931/5613839
Email: schmitt@diabetes-zentrum.de
Website: http://www.diabetes-zentrum.de

Von: Stephanie Hills [mailto:shills@patriots.uttyler.edu]
Gesendet: Montag, 7. Oktober 2013 17:05
An: Schmitt Andreas
Betreff: Permission to use tool

Andreas Schmitt:

I am seeking your permission to use the The Diabetes Self-Management Questionnaire (DSMQ) in my dissertation research. I believe your tool is a great fit for my study evaluating the affects of a tool to provide diabetic education on self-management behaviors. I would ensure that you are credited with the devopment of the tool and cited in the article.

Sincerely,

Stephanie Hills, RN, MSN, Phd(c)

Appendix I: Demographic Survey

Date: _____ Time of Interview: _____

Interviewer: Stephanie Hills

Participant:

Age (in years): _____

Gender: Male or Female

Race/Ethnicity: White AA Hispanic A/PI AI/AN Other _____

Hispanic / Non-Hispanic

Highest level of education: High school
Some College
College Graduate
Graduate School

What is your current marital status? Divorced
Married
Never married/single
Widow
Significant Other
Would rather not say

How long have you been diagnosed with diabetes?

< 1 year

1-3 years

3-5 years

>5 years

Appendix J: Foot Self-Care Text Messages

If the patient response on the FCBS is insufficient for any of these questions:	*The below targeted text messages will be sent:*
1. Taking special foot care due to diabetes? 2. Daily inspection of the feet to control for the presence of ulcers? 3. Daily washing of the feet? 4. Not walking barefoot? 5. Adequate fitting of the shoes? 6. Visiting the doctor for wound care? 7. Special shoe demands? 8. Care of the feet? 9. Daily washing of the feet? 10. The use of oil for the skin? 11. Examining the feet for wounds daily? 12. The use of a mirror for inspection? 13. Foot inspection by others? 14. Not to walk barefoot? 15. Inspection of the shoes? 16. Wearing seamless stockings? 17. Condition of nails 18. Condition of skin 19. Stockings 20. Fitting of stockings 21. Inside of shoes 22. Fitting of shoes 23. Shoe counter 24. Sole 25. Pressure distributing inlay 26. Pressure of rocker bottom	Look at your feet every day to check for cuts, sores, blisters, redness, calluses, or other problems. If you cannot bend over or pull your feet up to check them, use a mirror. Wash your feet in warm water every day. Dry your feet well, especially between your toes. If your skin is dry, rub lotion on your feet after you wash and dry them. Do not put lotion between your toes. Wash your feet in warm water every day. Make sure the water is not too hot by testing the temperature with your elbow. If you cannot see well, ask someone else to check your feet. Cut your toenails once a week or when needed. Cut toenails when they are soft from washing. Cut them to the shape of the toe and not too short. File the edges with an emery board. Always wear slippers or shoes to protect your feet from injuries. Always wear socks or stockings to avoid blisters. Do not wear socks or knee-high stockings that are too tight below your knee. Wear shoes that fit well. Shop for shoes at the end of the day when your feet are bigger. Break in shoes slowly. Wear them 1 to 2 hours each day for the first few weeks. Before putting your shoes on, feel the insides to make sure they have no sharp edges or objects that might injure your feet.