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A Scholarly Project  
Submitted to the  
Faculty of Liberty University  
In partial fulfillment of  
The requirements for the degree  
Of Doctor of Nursing Practice  
By  
Patricia Ann Perryman  
Liberty University  
Lynchburg, VA  
October 19, 2017

Scholarly Project Committee Approval:

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Influence of Smartphone Diabetic Messaging on HbA1c

Pat Perryman

Liberty University

## Abstract

Associated personal, financial, and societal costs of a diagnosis of Type 2 Diabetes Mellitus impacted over 22 million Americans at a cost of over \$245 billion in 2012. The project provided evidence-based outcomes that demonstrated improved HbA1c levels in the intervention group and positive feedback on diabetes related text messages. Ongoing opportunities are available to expand text messaging within the physician network; the potential for replication studies; and the feasibility and effectiveness of text messaging for improving engagement in managing people with T2DM health are also findings within the study.



## Acknowledgement Page

There are so many wonderful people to thank who facilitated this incredible journey. First and foremost, I praise Jesus, my Lord, and Savior. The presence, grace, power, and love of God are the gifts He bestowed upon me through the challenges, frustrations, and triumph of this degree. I especially want to thank my husband, Van, who without his constant encouragement, focus, and love this journey would not have even begun.

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## Influence of Smartphone Diabetic Messaging on HbA1c

The complications from Type 2 diabetes mellitus (T2DM), are devastating. The cost of diabetes care alone consumes 10% of the total health care expenditures. This expenditure is an approximate \$245 billion for 2012 (Yeaw et al., 2014). The expanded cost of healthcare was estimated to be 17.9% of the 2011 gross domestic product (American Health Drug Benefits, 2013). The current estimates of people affected with diabetes (22.3 million or one in nine) are expected to significantly increase to “one in three by 2050” (Yeaw et al., 2014, p. 220). The personal costs to patients and their families are devastating, as well, through complications such as renal failure, hypertension, blindness, and amputations (Hunt, Sanderson, & Ellison, 2014). The doctorally prepared nurse (DNP) provides analysis, facilitation, interprofessional collaboration, and leadership to various populations thus improving outcome measures (AACN 2006). The DNP utilizes their influence and knowledge as an advance practice nurse to initiate timely diabetes specific educational interventions.

### **Background**

The personal, business, and economic costs of T2DM complications are substantial and increasing. Patients with co-morbid conditions are at significantly higher risks of complications and increasing costs. Glycemic control delays or neutralizes the detrimental effects to the patient’s overall health and individual organ systems (Yeaw et al., 2014). Type 2 diabetes, as with other chronic health conditions, require consistency in management and interactions with the patients and providers (Graffigna, Barello, Bonanomi, & Menichetti, 2015). Diabetes self-management is instrumental in successful disease control. Sporadic or poor medication adherence is a barrier to maximizing the best outcomes. Inconsistent behavioral changes, nonadherence, and inconsistent lifestyle modifications add to the barriers to attaining the best

glycemic outcomes (Abughosh et al., 2016). Studies (Dodson et al., 2016, Dobson et al., 2015, Quinn et al., 2016, Waki et al., 2016) demonstrated patients with T2DM with a higher knowledge of their disease and self-management demonstrated improved health outcomes.

Indirect costs added to the impact of non-adherence or poor control. Factors affecting the indirect costs included reduced productivity, the inability to work, chronic absenteeism, and decreased life span negatively affecting income generating years. The estimated indirect costs by the American Diabetes Association are \$69 billion (American Diabetes Association Press Release, 2014).

### **Problem Statement**

The increasing number of people affected by T2DM place growing burdens on the patients themselves, their providers, and the healthcare system.

### **Purpose/Aim**

The purpose of the project was to evaluate the effect of a behavior change educational intervention administered via text messaging to adult patients with T2DM to improve HbA1c after a 3-month intervention.

### **Plan Outline**

The project progression followed the general outline identified in Table 1.1 Project Objective and Goals. The plan incorporated the literature references, data validation, and DNP Essentials. Each goal established a portion of the project with identified and measurable objectives utilizing the SMART objective model (Tofade, Khandoobhai, & Leadon, 2012).

Table 1.1 Project Objective and Goals

<b>Goals</b>	<b>Objectives</b>	<b>Essentials of Doctoral Education (American Association of Colleges of Nursing [AACN], 2006)</b>
1. Collaborate with the physician management leadership to facilitate access to data and clinic personnel.	1.1 Meet with physician management group administration. 1.2 Establish contractual agreements for access to patient data, clinic and provider identification 1.3 Secure data access for analysis 1.4 Establish contact nurse at the identified Family Practice and Internal Medicine clinics	Essential II, VI (AACN 2006) (Yeaw et al., 2014) (Dobson et al., 2015)
2. Identify the intervention population for the project study.	2.1 Organize patient populations meeting specific criteria into the intervention group 2.2 Inform patients of a post participation survey in the intervention study 2.3 Develop text messaging access (gather numbers) for use in the messaging intervention	Essential III (AACN 2006) (Dobson et al., 2015) (Waki et al., 2016)
3. Construct the teaching protocol(s) for text messaging to identified patients.	3.1 Differentiate the texting protocols – medications, dietary, exercise, encouragement 3.2 Formulate timeline for responses to interventional group 3.3 Support contact nurse(s) in actions and feedback from patients in study through weekly communications	Essential IV (AACN 2006) (Dodson et al., 2016)
4. Design protocol/policy approach for identified clinic nurse(s) to provide	4.1 Categorize the messaging components into the four identified areas:	Essential I (AACN 2006) (Abughosh et al., 2016)

the text messaging based upon patient messaging criteria.	medications, dietary, exercise, encouragement	
	4.2 Develop and write specific policy and procedures for the clinic contact nurse(s) for utilization during the study	
	4.3 Obtain signatures and implement the actionable items from the policy/procedures	
5. Expand the education application into the patient's behaviors to improve their glycemic control and reduce their HbA1c.	<p>5.1 Compare and contrast the current diabetes education and the text messaging diabetes education for effectiveness</p> <p>5.2 Calculate the effectiveness of the text messaging based upon comparative HbA1c levels</p> <p>5.3 Determine opportunities to broaden the education methodology (text messaging) to more patients in the clinic system</p>	Essential VII (AACN 2006) (Nundy et al., 2014)
6. Formulate a utilization strategy of the project outcomes to educate physician management administration, the board of directors, and clinic staff to impact improve patient outcomes.	<p>6.1 Examine the data, feedback, and results to determine impact of the intervention</p> <p>6.2 Defend the study outcomes at the physician management administration, board of directors, and clinic staff</p> <p>6.3 Construct a plan to continue the interventions and/or implement in other clinics within the group</p> <p>6.4 Decide the sustainability of the intervention through collaboration</p>	Essential II, V, VIII (AACN 2006) (Dodson et al., 2016) (Chism, 2016) (Zaccagnini & White, 2014) (Brownson, Colditz, & Proctor, 2014)

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with the group  
administration  
6.5 Determine further  
opportunities to  
disseminate the outcomes  
to outside entities

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### **Clinical Question**

The PICOT statement included the patient population/pilot area, problem, intervention, comparison, and timeline. A PICOT statement for the project: does timely nurse initiated text message education interventions improve glycemic control through improved levels of the HbA1c measurement in the month following the conclusion of the study compared to the pre-intervention level?

### **Literature Synthesis**

A comprehensive literature review identified strong and sufficient research articles. The database searches utilized ProQuest, CINAL, and EBSCO host. Over 95 articles were reviewed. There were 44 core articles that met the synthesis criteria. The date range of the articles were 2012 or newer except for professional standards material. A literature matrix is in Appendix D. The Essentials of Doctoral Education for Advanced Nursing Practice and program textbooks were also utilized (AACN, 2006).

### **Literature Review and Criteria**

The identified core articles were reviewed and evidence levels assigned. The date delimitations were set at 5 years or less to embrace the latest research on digital patient engagement except for seminal articles or textbooks (Roush, 2015). Fourteen articles were identified utilizing similar project parameters and found a decrease in HbA1c levels in the studies. Three study articles identified neutral changes in lab work levels. All seventeen of these



HbA1c studies reviewed identified specific timed interventions. Articles acknowledging self-efficacy included a total of seventeen with eleven articles specific to Bandura's theory. Five of the articles included both improved HbA1c and self-efficacy variables.

The Melnyk Levels of Evidence was used to determine the article levels. Evidence levels ranged from 1 through 7. The literature review aligned into three predominate categories. Reduced HbA1c results, neutral or no change in HbA1c results, and self-efficacy were the categories. Holcomb (2015) provided an integrated review of studies similar in focus and intent. The synthesis identified best results as weekly interaction and 3-month duration (Holcomb, 2015). Several articles (Dodson et al., 2016, Dobson et al., 2015, Hunt et al., 2014, Nundy et al., 2014, Quinn et al., 2016) identified controlled trials utilizing mobile phones, diabetic messaging, and HbA1c measurements and demonstrated improved lab levels. Two DNP projects were identified measuring the self-efficacy aspect of diabetes self-management. One study utilized a log book and have no change in HbA1c levels but significant perceived improvement in self-efficacy (Sutton, 2015). A second DNP project utilized a smartphone app to measure self-efficacy and HbA1c levels. The study was small but measured both variable scores of HbA1c reduction and higher self-efficacy improved (Schaub & Moffett, 2017). The literature review included systematic reviews, randomized controlled trials, DNP projects, and expert opinions. The project utilized Melnyk Levels of Evidence for articles as indicated in the Chart 1.1 Levels of Evidence for Project Literature Reference. Previous studies provided the direction of the project development by establishing the evidence of digital engagement and self-efficacy development. There were consistent results referring to the need for further studies.

Chart 1.1 Levels of Evidence for Project Literature Reference

Numeric Level	Evidence Category	Number of articles for project
1	Systematic Review & meta-analysis of randomized controlled guidelines	7
2	One or more randomized controlled trials	4
3	Controlled trial (no randomization)	6
4	Case-control or cohort study	5
5	Systematic review of descriptive & qualitative studies	6
6	Single descriptive or qualitative study	1
7	Expert opinion	15

### Key Words

The focus of the literature search terminology guided the selection of articles to be used in the project. Key words included: diabetes, Type 2 diabetes mellitus, smartphone, text messaging, mHealth, short message service (SMS), behavioral intervention, and vulnerable population.

An interesting finding was the increasing use of mHealth as a term in the most recent articles. The terminology of digital engagement, virtual care, and digital participation was additional terminology being used in the literature regarding the use of smartphones and wearable health devices. The mHealth terminology, digital engagement, and wearable health devices identify areas specific to population health with digital communication and were used in the majority of studies.

### Theoretical and Conceptual Frameworks

It was vital for a scholarly project to be structured on sound principles and frameworks. A conceptual model supported the logistical scientific underpinnings of the project. It was based on standards that withstand validation rigor. The doctoral level outcomes met professional

expectations and essential standards (AACN, 2006). The project as with all doctoral projects reflected the professional level of effective, substantial, and replicable frameworks. It was fundamental and essential to the purposes of scholarly recognition (Bonnel & Smith, 2014). A theoretical framework for the project that promotes the patient's self-efficacy was identified. The patient's engagement in self-efficacy or healthy behavioral changes provided the direction and structure necessary for enhanced regime adherence (Hunt et al., 2014).

The project presented the critical overarching theoretical expectations of advanced professional practice. It provided guidance and direction to the application of the outcomes in the focused area. The theoretical component furnished the relational aspect of the project's importance in advancing the nursing field (Moran, Burson, & Conrad, 2014).

### **Conceptual Model – IOWA Model**

The IOWA model was utilized in the scholarly project. The format aligned with an evidence-based project. It was a vetted tool. Permission for use in the project was approved and is located in Appendix A. The practice management administration, medical director, key stakeholders, and patients were included in the identification of the project intervention(s). The triggering focus identified by the practice management leadership was improving adherence to behavior changes to lower HbA1c. The 2017 strategic goals included quality improvement initiatives. PPN's Clinical Services department served as the point of contact and were active in participating as an accountable care organization (ACO). As an ACO, clinical services identified specific quality metric levels to achieve in order to maximize care improvement outcomes.

The process component of the project embraced the logistical procedures including the text messaging, identification of glycemic control measures, data access, and staff engagement. Analysis and synthesis of the outcomes finalized the IOWA model of outcomes. The validity of

the project performance and outcome attainment determined the authenticity of following the conceptual principles. The conceptual model provided the potential for ongoing sustainability and replication into other clinics.

A continuous struggle between proficiency of practice through repetition and the demand for constant change to assure improvement was an incessant challenge. The doctorally prepared nurses (DNP), consistently have met the ability and skill set to design care models that embrace scientific foundations, quality standards, and relational competencies to impact patient care. In a recent study involving Sister Callista Roy, many nurse-designed models established several shared areas that validate the use of conceptual contexts such as holistic approach, community focused, or relationship based care (Mason, Jones, Roy, Sullivan, & Wood, 2015). Innovation into nursing care was a mandate for the DNP to acquire.

The Institute of Healthcare Improvement (IHI) provided courses that identify, support, and advanced quality of care. The Patient Safety section provided PS104 – Teamwork and Communication in a Culture of Safety. It identified the necessary environment to provide an innovative improvement of patient care. Core overarching sections included psychological safety, open communication, and respect. These included active leadership, transparency, and fairness. It was important for the DNP to accurately assess the culture of the organization for change readiness (Institute for Healthcare Improvement, 2015, PS104).

As Table 1.1 identified, collaborative identification of digital goals, communication strategy, and clinic availability were essential to the project process. It involved active leadership to articulate and clarify the goals. The communication strategy afforded a solid platform of transparency. Fairness in balancing the work impact was essential for clinic staff and clinical

services department. Ease of engagement was important for patients to accomplish their goal attainment.

### **Theoretical Framework**

The scholarly project engaged the use of digital messaging to patients with T2DM to facilitate positive behavior changes to improve HbA1c levels. A middle-range theory generated guidance at the juncture of practice and research based projects (Smith & Liehr, 2014). Diabetes and its critical need for improved outcomes has potentially a global reach

The Theory of Self-Efficacy originating with Bandura was chosen. The Theory of Self-Efficacy identified actions and interventions that positively influenced patient behaviors. The studies by Alvarez, Smith, and Wu embraced the self-efficacy theory in successful health behavioral changes, improved perceptions of health, and patient outcomes (Alvarez, 2015) (Smith, Men, & Al-Sinan, 2015) (Wu et al., 2013) (Verevkina, Shi, Fuentes-Caceres, & Scanlon, 2014). Utilization of the Theory of Self-Efficacy directed and solidified steps of the messaging protocols. The theory incorporated a social cognitive theory based on person-behavior-environment interaction.

Within the theory were two components: self-efficacy and outcome expectations. The individual patient's judgment weighed significantly in the perceived value of the messaged intervention. The challenge was the perceived value which may or may not be strong enough to change a behavior. The original self-efficacy theory identified informational sources including enactive attainment or the ability to successfully master an activity, vicarious experience or witnessing the success of others, and a sense of autonomy or locus of control (Smith, Men, & Al-Sinan, 2015).

Application of the theory incorporated digital technology in the form of text messaging during specific times. Verbiage for text messages was reviewed by the DNP student, preceptor, and Clinical Services Director. The specifically approved verbiage was then used to potentially trigger the successful ability to change behaviors. The verbal dialog was replaced by the text messaging from the clinic nurse to the patients. Feedback was obtained from timed interactive responses and a personalized short survey was sent to the perceived assistance in adherence to positive behaviors. The patient was in their environment with distance communication via technology. The transparency of communication to the patient in acting on the messaging was incorporated and supported with the available feedback loop to the provider. Guidelines of expected actions to the text messages were included in the initial orientation with the identified intervention population.

The theory's behavioral focus provided the foundational direction to support the conceptual principles. The theory's history of use in studies of patients with diabetes demonstrated improvements following interventions (Alvarez, 2015) (Wu et al., 2013). Articulate and focused messaging increased self-efficacy and professed support from the provider (Alvarez, 2015) (Dobson et al., 2015) (Wu et al., 2013).

Literature reviews provided summaries of diabetes studies regarding motivations and dynamics to influence behavioral changes that improved glucose control and delayed complications. Eisenstat et al. (2012) identified core mechanisms that integrated support systems to improve care outcomes. One major mechanism recognized enhancement of self-management skills as pivotal to positive outcomes (Eisenstat, Ulman, Siegal, & Carlson, 2012). Waki et al. (2016) implemented a small study utilizing smartphones and text messaging to improve self-

management of diabetes. Initially, the study showed very positive results but larger studies are needed to be initiated to validate the findings (Waki et al., 2016).

### **Alignment of Concepts and Theory Components**

The alignment between the concepts and theory components were congruent with the goals and expectations of the project. Each supported the fundamental application of texting interventions. The structure supported the acquisition of administrative and provider support for the approval, access, and expectations of the people-behavior-environment triad of the self-efficacy theory (Smith & Liehr, 2014). The process included how the messages were articulated, how often, and collaborative efforts of the healthcare providers. This process support allowed the overarching ability to provide vicarious experiences and proper influential persuasion. The process construction offered the theory's enactive attainment ability to successfully master an activity. The final alignment was when outcomes met the feedback of the providers and patients. The anticipated behavior change was supported the physiological feedback of the survey results. The concepts and theory aligned with the Essentials of Doctoral Education for Advance Nursing Practice (AACN 2006, 2006). Table 1.2 Alignment of Concepts and Theory demonstrated the parallel walk of the conceptual IOWA model of and the Theory of Self-Efficacy to the DNP Essentials.

Table 1.2 Alignment of Concepts and Theory

<b>IOWA Conceptual Framework</b>	<b>Theory of Self-Efficacy</b>	<b>DNP Essentials*</b>
		<i>(*Not all inclusive)</i>
Problem Focused Triggers: Risk Management data, ACO quality metrics  Identification of clinical problem	Sense of autonomy: Audience: administrators, providers, patients	Essential III – Clinical Scholarship and Analytical Methods for Evidence-Based Practice Essential VI – Interprofessional Collaboration for Improving Patient and Population Health Outcomes
Research validation  Critique and evaluation of literature	Vicarious experiences Enactive attainment Audience: patients, providers	Essential I – Scientific Underpinnings for Practice Essential IV – Information Systems/Technology and Patient Care Technologies for the Improvement and Transformation of Health Care
Select, design, implement, and evaluate intervention and outcome measures	Intervention feedback Physiological feedback Audience: providers, administrators, DNP student	Essential VIII – Advanced Nursing Practice

(AACN, 2006); (Moran et al., 2014); (Smith & Liehr, 2014)

Multiple models of conceptual, quality improvement, theoretical foundations, and research were reviewed and summarized to identify the ideal alignment for the project. These included the evidence based IOWA model and the Theory of Self-Efficacy. Both models complemented and supported the DNP Essentials.

### **Methodology**

The project objectives identified focused and measurable outcomes that supported and validated the intent of the intervention. Within the methodology, the objectives, participants, environment, tools regarding the phenomenon of interest, criteria of the intervention, and the data collection process were identified. A cohort study format was used for the patients meeting the inclusion criteria with the addition of a structured intervention.



## Objectives

At completion, the project provided evidence-based outcomes that demonstrated:

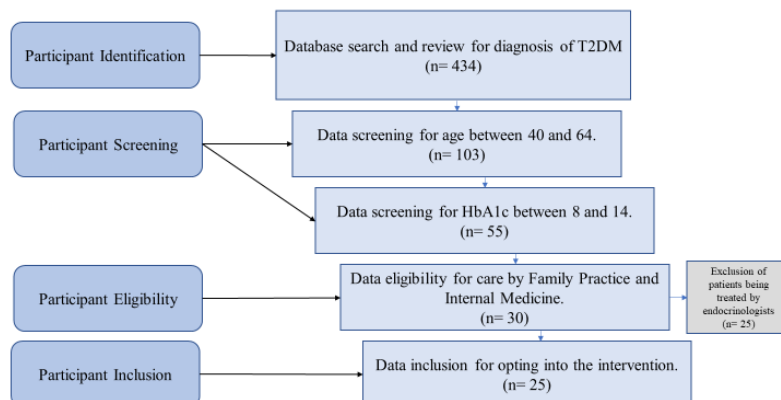
- Improved patient HbA1c levels in the intervention group
  - a statistically non-significant improvement in between pre- and post-intervention HbA1c
- Positive feedback on diabetes related text messaging by the patients
  - 24% return on individual survey measures; all positive feedback
- Opportunities to expand text messaging within the physician network
  - roll-out messaging to all clinics in the group; additional projects in the planning stages
- Potential for replication studies
  - A presentation of findings to was provided to administration, board of directors
- Feasibility and effectiveness of text messaging for improving members' engagement in managing their health
  - establish guidelines to facilitate expanded use of messaging; new policies were developed

## Cohort Identification

The initial review of cohort criteria began with the selection of an ICD-10 code of E11 for Type 2 diabetes. This step yielded 434 patient names in the PPN database. The next criterion within the narrowed database was the age range of 40 to 64 years of age. The identified cohort was narrowed down to 103 participants. The next criterion was to narrow the HbA1c between 8.0 and 14.0. This narrowed the selection population to 55 names. It was noted in the database there were several HbA1c levels above the 14.0 project ceiling. Levels as high as 19 were noted.

A phone screening, completed by the DNP student, to participate was accomplished per approved script. This yielded 30 participants that met the project inclusion criteria. The flow diagram, Diagram 1.1 Inclusion Determination, identifies the process flow for cohort identification. There were 25 potential participants under the care of an endocrinologist and certified diabetic educator. This sub-set was excluded from the study.

Diagram 1.1 Inclusion Determination



## Environment

The setting for the project was a managed physician group of family practice and internal medicine clinics. Third party payer information on HbA1c and blood pressure measurements were provided. Data mining was necessary to analyze lab results prior to intervention and for comparable post-intervention results. The inclusion data included a very specific patient population. It included persons with Type 2 diabetes mellitus. The age range was 40-64 years of age. Patient HbA1c levels included in the study ranged from 8.0 to 14.0. The narrow inclusion criteria, short study timeline, and singular scope of text messaging/survey limited the interpretation of a board scope of treatment influence. Exclusion criteria for the study were not measured. The exclusion variables were the influences of gender, ethnicities, religion, or cultural background aspects.

Initial meetings with management group administration and physician preceptor established their priorities in the project. Two physician practice specialties (Family Practice and Internal Medicine) were used for the text messaging project. Quality metrics of HbA1c testing and control were the focus of the administration. The PPN's Accountability Organizations third

party payer partners (ACO) data were utilized to identify the study cohort. The management administration prioritized improvement in HbA1c as one of their strategic 2017 care goals. Advancing the positive results of the project benefited the local and area clinic goals with the potential to broaden into an efficient and effective healthcare model (Sprey, 2015).

### **Tools**

The project was approved by the Liberty University Institutional Review Board (IRB) (Appendix B). The IRB identified the project as an evidence-based practice project. The project was not considered as a human subject research activity. Approval for the project was also secured through the PPN executive team. The support letter from the Chief Executive Officer was an important aspect in the collaboration and database access (Appendix E).

The IOWA model flow chart was utilized as a tool to establish priorities and structure for the information accumulated during the evidence-based study (White & Spruce, 2015). A survey tool was developed to utilize to measure patient satisfaction feedback. The eight-question survey measures the patients' satisfaction with specific points of the text messaging diabetic intervention (Appendix C). A similar survey tool was used in a large study to measure patient satisfaction after a text messaging pilot for diabetes and pregnancy (Regence, 2014). Results of the survey questions facilitated the opportunity for communication and education to physicians and clinic staff. The messaging vendor distributed the patient satisfaction tool and provided results following the study.

### **Intervention**

The managed physician group previously contracted with a local communication firm to send text messages out on annual wellness checks such as mammograms, lab work, and colonoscopies earlier in the year. Several meetings with the DNP student and the Clinical

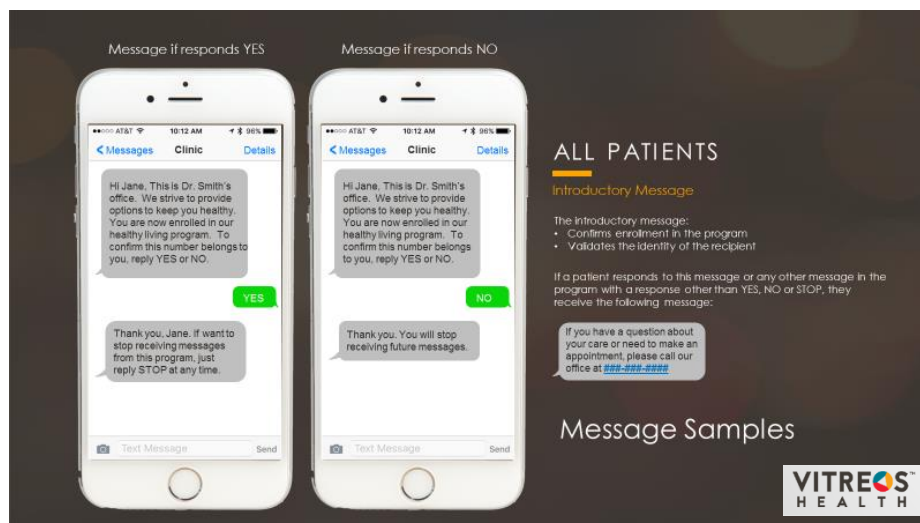
Services Director were held to determine message focus, timelines, verbiage and roll out date. Messages had a fixed static component and some with a fixed interactive option. Planning collaboration between the administration, communication firm, and the DNP student identified the optimum timelines for messaging, the verbiage of the messaging, and measurements of the HbA1c at a specific office visit. Final sequencing of messaging was determined by the DNP student upon approval of the project. PPN clinical services staff notified the Family Practice and Internal Medicine clinics of the names identified for the project and requested that treatment modalities not be adjusted during the 3-month study. The communication included that if a delay may have detrimental effects on the patient outcomes, treatment must be adjusted. Table 1.3 Intervention Steps delineated the primary steps for the intervention. The table identified major components with an understanding of multiple logistical steps within those listed.

Table 1.3 Intervention Steps

<b>Intervention Step</b>	<b>Responsible Party</b>	<b>Description</b>	<b>Rationale</b>
Administration Stakeholder meeting; secure approval of project with management group and Liberty School of Nursing	DNP student, Director of Clinical Services, CEO, Medical Director (preceptor)	Establish collaborative project goals, outcomes, access, and presentation of project	Attainment of DNP essentials is critical in meeting professional growth and influence. (AACN 2006, 2006)
Identify physician/clinic to participate in the project	DNP student and medical director  Physician and staff of the identified clinic	Physician clinic with identified patients with diabetes.	Participating physician clinic identification is critical to have continuity and consistency in messaging. (West, 2012)
Secure the patient cohort meeting the criteria	Patient Care Coordinator (PCC), clinic staff, patients, and DNP student	Patients willing to participate in the messaging intervention. Approval forms signed. Phone orientation to the project format and messaging access.	The inclusion of specific clinical criteria will be used to identify the cohort characteristics for the study. (Moran, Burson, & Conrad, 2014)
Secure patient approval and project criteria for access to smartphone numbers	PCC Communication company	Communicate through PCC to patient cohort  Secure texting capabilities, acquisition of smartphone numbers	One of the primary ethical requirement is informed consent. Respect of persons must be maintained and voluntary participation assured. (Mateo & Foreman, 2014)
Develop and implement text messaging criteria with the communication company, medical director, and director of clinical services	Physician PCC Medical Director Communication company	Collaborate with physician, medical director, and PCC what messaging content and timeline	Specific automated text messaging can support diabetes self- management. (Dodson et al., 2016)

Utilize patient care coordinator (PCC) to secure survey dissemination to participants at the end of the project timeline	PCC Patients	Use survey tool through a web link or phone survey	Empirical data analysis can identify specific areas of intervention success. (Wu et al., 2013)
Physician clinic order HbA1c at the end of the project measuring period	Physician clinic PCC		Lab monitoring criteria support frequent testing to measure diabetes self-management and risks for complications. (Brunisholz et al., 2014)
Project outcomes to be presented and information disseminated	Administration Medical director Board of Directors Clinical services staff	Formal presentations will be given to leadership  Training and in-services will be given to PCCs and clinic personnel	Improved patient outcomes and increased efficiencies of costs need to be disseminated and implemented. (Brownson, Colditz, & Proctor, 2014)

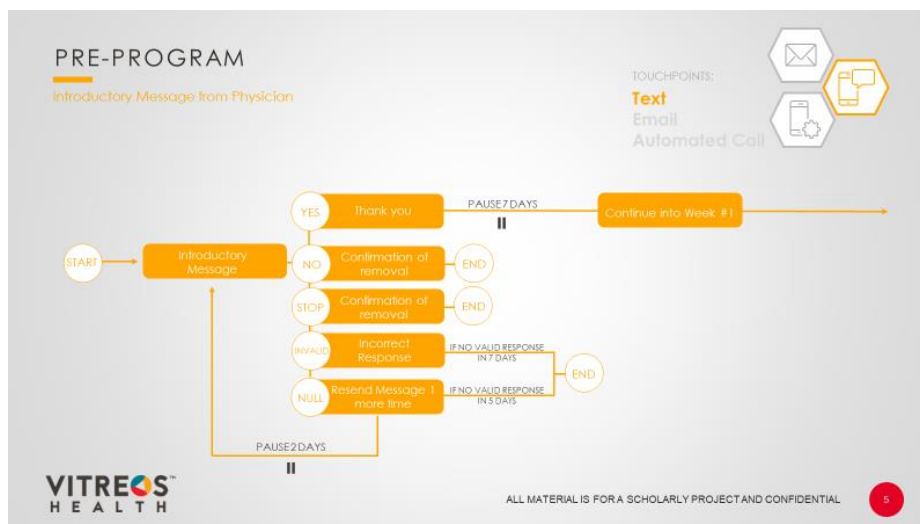
**Example of Text Messaging:**



The vendor provided the capability to verify ability to receive SMS messages and send digital reports of the messaging to be included in the medical records of the patients engaged in the project. The messaging was included through the communication (secured email) directly to the physician as well as the patient record. Copies of the email were either merged into an electronic health record or printed to be included in the hardcopy file by individual clinic staff.



## Messaging Flow Example



## Data Collection

Initial data collection was used to identify the patient population to be used in the project. The most current ACO quality metrics reports provided the specific source for patient criteria. It was used to identify patients with diabetes meeting the project criteria. A preliminary patient group was secured. After permission was attained, the remaining cohort group participated in messaging time sequences (Nundy et al., 2014), (Dobson et al., 2015). A secured spreadsheet contained the patient information criteria. Pre- and post-intervention HbA1c values were entered into a password protected spreadsheet. The spreadsheet was housed in a password protected data storage area within the administration IT department encrypted server. Comparison between the HbA1c values was completed and reviewed.

## Evaluation and Analysis

### Evaluation

Descriptive statistics for continuous variables were used to analyze the HbA1c results. Graphs were used to display the changes of HbA1c (Sullivan, 2012, Chapter 4). The patient lab results, participation percentage, and survey measurements were included in the project analysis.

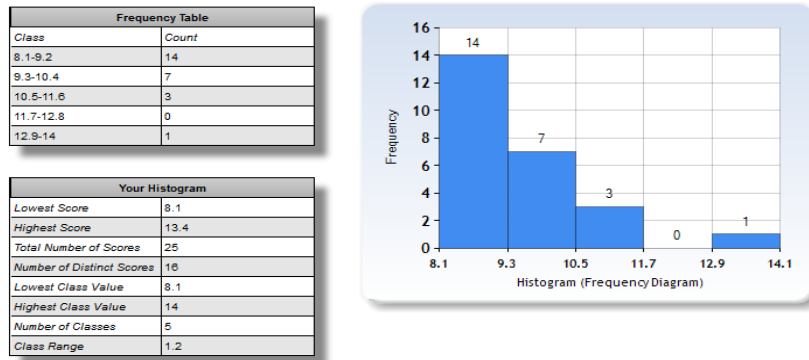
## **Analysis**

An initial group of 30 people with T2DM were identified that met the inclusion criteria. Three people declined participation in the project in the telephone contact phase. Two additional people opted out through the digital contact. The remaining 25 participants received a short message service (SMS) on Tuesdays at 10:00 AM. The SMS texts included static and interactive messages. An eight-question participant satisfaction survey was delivered in the last week of the 12-week project.

## **Lab Results**

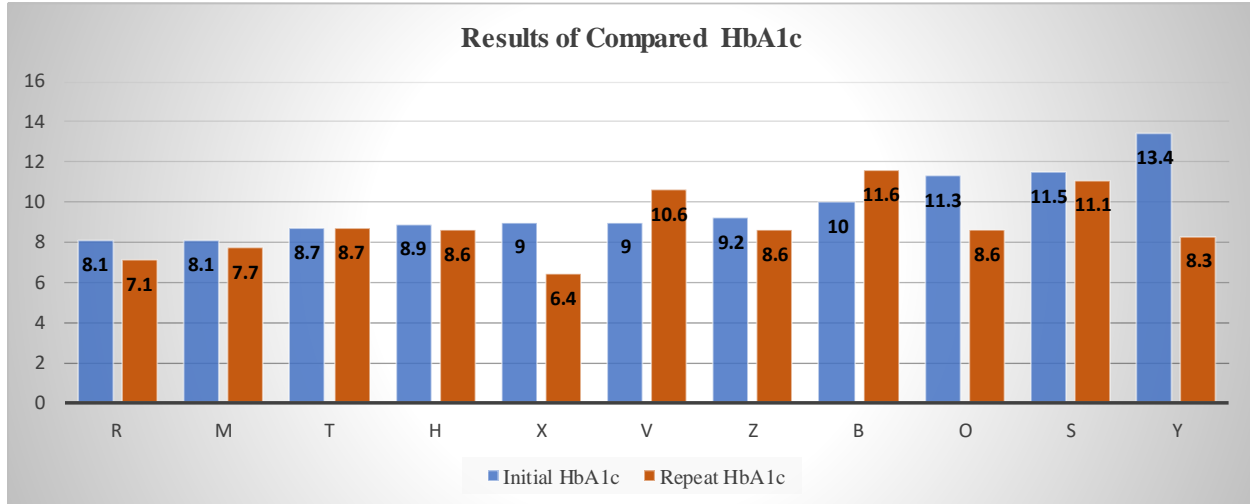
The data was analyzed from the cohort's HbA1c at the end of the study period. Comparison of HbA1c results from the ACO data set prior to the start of the messaging intervention and the HbA1c collected in the month after the messaging timeline revealed project results. The anticipated outcomes revealed non-significant improvement by certain individual patients. The initial median HbA1c level was 9 with a repeat HbA1c level of 8.6. Chart 1.2 Initial HbA1c Range demonstrated the majority of the cohort's HbA1c results ranged between 8 and 10.5. One participant had an initial HbA1c of 13.4. The significance of the histogram results were the opportunities to continue decreasing the HbA1c in the 8 to 9 range group to within the established quality metrics.

Chart 1.2 Initial HbA1c Range



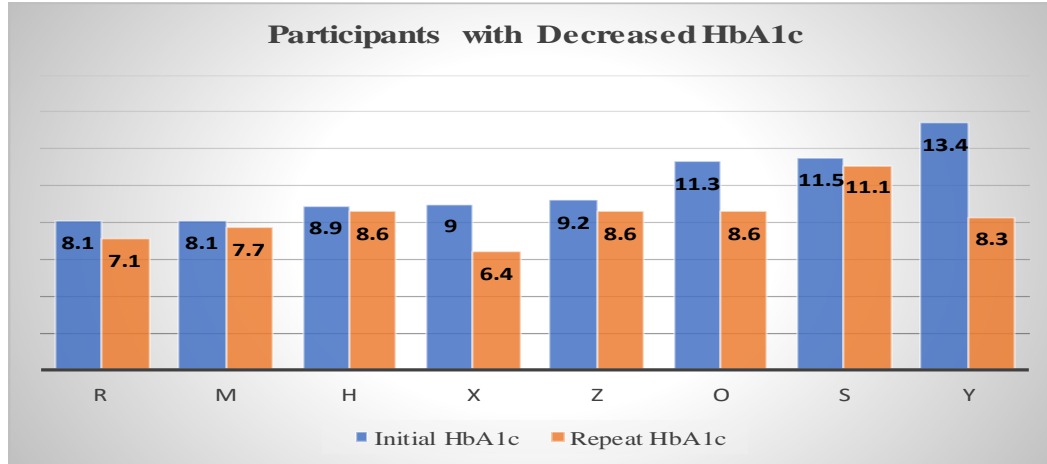
There was a 44% (11 of 25) lab result return. The participant results available demonstrated 72% (8 of 11) decreased their HbA1c. Two of the participants had an increase in HbA1c levels. Follow up phone calls with the participants by the PCCs identified personal issues during the intervention period. The two participants with an increase were contacted by the PCC per protocol. The PCC received information of a family emergency in one case and confusion regarding a medication refill on the second who was then referred to their provider. One participant had no change in their results.

Chart 1.3 Results of Compared HbA1c



The participants with a decrease in HbA1c results averaged over the 4% objective criterion. The overall average of participants with a decreased HbA1c demonstrated a small decrease. Chart 1.4 Participants with decreased HbA1c identifies the comparison of pre-and post-text messaging results. The average of all participants with both initial and repeat HbA1c results continued to present with an overall decrease from 9.8 down to 8.87.

Chart 1.4 Participants with Decreased HbA1c



### Statistical Analysis

A repeated-measures t-test was used to answer the clinical questions. The first check was for the assumption of normality for each distribution using skewness and kurtosis statistics. The Chart 1.5 Descriptive Statistics identified the analysis of the initial and repeat HbA1c levels.

Chart 1.5 Descriptive Statistics

Descriptive Statistics							
	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
InitialA1 c	11	9.7455	1.65974	1.239	.661	.925	1.279
RepeatA1 c	11	8.8455	1.63056	.454	.661	-.542	1.279
Valid N (listwise)	11						

Because both skewness and kurtosis statistics for each distribution was less than an absolute value of 2.0, the assumption was they were normally distributed. The next step identified in the Chart 1.6 Paired Samples Test analysis included the use of the repeated-measures t-test.

Chart 1.6 Paired Samples Test

<b>Paired Samples Test</b>				
		t	df	Sig. (2-tailed)
Pair 1	InitialA1c - RepeatA1c	1.530	10	.157

There was a non-significant decrease in A1c from initial to repeat,  $p = .16$ . The means and standard deviations for this analysis were developed and identified in the Table 1.4 Paired Samples Statistics table.

Table 1.4 Paired Samples Statistics

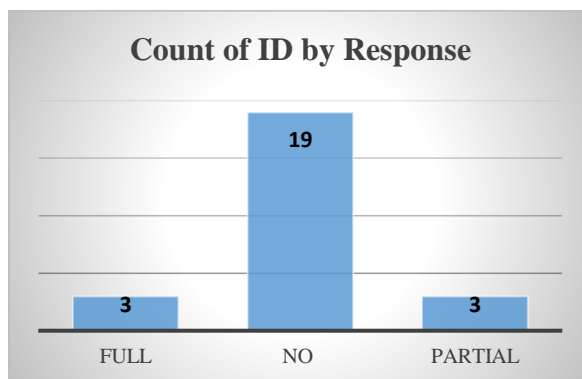
<b>Paired Samples Statistics</b>			
		Mean	Std. Deviation
Pair 1	InitialA1c	9.75	1.66
	RepeatA1c	8.85	1.63

### **Survey Results**

Survey participation definitions were full, partial, and no participation in the survey. The survey answers were summarized and reviewed with the expectation of positive feedback with “satisfied” to “very satisfied” above 60% per question. The completed surveys in both the full and partial groups were completed with 100% positive responses for “information was valuable to me”. The subsequent results did not yield the participation rate anticipated. The percentages of full (3) and partial (3) survey participation were 12% in each measurement. No participation resulted in 76% of overall survey engagement. Significant findings of improved satisfaction could not be found in the low rate of return. Table 1.5 Participation by ID Response illustrates the participation in the survey at the end of the intervention study.



Table 1.5 by ID Response



### Summary of Data

The overall project objectives were met with the anticipated outcomes. Participation was lower than preferred but constant through the intervention phase. Survey results were low but consistent with typical return rates. The small study demonstrated improved HbA1c levels in 72% (8 of 11) of the cohort. Survey results were very positive in the questions answered. The scholarly project findings aligned with previous studies.

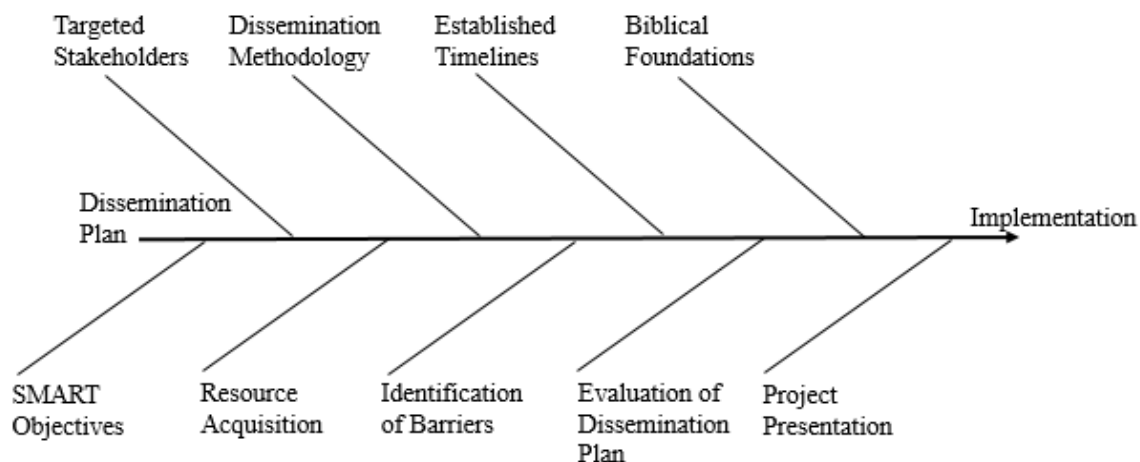
Follow up phone calls after completion of the project, per PPN protocol, yielded feedback that three of the participants with decreased HbA1c levels did not have a medication change and followed the educational recommendations. The remaining four participants with a decreased HbA1c had medication changes at the beginning of the project timeline. The remaining participant was not available to respond to their follow up. The contacted participants agreed the educational text messages were beneficial.

A broad range of opportunities presented themselves during discussions with the PPN leadership in future engagement initiatives. Detailed follow through with the current cohort are planned from the interactive data trending. Further educational text projects are planned for other chronic health conditions.

## **Dissemination**

The dissemination of the project embraced several components and an established timeline. The plan engaged key targeted stakeholders. It utilized a specific methodology through a systematic approach. Discussions with stakeholders regarding the outcomes and analysis were held (Moran, Burson, & Conrad, 2014). A presentation was given to the management administration, medical director, and board of directors. It was followed by an in-service to the physician and office staff. The propagation of the findings specifically related to diabetes teaching along with the behavioral change theory was important and was used to train the PCC staff (Jahromi, Ramezanli, & Taheri, 2015). Replication of the project in additional clinics was recommended. Diagram 1.2 Dissemination Fishbone Diagram identified key aspects of the dissemination and implementation plan. A final presentation of the project was completed at PPN to the executive leadership and preceptor.

Diagram 1.2 Dissemination Fishbone Diagram



### Conclusion

Appropriate methodologies, accurate analysis, scientific evaluation, timely and relevant dissemination structured the professional project platform. It designed the body of the project for distribution and replication. The influence of text messaging demonstrated the strong potential stimulus to improve HbA1c outcomes through digital engagement. Further studies are warranted to measure sustainable outcomes.

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## Appendices

Appendix A – IOWA Model Approval

Appendix B – IRB Documents

Appendix C – Survey Tool

Appendix D – Literature Matrix

Appendix E – Project Site Approval Letter

## Appendix A – IOWA Model Permission

Permission to Use and/or Reproduce The Iowa Model (2015) - Perryman... <https://outlook.office365.com/owa/?viewmodel=ReadMessageItem&I...>

### Permission to Use and/or Reproduce The Iowa Model (2015)

Kimberly Jordan - University of Iowa Hospitals and Clinics <noreply@qualtrics-survey.com>

Mon 2/6/2017 10:09 AM

To: Perryman, Pat <pperryman1@liberty.edu>;

#### Liberty University

You have permission, as requested today, to review/use The Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care (Iowa Model). Click the link below to open.

Copyright will be retained by The University of Iowa Hospitals and Clinics.

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#### The Iowa Model - 2015

Citation: The Iowa Model Collaborative. (In press). The Iowa Model Revised: Development and validation. Worldviews on Evidence-Based Nursing.

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## Appendix B – IRB Documents

**LIBERTY UNIVERSITY.**  
INSTITUTIONAL REVIEW BOARD

May 2, 2017

Pat Perryman  
IRB Application 2861: Influence of Smartphone Diabetic Messaging on HbA1c

Dear Pat Perryman,

The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study does not classify as human subjects research. This means you may begin your research with the data safeguarding methods mentioned in your IRB application.

Your study does not classify as human subjects research because evidence-based practice projects are considered quality improvement activities, which are not considered “research” according to 45 CFR 46.102(d).

Please note that this decision only applies to your current research application, and any changes to your protocol must be reported to the Liberty IRB for verification of continued non-human subjects research status. You may report these changes by submitting a new application to the IRB and referencing the above IRB Application number.

## Appendix C – Survey Tool

### Post-Intervention Text Messaging Survey - Perryman Project

1. The information I received in the text messages was valuable to me.
2. The ability to learn more about certain topics was valuable to me.
3. I understand my condition better after receiving these messages.
4. I appreciated receiving the messages.
5. I was able to make positive changes in the way I manage my condition because of these messages.
6. The number of messages I received was good.
7. My experience with the texts was free of technical issues
8. The program affected the way I think about <<Clinic Name/Dr. Name>>

## Appendix D – Literature Matrix

Citation	Guidelines, Reviews, and Other Literature			
	Critique: Type & Level of Evidence/ Limitations	Scope	Relevant Findings	Other
<b>Abughosh, S. M., Wang, X., Serna, O., Genges, C., Masilamani, S., Essien, E. J., ... Fleming, M. (2016). A pharmacist telephone intervention to identify adherence barriers and improve adherence among nonadherent patients with comorbid hypertension and diabetes in a Medicare Advantage Plan. <i>Journal of Managed Care &amp; Specialty Pharmacy</i>, 22(1), 63-73. Retrieved from <a href="http://www.amcp.org">www.amcp.org</a></b>	Level 5 Retrospective cohort study Enrolled in Medicare prescription plan 18-month review	N = 391 (186 had DM with HTN) 87 received phone calls Brief phone call by pharmacist Identified nonadherence to medication regimes Descriptive analysis t tests used Chi-square tests Bivariate analysis Multiple linear regression	Phone calls had significant improvement to medication adherence	Medication adherence continued to improve 6 months after the intervention
<b>Alvarez, S. (2015). Type 2 diabetes program geared toward Latinos fosters more than self-management. <i>Generations-Journal of the American Society on Aging</i>, 38(4), 41-45.</b>	Level 2 Stanford Spanish Diabetes model used	533 Spanish speaking speakers with diabetes 6-month study	Culturally grounded materials Community engagement and empowerment utilized	Funded by grant from National Institute for Nursing Research
<b>American Diabetes Association Press Release. (2014). <a href="http://www.diabetes.org/newsroom/press-releases/2014/america-gets-cooking-to-stop-diabetes-1.html">http://www.diabetes.org/newsroom/press-releases/2014/america-gets-cooking-to-stop-diabetes-1.html</a></b>	Level 7 Expert opinions and research	National research and resources	Statistics relevant to T2DM in population and fiscal impacts	
<b>American Health Drug Benefits. (2013).</b>	Level 7 Expert opinions and research	National research and resources	Statistics relevant to T2DM in	

<a href="http://www.ahdbonline.com">http://www.ahdbonline.com</a>			population and fiscal impacts	
<b>Bloss, C.S., Wineinger, N.E., Peters, M., Boeldt, D.L., Ariniello, L., Kim, J.y., Sheard, J., Komatireddy, R., Barrett, P., &amp; Topol, E. J. (2016). A prospective randomized trial examining health care utilization in individuals using multiple smartphone-enabled biosensors. <i>PeerJ</i>. <a href="http://dx.doi.org/10.7717/peerj.1554">http://dx.doi.org/10.7717/peerj.1554</a></b>	Level 1 Prospective randomized trial	47 participants in the diabetes trial	Did not find a difference in baseline and final HbA1c levels	No difference in healthcare costs
<b>Bonnel, W., &amp; Smith, K. V. (2014). Framing the advanced clinical project with relevant clinical frameworks. In <i>Proposal writing for nursing capstones and clinical projects</i> (pp. 59-69). New York: Springer Publishing Company.</b>	Level 7 Textbook			
<b>Brunisholz, K. D., Briot, P., Hamilton, S., Joy, E. A., Lomax, M., Barton, N., ... Cannon, W. (2014). Diabetes self-management education improves quality of care and clinical outcomes determined by a diabetes bundle measure. <i>Journal of Multidisciplinary Healthcare</i>, 7, 533-542.</b>	Level 3	N = 4,587 Intervention cohort = 384 Comprehensive review of data	Consistent findings on barriers to adherence, time, and engagement	Supports existing studies

<http://dx.doi.org/10.2147/JMDH.569000>

<b>Chism, L. A. (2016). <i>The doctor of nursing practice: A guidebook for role development and professional issues</i> (3rd ed.). Burlington, MA: Jones &amp; Bartlett Learning.</b>	Level 7 Textbook			
<b>Collins, S., Piper, K. B., &amp; Owens, G. (2013, January/February). The opportunity for health plans to improve quality and reduce costs by embracing primary care medical homes. <i>American Health &amp; Drug Benefits</i>, 6(1), 30-38. Retrieved from <a href="http://www.AHDBonline.com">www.AHDBonline.com</a></b>	Level 7 Expert opinion from American Health & Drug Benefits	Coordinated collaborative care to support patients to used their provider (medical home)	Improve continuity of care; consistency; decrease costs	Evaluation of successful medical home models
<b>Cui, M., Wu, X., Mao, J., Wang, X., &amp; Mie, M. (2016). T2DM self-management via smartphone applications: A systematic review and meta-analysis. <i>PLoS ONE</i>, 11(11). <a href="http://dx.doi.org/journal.pone.0166718">http://dx.doi.org/journal.pone.0166718</a></b>	Level 1 Systematic review Between 2005 to 2016 1,022 patients	Articles reviewed 2,596 13 were included in study Meta-analysis included	Smartphone apps showed benefits in T2DM self-management	
<b>Dobson, R., Carter, K., Cutfield, R., Hulme, A., Hulme, R., McNamara, C., ... Whittaker, R. (2015). Diabetes text-messaging self-management support program (SMS4BG): A pilot study. <i>JIMR MHealth and Uhealth</i>,</b>	Level 3 3-month nonrandomized study t tests used Changes in HbA1c were calculated by Wilcoxon signed rank test	Type 1 and 2 diabetic patients between the ages of 17-69 Type 1 – 12 Type 2 – 30 Intervention to increase self-efficacy through text messaging	Average of 109 messages sent 100% reported high levels of satisfaction	Culturally adjusted Tailored messaging mHealth term used

<p>e32. Retrieved from <a href="http://mhealth.jmir.org/2015/e32">http://mhealth.jmir.org/2015/e32</a></p>			<p>97% would recommend Improved HbA1c levels</p>	
<p><b>Dodson, R., Whittaker, R., Jiang, Y., Shepherd, M., Maddison, R., Carter, K., ... Murphy, R. (2016). Text message-based diabetes self-management support (SMS4BG): Study protocol for a randomized controlled trial. <i>BioMed Central</i>, 17:179. <a href="http://dx.doi.org/10.1186/s13063-1016-1305-5">http://dx.doi.org/10.1186/s13063-1016-1305-5</a></b></p>	<p>Level 3 9-month trial randomized trial Participants 16 years of age or older Mobile phone with text capabilities 2 sided statistical tests Linear regression to evaluate outcomes</p>	<p>N = 1000 500 in trial 500 in control 3 and 6 month HbA1c</p>	<p>Measured HbA1c improvement Measured increase in self-efficacy</p>	<p>Perceived useful by participants mHealth term used</p>
<p><b>Economic costs of diabetes in the U. S. in 2012. (2013). <i>Diabetes Care Journal</i>, 36, 1033-1044. <a href="http://dx.doi.org/10.2337/dc12-2625">http://dx.doi.org/10.2337/dc12-2625</a></b></p>	<p>Level 7 Expert opinions and research</p>	<p>National research and resources</p>	<p>Statistics relevant to T2DM in population and fiscal impacts</p>	
<p><b>Eisenstat, S. A., Ulman, K., Siegal, A. L., &amp; Carlson, K. (2012, December). Diabetes group visits: Integrated medical care and behavioral support to improve diabetes care and outcomes from a primary care perspective. <i>Current Diabetes Report</i>, 13, 177-187. <a href="http://dx.doi.org/10.1007/s11892-012-0349-5">http://dx.doi.org/10.1007/s11892-012-0349-5</a></b></p>	<p>Level 5 In-depth study review</p>	<p>Analysis of group visits on improving outcomes and increasing use of medical homes</p>	<p>Meeting followed a basic 10 step format Divided into 3 sections: access, education, behavior changes</p>	<p>Overview of evolution of medical homes</p>
<p><b>Greenwood, D. A., Gee, P.M., Fatkin, K.J. &amp; Peeples, M., (2017). A systematic review of reviews evaluating</b></p>	<p>Level 1 25 studies were reviewed between 2013 and 2017</p>	<p>Technology enabled self-management feedback loop can be</p>	<p>18 of the 25 studies reported significant</p>	<p>Key elements: Communication</p>



<p>technology-enabled diabetes self-management education and support. <i>Journal of Diabetes Science and Technology</i>, 11(5).  <a href="http://dx.doi.org/10.1177/1932296817713506">http://dx.doi.org/10.1177/1932296817713506</a></p>		<p>beneficial in a value based healthcare program Behaviorally designed interventions are critical</p>	<p>reduction of HbA1c</p>	<p>Patient – generated health data Education Feedback</p>
<p>Graffigna, G., Barello, S., Bonanomi, A., &amp; Menichetti, J. (2015). The motivating function of healthcare professional in eHealth and mHealth interventions for Type 2 diabetes patients and the mediating role of patient engagement. <i>Journal of Diabetes Research</i>, 2016.  <a href="https://doi.org/10.1155/2016/2974521">https://doi.org/10.1155/2016/2974521</a></p>	<p>Level 2          Research article          Five hypotheses were proposed</p>	<p>N = 93          Questionnaires were used: Patient Health Engagement Scale Patient Activation Measure Morisky Medication Adherence Scale Health Care Climate Questionnaire Demographic characteristics/frequency of mHealth/ eHealth use</p>	<p>Found common results Importance of provider and patient relationship Promotion of patient autonomy Multidimensional psychosocial inclusion of cognitive, emotional, and behavioral</p>	<p>Questions of readiness impacted results Small study</p>
<p>Holcomb, L. S. (2015). A taxonomic integrative review of short message service (SMS) methodology: A framework for improved diabetic outcomes. <i>Journal of Diabetes Science and Technology</i>, 9(6), 1321-1326.  <a href="http://dx.doi.org/10.1177/1932296815585132">http://dx.doi.org/10.1177/1932296815585132</a></p>	<p>Level 5          Integrative review</p>	<p>6 studies were involved Various lengths of study</p>	<p>SMS interventions were effective, sustained engagement Recommended continued studies</p>	
<p>Hunt, C. W., Sanderson, B. K., &amp; Ellison, K. J. (2014,</p>	<p>Level 5          Study use of technology and</p>	<p>Recruited from employee health groups</p>	<p>No significant difference</p>	

<b>July-August). Support for diabetes using technology: A pilot study to improve self-management. <i>Medsurg Nursing, 23 (4), 231-237.</i></b>	diabetes self-management Two group crossover, repeated measures design for pilot study	2 groups – intervention and control 3-month study  Descriptive statistics Pre/post tests on self-efficacy Mixed model analysis	between the two groups	
<b>Institute for Healthcare Improvement. (2015). <a href="http://www.ihl.org">www.ihl.org</a></b>	Level 7 Expert opinions and research	National research and resources	Statistics relevant to T2DM in population and fiscal impacts	
<b>Jahromi, M. K., Ramezanli, S., &amp; Taheri, L. (2015). Effectiveness of diabetes self-management education on quality of life in diabetic elderly females. <i>Global Journal of Health Science, 7 (1), 10-15.</i> <a href="http://dx.doi.org/10.5539/gjhs.v7n1p10">http://dx.doi.org/10.5539/gjhs.v7n1p10</a></b>	Level 4 Interventional study	N = 90 Females 60-74 years old 3 groups	Intervention group had positive results of the study	
<b>Katz, R., Mesfin, T., &amp; Barr, K., (2012). Lessons from a community-based mHealth diabetes self-management program: “It’s not just about the cell phone”. <i>Journal of Health Communication, 17, 67-72.</i> <a href="http://dx.doi.org/10.1080/10810730.2012.650613">http://dx.doi.org/10.1080/10810730.2012.650613</a></b>	Level 3 Study in 2010 Technology issues were identified	N = 32 All African American participants	Hospital and emergency department visits were reduced	Phone and service were provided by study
<b>Kharirat, S., &amp; Garcia, C., (2014). Developing and mHealth</b>	Level 6 Development of application	N = 30	Innovation to 5 areas:	Identification of human to

<p>framework to improve diabetes self-Management. <i>e-Health - For Continuity of Care</i>. <a href="http://dx.doi.org/10.3233/978-1-61499-432-9-533">http://dx.doi.org/10.3233/978-1-61499-432-9-533</a></p>		<p>Patients and diabetes educators</p>	<p>EHR compatibility Automating guidelines Delivering EB education modules Using Geographic information systems Provider output options</p>	<p>computer interaction research needed</p>
<p><b>Kitsiou, S., Pare, G., Jaana, M., &amp; Gerber, B. (2017). Effectiveness of mHealth interventions for patients with diabetes: An overview of systematic reviews. PLoS ONE, 12(3).</b> <a href="http://dx.doi.org/10.1372/journal.pone.0173160">http://dx.doi.org/10.1372/journal.pone.0173160</a></p>	<p>Level 1 Appraisal of multiple systematic reviews</p>	<p>15 systematic reviews between 2008 and 2014 Direct evidence</p>	<p>Findings were consistent with improvements Recommendations for further research</p>	<p>Focus to inform policy makers, providers, and researchers</p>
<p><b>Mason, D. J., Jones, D. A., Roy, C., Sullivan, C. G., &amp; Wood, L. J. (2015). Commonalities of nurse-designed models of health care. Nursing Outlook, 63, 540-553.</b> <a href="http://dx.doi.org/10.1016/j.outlook.2015.04.009">http://dx.doi.org/10.1016/j.outlook.2015.04.009</a></p>	<p>Level 5 Systematic review</p>	<p>15 models of care reviewed</p>	<p>Consistent themes of: Individual Family Community</p>	
<p><b>Mateo, M. A., &amp; Foreman, M. D. (2014). Research for advanced practice nurses: From evidence to practice (2nd ed.). New York, NY: Springer Publishing Company.</b></p>	<p>Level 7 Textbook</p>			

<p>Nundy, S., Dick, J. J., Chou, C., Nocon, R. S., Chin, M. H., &amp; Peek, M. E. (2014). Mobile phone diabetes project led to improved glycemic control and net savings for Chicago plan participants. <i>Health Affairs</i>, 33(2), 265-272. Retrieved from content.healthaffairs.org</p>	<p>Level 3 Quasi-experimental, Two-group pre-post study Descriptive analysis t tests used for measurements</p>	<p>N = 348 Clinical data obtained from EHR and billing codes Brief Diabetes Distress Screening Instrument used</p>	<p>HbA1c improved Satisfaction increased Costs declined</p>	<p>mHealth term used Connected health solutions term used</p>
<p>Ory, M. G., Ahn, S. N., Jiang, L., Lorig, K., Ritter, P., Laurent, D. D., ... Smith, M. L. (2013). National study of chronic disease self-management: six-month outcome findings. <i>Journal of Aging and Health</i>, 25(7), 1258-1274. <a href="http://dx.doi.org/10.1177/0898264313502531">http://dx.doi.org/10.1177/0898264313502531</a></p>	<p>Level 3 Single cohort Pre-and-post longitudinal study</p>	<p>N = 903 6-month study</p>	<p>Participation and engagement increased satisfaction and improved relationship with provider</p>	
<p>Presseau, J., Ivers, N. M., Newham, J. J., Knittle, K., Danko, K. J., &amp; Grimshaw, J. M. (2015). Using a behaviour change techniques taxonomy to identify active ingredients within trials of implementation interventions for diabetes care. <i>Implementation Science</i>, 10(55), 1-10. <a href="http://dx.doi.org/10.1186/s13012-015-0248-7">http://dx.doi.org/10.1186/s13012-015-0248-7</a></p>	<p>Level 1 Secondary analysis of trials</p>	<p>Identification of behavioral measuring tool for interventions</p>	<p>Tool was successful in measuring implementation interventions</p>	<p>Developing taxonomy</p>

<p><b>Quinn, C. C., Shardell, M. D., Terrin, M. L., Barr, E. A., Park, D., Shaikh, F., ... Gruber-Baldini, A. L. (2016). Mobile diabetes intervention for glycemic control in 45 – 64-year-old persons with type 2 diabetes. <i>Southern Gerontological Society, 35</i>(2), 227-243. <a href="http://dx.doi.org/10.1177/0733464814542611">http://dx.doi.org/10.1177/0733464814542611</a></b></p>	<p>Level 2 N = 118 Type 2 diabetic between 18 – 64 years of age HbA1c &gt;7.5</p>	<p>Physician practice randomized Patients randomized into four groups Linear mixed-effects model</p>	<p>No difference between &lt;55 and &gt;55 groups Difference in both groups on improved HbA1c</p>	
<p><b>Regence. (2014). <a href="http://www.regence.com">www.regence.com</a></b></p>	<p>Level 4  Major cohort study through Blue Cross Blue Shield</p>	<p>Collaboration with Krames Stay Well</p>	<p>Positive results in decreasing HbA1c and improving patient satisfaction</p>	
<p><b>Smith, B. G., Men, R. L., &amp; Al-Sinan, R. (2015). Tweeting Taksim communication power and social media advocacy in the Taksim square protests. <i>Computers in Human Behavior, 50</i>, 499-507. <a href="http://dx.doi.org/10.1016/j.chb.2015.04.012">http://dx.doi.org/10.1016/j.chb.2015.04.012</a></b></p>	<p>Level 1</p>	<p>N = 770 Significant complexity in analysis</p>	<p>Direct application of Bandura's Theory of Self Efficacy</p>	
<p><b>Smith, M. J., &amp; Liehr, P. R. (2014). <i>Middle range theory for nursing</i> (3rd ed.). New York, NY: Springer Publishing.</b></p>	<p>Level 7  Textbook</p>			
<p><b>Sprey, E. (2015). Improving practice-payer collaboration. <i>Medical Economics, 40-45</i>. Retrieved from</b></p>	<p>Level 7: Expert opinions Surveyed physician data (PayerView) on</p>	<p>Physician practices and office efficiencies in supporting patient outcomes</p>	<p>Identified areas of payer created problems and</p>	<p>Offered points to improve relationship and office</p>

<a href="http://medicaleconomic.com">http://medicaleconomic.com</a>	negotiating with payers	against payer criteria	declining physician relationships.	efficiencies to maximize payment and improve patient outcomes
<b>Schaub, K. &amp; Moffett, C. (2017). Diabetes self-management education through technology. <i>Doctor of Nursing Practice Projects.</i> <a href="https://repository.asu.edu/items/44479">https://repository.asu.edu/items/44479</a></b>	Level 4 Cohort study	N = 10 initial 4 opted out or non-participation  6 completed the study	Measured self-efficacy and logged multiple variables: Blood pressure, BMI HbA1c	No change in HbA1c levels
<b>Sullivan, L. M. (2012). <i>Essentials of biostatistics in public health</i> (2nd ed.). Boston, MA: Jones &amp; Bartlett Learning.</b>	Level 7 Textbook			
<b>Sutton, M. D., (2015). A Quality improvement project to increase diabetes self-efficacy in a rural primary care clinic through patient utilization of a diabetic log book. <i>Doctor of Nursing Practice(DNP) Projects.56.</i> <a href="http://repository.usfca.edu/dnp/56">http://repository.usfca.edu/dnp/56</a></b>	Level 4 Cohort study	N = 20 3 month study	Log book and self-efficacy scale used  Improved self-efficacy  Improved HbA1c	No digital technology used
<b>Tofade, T., Khandoobhai, A., &amp; Leadon, K. (2012). Use of SMART learning objectives to introduce continuing professional development into the pharmacy curriculum. <i>American Journal of Pharmaceutical</i></b>	Level 7	Informative on formatting effective behavioral objectives		

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<p><b>Verevkina, N., Shi, Y., Fuentes-Caceres, V. A., &amp; Scanlon, D. P. (2014). Attrition in chronic disease self-management programs and self-efficacy at enrollment. <i>Health Education &amp; Behavior, 4(6), 590-598.</i></b>  <a href="https://doi.org/10.1177/1090198114529590">https://doi.org/10.1177/1090198114529590</a></p>	<p>Level 5 Systematic review of descriptive &amp; qualitative studies</p>	<p>Measured attrition in chronic disease participants</p>	<p>Low initial self-efficacy scores had a higher rate of attrition</p>	<p>Was not specific to people with diabetes</p>
<p><b>Waki, K., Fujiu, K., Hayashi, A., Kimura, S., Kobayashi, H., Nangaku, M., ... Ohe, K. (2016). DialBetics: Smartphone-based self-management for Type 2 Diabetes patient on insulin injections. <i>Journal of Diabetes Science and Technology, 10(3), 804-805.</i></b>  <a href="http://dx.doi.org/10.1177/1932296815619638">http://dx.doi.org/10.1177/1932296815619638</a></p>	<p>Level 4</p>	<p>Pilot study Short duration of one month Very small cohort – n = 10</p>	<p>Improved HbA1c Decreased BMI</p>	<p>Need larger, longer study to validate early results</p>
<p><b>West, B. (2012, November). Rapid cycle improvement: Avoid the pitfalls. <i>Nursing Management, 50-53.</i></b>  <a href="http://dx.doi.org/10.1097/01.NUMA.0000421673.95475.80">http://dx.doi.org/10.1097/01.NUMA.0000421673.95475.80</a></p>	<p>Level 7</p>	<p>Change management and organizational readiness</p>	<p>Effective methods to assess and adjust for change</p>	
<p><b>White, S., &amp; Spruce, L. (2015). Perioperative nursing leaders implement clinical practice guidelines using the Iowa Model of Evidence-Based</b></p>	<p>Level 7</p>	<p>Informative in appropriate utilization of the IOWA model in developing an</p>		

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<p><b>Practice. <i>AORN Journal</i>, 102(1), 50-59.</b>  <a href="http://dx.doi.org/10.1016/j.aorn.2015.04.001">http://dx.doi.org/10.1016/j.aorn.2015.04.001</a></p>	<p>evidence based project</p>			
<p><b>Wu, C. J., Sung, H. C., Chang, A. M., Atherton, J., Kostner, K., Courtney, M., &amp; McPhail, S. M. (2013, October 9). <i>Protocol for a randomised blocked design study using telephone and text-messaging to support cardiac patients with diabetes: A cross cultural international collaborative project</i>, 13(402).</b>  <a href="http://dx.doi.org/10.1186/1472-6963-13-402">http://dx.doi.org/10.1186/1472-6963-13-402</a></p>	<p>Level 2 Randomized controlled trial</p>	<p>N = 180 90 from Australia 90 from Taiwan Randomized onto groups of 45 Control and intervention groups</p>	<p>Challenges with variations in research processes, provider knowledge, and skill sets in two countries</p>	<p>Included self-efficacy models scale  Strong model structure</p>
<p><b>Yeaw, J., Halinan, S., Hines, D., DeLozier, A., Perez, M., Boye, M., ... Blanchette, C. M. (2014, February). <i>Direct medical costs for complications among children and adults with diabetes in the US commercial payer setting. Applied Health Economics Health Policy</i>, 12, 219-230.</b>  <a href="http://dx.doi.org/10.1007/s40258-014-0086-9">http://dx.doi.org/10.1007/s40258-014-0086-9</a></p>	<p>Level 1 Records review of multi-payer claims database</p>	<p>Major study 119,715 in study; database of 566,729 Descriptive statistics</p>	<p>Direct costs of managing and treating diabetes-related issues</p>	<p>Did not separate Type 1 from Type 2 in study but findings were separated</p>
<p><b>Zaccagnini, M. E., &amp; White, K. W. (2014). <i>The doctor of nursing practice essentials</i> (2nd ed.). Burlington, MA: Jones &amp; Bartlett Learning.</b></p>	<p>Level 7 Textbook</p>			



## Appendix E – Project Site Approval Letter



A Medical Service Organization Dedicated to Optimizing the Patient/Physician Relationship

February 16, 2017

Dr. Lynne Sanders, Committee Chair  
Liberty University Doctor of Nursing Program  
1971 University Blvd.  
Lynchburg, VA 24515

Dear Dr. Sanders,

The Scholarly Project proposed by Pat Perryman aligns with our focused quality initiatives. The improvement of HbA1c levels in our diabetic patient population is one of our strategic goals for 2017.

An evidence based project will facilitate our physician clinics in meeting their clinical goals.

We appreciate the opportunity to collaborate with a doctoral nursing student to achieve our organizational outcomes.

Sincerely,

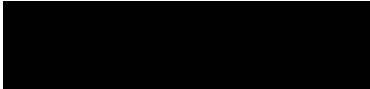


Sheila Ware  
President and Chief Executive Officer

## Appendix F – Vitreos Health Approval

Please consider the below message as approval to use the VitreosHealth logo for this specific project in your educational program. Please also place our logo on all screen shots and be sure there is a confidentiality statement on the bottom of the page or image.

VitreosHealth authorizes Patricia Perryman, to use its logo for educational purposes.



Ben Wheeler

EVP of Customer Success

Direct: 214-642-5160

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