DEVELOPMENT AND EVALUATION OF A NURSE PRACTITIONER-DIRECTED DIGITAL HEALTH TECHNOLOGY INITIATIVE FOR ADULTS WITH TYPE 2 DIABETES IN A PRIMARY CARE PRACTICE

An Evidence-Based Scholarly Project

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Title: Development and Evaluation of a Nurse Practitioner-Directed Digital Health Technology Initiative for Adults with Type 2 Diabetes in a Primary Care Practice

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Background: Type 2 diabetes mellitus is a chronic disorder that arises due to the way the body metabolizes blood glucose. Provision of continuous care/monitoring may help patients cope with daily challenges. The implementation of digital technology (mobile app) is an innovative way to motivate patients and ensure full participation in self-care management (Jeffrey et al., 2019). Using mobile apps can further improve the quality of care, promote patient safety, and provide cost-effective care for patients, families, and practices (Kim et al, 2021).

Problem: Type 2 diabetics lack the knowledge and skills required to effectively manage their illness. Numerous studies have shown that the standard diabetic care plan is a slower approach with poorer outcomes, not fully capable of improving self-care skills despite various educational efforts (O'Neill et al., 2021). The use of mobile apps, such as Glucose Buddy is an innovative way to engage diabetic patients.

Purpose: The purpose of this project was to determine the effectiveness of using mobile apps to help type 2 diabetics engage better in self-care skills over a six-week period.

Methods: Thirty participants who own a smartphone were selected for this quality improvement project. The Glucose Buddy app, which is the intervention, was downloaded on participants' smartphones. Survey and patient activation measure (PAM-13) score questionnaires were distributed pre- and post-intervention. The questionnaires captured participants' responses and willingness to engage. The healthcare team communicated with the participants on the app through text messages, reminders to improve medication adherence, dietary compliance, physical

activity, and attendance at scheduled clinic appointments. Providers were able to log into the app, review patients' data, and give appropriate feedback.

Results: Improvement in health engagement was observed among the participants following the use of digital technology via the mobile app. Even though a small difference in PAM-13 scores was seen between the pre- and post-PAM scores, a single point change in PAM-13 score was recognized as valuable. There was evidence to support improvement in patient health engagement with the app use, such as the three-point median increase in PAM-13 score. Past studies have shown an increase in patient health engagement, user empowerment as well as an improvement in overall quality of life with mobile app use (Jeon & Park, 2019). Frequent, real-time communication and provider feedback were essential in supporting changes in behavior, which improved patients' self-care skills.

Conclusion: The mobile app, Glucose Buddy is a powerful tool that provides continuous care to patients outside the clinical setting. Providers were able to collaborate with other health professionals involved in the care of patients. Furthermore, participants gained emotional support and confidence by socially interacting with other app users who shared similar health experiences, thereby promoting a positive and proactive attitude for type 2 diabetics.

Keywords: mobile application, self-care, type 2 diabetes mellitus, health engagement

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ABBREVIATIONS

AACN	American Association of Colleges of Nursing
ADA	American Diabetes Association
APRN	Advanced Practicing Registered Nurses
ARCC	Advancing Research & Clinical Practice through Close Collaboration Model
BMI	Body Mass Index
CCM	Chronic Care Model
CDC	Centers for Disease Control and Prevention
DM	Diabetes Mellitus
DNP	Doctor of Nursing Practice
EBP	Evidence Based Practice
HSRC	Human Subject Review Committee
OSU	The Ohio State University
PAM	Patient Activation Measure
PHE	Patient Health Engagement
PICOT	Population, Intervention, Comparison, Outcome, and Time
QI	Quality Improvement
RCT	Randomized Controlled Trial
RN	Registered Nurse
SPSS	Statistical Package for Social Sciences
T2DM	Type 2 Diabetes Mellitus
WU	Wilmington University

CHAPTER ONE

INTRODUCTION

Problem Description

Background and Significance

Diabetes mellitus (DM) is a lifelong disease with debilitating consequences. Presently, it has no cure, is difficult to control, and continues to pose a threat to public health, due to the alarming increase in the number of new individuals afflicted by the disease (American Diabetes Association [ADA], 2018). In 2017, diabetes was listed as the seventh leading cause of death in the United States (Centers for Disease Control and Prevention [CDC], 2017). According to a CDC report (2021), there are over 34 million Americans living with DM (about one in 10 persons) and 90-95% of them have type 2 diabetes mellitus (T2DM).

DM is a metabolic disorder that can affect any age group: children, teens, young adults, and the elderly, but it is very common in individuals over the age of 45 years old (Wu et al., 2018). The underlying illness, hyperglycemia, stems from the inadequate production of insulin by the pancreas as seen in type 1 DM or impaired sensitivity of body cells to the action of insulin (insulin resistance), seen in type 2 DM (Agarwal et al., 2019). T2DM has been described as a silent killer because the disease can go unnoticed for several years before showing any symptoms (Bene et al., 2019). A fasting blood glucose level of 126 mg/dl or greater, done on two or more occasions is required to make a diagnosis of DM (Sahin et al., 2019). Symptoms of DM include frequent urination, increased thirst, and increased hunger (ADA, 2018). This disease is of high significance because a person can develop T2DM at any point during their lifetime (CDC, 2021).

Incidence and Prevalence

The 2021 Diabetic Statistical report revealed that 34.2 million Americans have diabetes, and over 88 million American adults (one in three people) are pre-diabetic (CDC, 2021). Thirty-eight percent of adults with pre-diabetes are aware of their condition, though many people still remain unaware of their condition (CDC, 2021). In 2018, the prevalence of diabetes among various age groups were as follows: 3.6 million adults with DM were aged 18-44 years; 11.7 million adults were 45-64 years; and 21.4 million adults were ≥ 65 years (CDC, 2021).

Incidence, or number of new cases of diabetes in 2018 among young adults ages 18 years and older was reported to be 1.5 million or 6.9 per 1000 persons (CDC, 2021). In the general population, new DM cases were higher among racial and ethnic minorities, namely non-Hispanic Blacks, Hispanics, Asians, and non-Hispanic Whites. Among the various ethnic groups, reported new rates include nine per 1000 persons for Hispanics; 7.9 per 1000 persons for non-Hispanic Blacks; 7.2 per 1000 persons for Asians; and 5.4 per 1000 persons for non-Hispanic Whites (CDC, 2021).

Generally, among adults diagnosed with DM, there was a significant decrease in the number of new cases reported from 2008 through 2018. However, the number of existing cases (prevalence) was highest among Native Americans (CDC, 2021). The 2017-2018 statistical report further showed that among various gender types, more new cases at a rate of 7.3 per 1000 persons were reported in men compared to 6.6 per 1000 persons seen in women (CDC, 2021).

Impact of Diabetes on Patients/Families

Pre-disposing factors for the development of T2DM include increasing age, obesity, race/ethnicity (Black, Hispanic), and family history (ADA, 2018). DM is known to affect not only the individual patient, but also the family members, the community, and the nation

(Agarwal et al., 2019). Poorly controlled DM is linked with cardiovascular diseases and has been described in the past as a coronary artery disease equivalent (Wu et al., 2018). It further depicts a high morbidity and mortality potential as well as a poor quality of life as an outcome (ADA, 2018).

The consequences of poorly controlled DM include both short-term (macrovascular) and long-term (microvascular) complications (Kim et al., 2021). The short-term damages include stroke, heart disease, and atherosclerosis (Kim et al., 2021). The long-term effects include loss of vision and loss of sensation leading to peripheral nerve injury and decreased renal function. The physiological impact of managing complicated DM is physically and emotionally draining on family members and caregivers, giving rise to neglect and poor quality of life as outcomes (Hou et al., 2018).

Financial Implications

The economic impact of managing T2DM is financially disabling to most individuals (ADA, 2018). The medical costs for diabetics are more than twice as high as for people without DM (CDC, 2021). The total medical costs and lost work and wages for people with DM is projected to be $245 billion a year (CDC, 2017). Also risk of death for adults with DM is 50% higher than for adults without DM (CDC, 2017). As a result, patients must be encouraged to become more directly involved in managing their own care to slow and prevent the early onset of DM complications.

Patient health engagement emphasizes changes in lifestyle habits such as medication adherence, dietary compliance with healthy foods, participation in physical activities, smoking cessation, decrease in alcohol consumption, and maintaining scheduled health appointments (Shaw et al., 2020). Families and caregivers are often frustrated that regardless of all the new

interventions and availability of new prescription medications to effectively manage DM, many type 2 diabetics still end up poorly controlled and with one or more complications (Chao et al., 2019). Bearing in mind that diabetes has no cure and can be quite difficult to treat, the need to utilize an innovative approach (digital health technology), such as mobile apps as a strategy to engage, motivate, and empower patients has become of uttermost importance (Jeffrey et al., 2019).

Due to the complex and burdensome nature of diabetes, patients need and will rely on continuous support outside clinic settings—at home, in school, at work—to promote adherence and reach desired goals (Chao et al., 2019). Mobile apps, such as Glucose Buddy can provide education, promote social connection, and increase communication between providers and patients, as well as among collaborating healthcare teams (Torbjornsen et al., 2019). Collaborative care is an integral part of diabetic management geared towards improving the care, health outcome, and quality of life for these patients (O'Neill et al., 2021).

Sociocultural Implications

It is important to note that diabetes is more common in certain ethnic/minority groups such as Blacks, Native Americans, Asians, and Hispanics (ADA, 2018). Contributing factors include genetic components as well as health-disparity-related factors among these populations (Veazie et al., 2018). Minority groups may not be able to afford health insurance due to poverty and poor accessibility to quality healthcare in diverse, underserved communities (Veazie et al., 2018). Other factors, such as illiteracy and poor knowledge also hinder awareness and opportunity for early diagnosis of T2DM (O'Neill et al., 2021). Many individuals from minority groups present late with complications or may become diagnosed by chance, following a health assessment for job employment (Torbjornsen et al., 2019). Poverty, as a result of unemployment,

can also determine the quality of food one eats, with most individuals making unhealthy food selections, living on fast foods and diets that are not balanced (Veazie et al., 2018).

Organization's Practice

The participants in this project were mostly patients who had T2DM for two or more years and who managed on diet and medications. These patients lacked adequate self-care skills and motivation for behavioral change and had failed to meet set goals for proper management of T2DM. Appointment data for participants revealed failure to keep to scheduled appointments with high no-show numbers, despite all education, non-adherence to medication therapy with blood glucose numbers that are extremely out of range, and a personal disclosure of engaging in a fast-food diet.

Jeffrey et al. (2019) found that the traditional model of care delivery, which includes a face-to-face interaction between patients and a healthcare provider that occurs during clinic appointments, is short lasting, may not be engaging enough, and yields limited impact on patient outcomes. Usually, this primary care practice allots a time frame of fifteen minutes for routine follow-up care. Providers hardly have enough time, to find out if there are new developments with patients since the last visit, examine, review laboratory results, make medication adjustments, and educate patients. Furthermore, healthcare providers working at the practice are typically running behind schedule and rushing to meet up with the next patient's appointment. Inadequate provider-patient time means patients with uncontrolled DM are not getting adequate education and support required to self-manage their diabetes.

Evidence-based studies have shown that lack of patient engagement is a major contributor to preventable deaths (Sahin et al., 2019). It is estimated that 40% of deaths in the United States are caused by modifiable behavioral issues, including smoking, obesity,

alcoholism, inadequate exercise, medication non-adherence, and neglect in attending follow-up medical appointments (CDC, 2021). Utilization of digital health technology is an innovative way for the healthcare team to promote patient engagement and deliver continuous care to patients outside the clinical setting (Hou et al., 2018).

Relevance to Nursing Practice

The nursing profession strives to implement the best strategy for patients' wellbeing, care, and safety (Melnyk & Fineout-Overholt, 2018). Mobile apps assist patients in monitoring their own health conditions and improve the speed and quality of care given to patients, thereby enhancing engagement (Jeon & Park, 2019). The nursing practice has benefited highly from digital technology in various aspects, such as enhancing communication, maintaining health records and information, providing care coordination, and monitoring and documenting patients' healthcare (Berman et al., 2018).

Rationale

Conceptual Framework

The conceptual framework that guided this DNP project was the chronic care model (CCM) (Jeon & Park, 2019). CCM is a widely used framework for organizing and providing care to individuals living with chronic conditions (e.g., T2DM) (Yasmin et al., 2020). The CCM is centered on bringing together the patients, provider, and intervention (mobile app) necessary to accomplish set goals for these patients (Struwe et al., 2020). Establishing a strong relationship through good communication builds trust and helps engage the patient and the provider to form the connection necessary to achieve desired outcomes for the patients (Jeon & Park, 2019). Building a good patient-provider relationship shaped the basis of the CCM for this project. A connection must be made between the patient and the healthcare provider. Incorporating type 2

diabetic preferences, values, and needs into the healthcare plan will help to engage, motivate, and empower these patients to take ownership of their care.

As soon as the healing and caring relationship begin to develop, members of the healthcare team can become inspired by this patient-centered approach and create a vision and a purpose towards improving the overall health outcome for these patients. The CCM describes how building quality provider-patient relationships can do the following for patients: (a) enhance engagement, (b) increase knowledge, (c) improve self-care skills, and provide empowerment, leading patients to fully participate in self-care and take ownership of their health.

Project Variables

The four patient health engagement variables in the project were defined as follows:

1. **Medication adherence** describes the extent to which a patient follows directions and takes medications dutifully as recommended by a healthcare provider.
2. **Dietary compliance** explains the extent to which a person's behavior, such as following changes in diet, is in keeping with recommendations from a healthcare provider.
3. **Physical activity** refers to any change in physical activity or increase in exercise (i.e., taking short walks in the neighborhood) that signify an improvement in engagement.
4. **Attending scheduled appointments** describes an evident change in behavior when patients dutifully resume attendance at scheduled appointments as recommended by a healthcare provider.

Project Assumptions

In this project, it was assumed that all participants:

- owned a smartphone,
- had reliable Wi-Fi at home for prompt internet connection,

- were 18 years or older in age,
- were diagnosed with T2DM for at least two years,
- had no diabetic complications, and
- were able to fluently read and write English to communicate while using the mobile app.

Specific Aims

PICOT Question

In adults with T2DM, how does utilization of digital health (mobile) application compared to standard care, affect patient health engagement over a six-week period?

Purpose of DNP project

The goal of this project was to determine the effectiveness of the use of digital health technology (mobile apps) in motivating adult type 2 diabetics, to participate in their own health care plan over a six-week period.

Definition of Terms

The following conceptual and operational definition of terms were used throughout the project:

Health outcomes are changes in health that are beneficial to patients, resulting from implementing measures or utilizing specific interventions, such as with a health and wellness app such as Glucose Buddy (Jeon & Park, 2019).

Mobile application, also known as digital health technology, is a technological tool (software) designed to run on a mobile device, such as a smartphone and is capable of enhancing specific tasks, such as communication that can facilitate patient engagement in chronic health conditions such as T2DM (Kim et al., 2021).

Patient empowerment is a process through which patients can make decisions and take actions pertaining to their wellbeing, so as to better control their health (Shaw et al., 2020).

Patient health engagement (PHE) is defined as the ability of a patient to choose to participate in care appropriately tailored to specific needs, in cooperation with a healthcare provider geared towards improving patient outcomes (Kearns et al., 2020). PHE includes and is not limited to the following:

- **Improving adherence to medications** involved the use of a diabetic app, Glucose Buddy to facilitate health engagement in patients. The standard care plan lacked the ability to remind patients to take their medications, and therefore, patients could not fully engage.
- **An increase in diabetic knowledge and self-care skills** shows the app's ability to provide continuous care to T2DM. Also, patients interacted and received feedback and appropriate guidance from their healthcare providers. More knowledge led to more commitment and empowerment.
- **An increase in dietary and physical activity compliance** was shown with Glucose Buddy's dietary and physical activity section where patients could log in data and track their performance.
- **An increase in attendance at scheduled appointments** was demonstrated when participants received reminders and used the app to confirm ability to keep to scheduled appointments.

Self-care is the ability to play an active role towards the upkeep of one's health to promote well-being, most especially during periods of ill-health (O'Neill et al., 2021).

Self-knowledge is the process of acquiring information and developing understanding and

awareness with the intent to promote health and limit illness (Yasmin et al., 2020).

Type 2 diabetes mellitus is a chronic disorder of impaired carbohydrate metabolism caused by the body's unresponsiveness to insulin, resulting in insulin resistance and abnormal levels of glucose in the blood and urine (Wu et al., 2018).

Chapter Summary

Chapter one introduced mobile apps as a type of digital technology that can be effective in improving PHE. The background and significance of the project were also explained, including an explanation of T2DM in the United States. The conceptual framework of the project (CCM) was also described as well as the purpose. The chapter ended with a definition of terms. Chapter two will discuss the search strategy and the application of the Ohio State University's Evidence-Based Project (EBP) model to support relevant findings.

CHAPTER TWO

REVIEW OF LITERATURE

Search Strategy

A review of literature to support this project involved a thorough search of databases. Selection of the key search terms relied heavily on the PICOT question and included the following: selfcare, adults, type 2 diabetes mellitus, mobile application, and health engagement. The date range searched was from January 2010 to January 2021. The search yielded a total of 418 articles, out of which 279 were derived from Cinahl; 33 originated from Ovid; 26 were from Sage Journals; 29 were from Google Scholar; and 51 originated from PubMed. Screening of searched articles yielded 170 articles after de-duplication (see Appendix A).

Seventy-seven full text articles were then assessed for eligibility. Inclusion criteria addressed the PICOT question with emphasis on factors such as adults ≥ 18 years, type 2 diabetics, and patients who can read and write English, who own a smartphone, and who have reliable wi-fi at home. Criteria for exclusion were as follows:

- Age < 18 years,
- type 1 DM,
- pregnancy,
- cognitive impairment,
- non-English speaking,
- receiving insulin treatment, and
- presence of complications such as nephropathy requiring dialysis.

Forty-seven articles were excluded that did not meet criteria. The total number of articles selected for this project that met the requirements was 30 (see Appendix A).

Evidence-Based Practice (EBP) Model

Translating research into clinical practice was a learning process where knowledge and information were captured and shared. EBP means incorporating study evidence as well as clinicians' judgment and patients' preferences in clinical decision making. The Ohio State University's (OSU) EBP model illustrates the Advancing Research and Clinical Practice through Close Collaboration (ARCC) model (Melnyk et al., 2017). The framework was first developed by Melnyk et al. (2017) to help advanced practice nurses provide EBP care to patients. The ARCC model requires combining resources that equip mentors with adequate skills and training necessary to apply EBP at point-of-care and throughout the organization. Study findings have shown that mentors who are well prepared, knowledgeable and uphold strong beliefs about the value of EBP are better able to implement, share ideas, and relay information to others (Melnyk & Fineout-Overholt, 2018).

The ARCC Model (Melnyk et al., 2017)

The ARCC model (Melnyk et al., 2017) has five steps:

- **Step 1: Evaluation of organizational culture for change** (Melnyk et al., 2017): EBP implementation was not an easy task. Any organization willing to adopt the ARCC model (Melnyk et al., 2017) has to shift its thinking and support the culture of change. Leaders must be on board with new ideas and abandon old ways of operation (Veazie et al., 2018). For this project, investing in technology and healthcare information was crucial to help providers access information easily during patient care delivery. The standard care approach for managing diabetes at the clinic site was not meeting required outcomes. This traditional method had long been in use, yet patients continued to lack the skills required to self-manage their DM. Therefore, changes needed to be made. A digital

strategy was recommended as a way to fully engage and provide continuous care desired by diabetic patients (Melnyk & Fineout-Overholt, 2018).

- **Step 2: Recognizing barriers to implementing the EBP process** (Melnyk et al., 2017). Recognizing and addressing barriers was important to avoid jeopardizing the success of EBP implementation. Barriers for this project included the following: (a) clinicians' who lacked EBP knowledge and skills; (b) clinicians who lacked EBP values; (c) clinicians who possessed an inaccurate perception that EBP was burdensome and time consuming; (d) poor communication among staff; and (e) not having enough EBP mentors. Even though stakeholders were always in agreeance with interventions that improve quality outcomes for patients, many practice sites still lacked a cultivation of EBP values among staff and sufficient mentors with EBP knowledge. Organizations needed to train old and new staff, not just for mentorship purposes but to better appreciate the benefits of an EBP care model to patients, families, and communities (Melnyk et al., 2017).
- **Step 3: Identification of EBP mentors** (Melnyk et al., 2017). Mentors are required in organizations that support EBP models to ensure sustenance of concepts (Hou et al., 2018). According to Melnyk et al. (2017), the EBP mentors are mostly advanced practice registered nurses (APRNs) who have acquired the training, skills, and knowledge to make clinical decisions at point-of-care. For this quality improvement project, I worked with type 2 diabetics receiving care in a primary care practice setting. A family nurse practitioner who has been providing excellent EBP care to diabetics for many years mentored me. The mentor incorporated both the CDC and ADA guidelines in managing diabetic patients. The use of mobile apps provided the full engagement required to bring

about behavioral changes, motivation, and empowerment to patients to self-manage their diabetes (Melnyk & Fineout-Overholt, 2018).

- **Step 4: Implementation of evidence into practice** (Melnyk et al., 2017). APRNs are responsible for educating staff about EBP concepts. During this project, it was very important that staff understood and accepted the EBP concepts. Likewise, Melnyk et al. (2017) have said that organizations must ensure resources are available, that staff understand practice data, and that the organization has established patient-centered goals. The EBP process consisted of seven steps:

    1. **Cultivating a spirit of inquiry** (Wu et al., 2018). The staff members, including me, were curious to find out why the standard care approach for managing type 2 diabetics was not meeting required outcomes.

    2. **Asking the clinical question in PICOT format** (Wang et al., 2019). The following PICOT question guided this project: In adults with type 2 diabetes, how does utilization of a mobile app compare to standard care affect patient health engagement within a six- week period? P represented the population, in this case adults with type 2 diabetes; I was the intervention, which was the mobile app; C was the comparison, which was the standard diabetes care; O was outcome, which was PHE; and T was the time period of six weeks.

    3. **Search for best evidence** (Torbjornsen et al., 2019). This step involved searching several databases, such as Cinahl, PubMed, Google Scholar, Sage Journals, and Ovid. The search yielded hundreds of articles which were screened to synthesize 30 articles. The literature further supported the evidence that the use of digital technology (mobile apps) can enhance PHE in type 2 diabetes (Yasmin et al., 2020).

4. **Critically appraise the evidence** (Agarwal et al., 2019). After reading the articles and assessing their usefulness, a system was used to identify strengths, limitations, feasibility, and generalizability. All levels of evidence were identified for the 30 articles, with the majority belonging to level one, which is the highest level of evidence (Agarwal et al., 2019).

5. **Integrate evidence with clinical expertise and patients' preferences** (Melnyk & Fineout-Overholt., 2018). Previous studies have shown that the use of mobile apps resulted in highly engaged patients and better outcomes, such as adhering to medication, maintaining scheduled appointments, complying with dietary restrictions, and attending scheduled appointments (Jeffrey et al., 2019). With mobile apps, healthcare providers could use available evidence, their judgment, and patients' needs and values to make clinical decisions (Hou et al., 2018). Applying EBP was valuable knowledge and information, to gather and work with when caring for these patients (Melnyk & Overholt, 2018).

6. **Evaluate outcomes based on evidence** (Yasmin et al., 2020). The mobile app was an effective tool that allowed for the following: (a) patients to receive 24-hour-care, (b) healthcare providers to access logged in data, (c) healthcare providers to review data, and (d) healthcare providers to give appropriate feedback and recommendations based on available results.

7. **Dissemination** (Chao et al., 2019). It was important to collaborate with other healthcare professionals and organizations to disseminate knowledge and information about the effectiveness of mobile apps in improving patient health engagement in T2DM. Melnyk and Overholt (2018) have added that influential groups in the

community can help communicate new evidence to reach audiences and consumers who will adopt and use the evidence-based findings.

- **Step 5: Evaluation of outcomes resulting from practice change** (Cui et al., 2016). For this project, it was important to monitor changes over time to determine improvement in patient outcomes. Proper documentation of information, data collection and analysis helped to determine whether there was improvement or not. As Melnyk et al. (2017) have suggested, time was the greatest barrier for nurses to using evidence at point-of-care to support practice. Nurses needed information readily available when implementing care for accuracy of clinical decision and efficiency of care. Through technology, APRNs are equipped and in a better position to apply evidence to improve care and outcomes for patients.

Available Knowledge

I was able to apprise the searched literature and synthesize supporting evidence that related to the effectiveness of mobile apps in improving PHE in T2DM. PHE is defined as the ability to get individuals interested and willing to participate in self-care for managing their chronic illnesses (Kearns et al., 2020). The degree of activation varies from patient-to-patient and includes the following: (a) knowledge, (b) understanding of the disease condition, (c) readiness to tackle responsibility, (d) aspects of behavioral change, and (e) health purpose as a whole (Kearns et al., 2020). PAM-13 score is a scale that measures the extent of patient engagement by assessing the following: (a) self-efficacy, (b) awareness, (c) knowledge, (d) self-care skills, and (e) confidence (Chew et al., 2018). In this project, there were 13 questions listed on the PAM score questionnaire, that subjectively analyzed patients' responses to self-engagement, with improvement in scores depicting ability and possession of skills required for adequate self-care

management (see Appendix C). Evidence-based research has shown that highly activated individuals were more likely to engage in positive health behaviors and to have better health outcomes (Jeffrey et al., 2019; Struwe et al., 2020).

Kearns et al. (2020) described the four stages of the PAM scale as it relates to acquisition of skills for self-care:

- **Stage one**: Patients are unwilling and not yet ready to manage their own health.
- **Stage two:** Patients are deficient in the skills and not confident enough to manage their own health.
- **Stage three:** Patients are engaging in self-care skills but may not be able to sustain the behavior.
- **Stage four:** Patients have acquired the skills for self-care but may derail in the face of adversity. The level of patient activation increases as progress is made from one level to another.

As patients' engagement in self-care behavior increases, so does the activation level, and the consequence is an improvement in health outcomes (Struwe et al., 2020). Patient activation further correlates with patients' utilization of healthcare services, overall experience, and expenses incurred on healthcare (Kearns et al., 2020). When type 2 diabetic patients routinely keep to scheduled appointments with providers, signs and symptoms of diseases are detected at the early stages, complications are milder, and less money is spent on healthcare costs (Struwe et al., 2020).

A patient's PAM-13 score is further used to choose an appropriate intervention based on the patient's level of activation (Kearns et al., 2020). Chew et al. (2018) has shown that patients with the lowest level of activation frequent emergency rooms (ER) the most and have the highest

level of hospitalization. Additionally, every point change in a PAM-13 score is highly significant; for instance, a point increase in PAM-13 score represents a 2% increase in medication adherence and a 2% decrease in hospitalization, respectively (Struwe et al., 2020). The PAM-13 score is also used as a guide by providers to coordinate patient care, educate, motivate, coach, and support patients (Chew et al., 2018). Previous evidence-based studies that used the PAM-13 score to assess the effectiveness of an intervention on patient activation showed significant improvements in health outcomes (Kearns et al., 2020; Chew et al, 2018).

Patient Health Engagement

PHE describes the willingness of patients to participate in those behaviors that will enhance knowledge and promote self-care skills leading to better management of their health condition. The four aspects of PHE described in this project were:

Medication Adherence

Berman (2018) showed that patients who received reminders via coaching calls (an average of four to five times per day) remembered to take their prescription medications as written and on time. Through enhanced communication via text messages on mobile apps, about 71% of type 2 diabetic patients with higher co-morbidities were highly motivated, sought for more support to monitor their health, and became adherent to medications (Chao et al., 2019). Likewise, Nkhoma et al. (2021) reported that mobile app usage at three months was effective in improving medication adherence in T2DM compared to usual care.

Dietary Compliance

O'Neill et al.'s (2021) study was conducted on 248 T2DM patients between the ages of 24-80 years, residing in various countries. Findings revealed with high confidence that mobile app usage among T2DM was useful for setting and monitoring health habits such as compliance

to healthy diet compared to non-app users (O'Neill et al., 2021). Participants were able to engage in healthy dietary choices and reported the truthfulness of app messages in reflecting their actual health status, thereby confirming effectiveness of digital technology on behavioral health (O'Neill et al., 2021). Meta-analysis of results from Sahin et al.'s (2019) study demonstrated that tailored mobile text messaging intervention, a form of digital m-health, could improve dietary compliance in T2DM.

Physical Activity Compliance

Reports from Shaw et al.'s (2020) descriptive study on mobile app usage among T2DM showed that overall engagement was highest for physical activity, blood glucose and weight loss, respectively. Also, among varied ethnic groups, Blacks had lower engagement for physical activity compared to Whites (Shaw et al., 2020). In Yasmin et al.'s (2020) research, a secondary outcome included lifestyle behavioral changes, such as compliance to physical activity, diet, and smoking cessation. Findings showed that patients from the intervention group (app users) were more likely to adhere to recommendations on physical activity and smoking cessation compared to non-users of the mobile app (Yasmin et al., 2020).

Self-care Knowledge

Chao et al.'s (2019) randomized controlled trial study conducted in China and Taiwan proved that type 2 diabetics with comorbidities, who utilize mobile apps, were highly motivated to change and achieved high scores in the self-care knowledge test (n = 49, 95% CI −0.26% to −0.24%, P = .052). Eighty-six percent of the patients improved their health knowledge through the use of mobile apps (Chao et al., 2019). Furthermore, with mobile app use, 71% of patients increased their attention to eating healthy, being physically active, and monitoring their general health condition (Chao et al., 2019).

Most users of mobile apps with chronic diseases, such as T2DM, who communicate well with their healthcare team, do encounter positive experiences such as increased knowledge, improved self-management skills, creating awareness, improved satisfaction, self-motivation, better health, and better quality of life (Jeffrey et al., 2019). Another study in China (Wang et al., 2019), further showed significant improvements among type 2 diabetics, who use mobile apps (test group) in creating disease awareness levels and self-management abilities compared to control groups (standard care). Reports have proven that the treatment group (app users) developed increased diabetic knowledge, improved adherence to diabetic practices, such as regular feet checks, and empowered perspectives that allowed them to take charge of their health in comparison to the control group (non-app users) (Wang et al., 2019).

According to Rangrazi-Jeddi et al.'s (2020) Iranian study, more interest for mobile app use was seen among younger T2DM patients than older patients. The app was very engaging for participants, who utilized it mainly for self-care purposes; ninety-six percent of app usage was mostly for dietary compliance; 90.9% for checking blood glucose levels, and 87.5% for contacting specialists (Rangrazi-Jeddi et al., 2020). Similarly, Odnoletkova et al.'s (2016) randomized controlled trial study revealed improved PHE with coach sessions. Odnoletkova et al.'s (2016) intervention consisted of five monthly telephone sessions of 30 minutes (on average) focused on achieving diabetes-recommended guidelines. There was improved PHE with the coach program, as 97.5% of participants reported a high level of medication adherence and overall patient satisfaction (Odnoletkova et al., 2016).

Torbjornsen et al.'s (2019) qualitative study demonstrated behavioral changes in mobile app users—motivation, problem solving, empowerment and health literacy—enhanced knowledge, improved skills, and encouraged self-control to better manage diabetes. Changes in

the depth and details of diabetes-related knowledge and confidence were observed, from specifics to the general, including enhanced competence in translating knowledge into practice (Torbjornsen et al., 2019). Mobile app use in T2DM promotes health, improves the quality of life, with beneficial outcomes such as reduction in complications of diabetes and lowering healthcare costs (Wu et al., 2018).

Blood Sugar Levels (Fasting Blood Sugar and A1C Level)

Fasting blood sugar (FBS) and glycosylated hemoglobin (HBA1C) levels are the glucose parameters commonly monitored as outcomes in type 2 diabetics. Since smartphones have become a part of people's lives, it is reasonable to incorporate this tool as a daily routine, to help bring blood glucose under good control (Berman et al., 2018). Wu et al. (2018) demonstrated that mobile app usage in diabetes had a clinically significant reduction in A1C levels, with larger reductions observed in T2DM than T1DM. Similarly, in Hao and Xu's (2018) 24-week study, results showed that app users had a higher A1C compliance rate for self-monitoring of blood sugar than standard care ($P < 0.01$). Similarly, Cui et al. (2016) found that mobile-app-based interventions caused a significant reduction in A1C levels in comparison to usual care. Veazie et al. (2018) further stated that mobile app usage may improve A1C levels when compared with support from a healthcare provider. Hou et al. (2018) reported a huge improvement in A1C levels with app usage, a mean reduction of 0.57% in A1C (95% CI 0.32 to 0.82; $P < 0.01$) compared to non-app users (standard care). Also, Kim et al. (2021) revealed a decrease in experimental group post-test FBS by 30.61 ± 62.01 mg/dl ($t = 2.79$, $P = .009$) in mobile app users when compared to standard care.

Chapter Summary

Chapter two presented the search strategy for selection of relevant articles for this DNP project. Other key areas included a discussion on The OSU EBP model (Melnyk et al., 2017) that translated research findings into practice. Available knowledge described the use of searched literature to synthesize supporting evidence. Chapter three will provide the context, interventions, and ethical considerations for the project.

CHAPTER THREE

METHODOLOGY

Context

The clinical setting for this DNP project provided primary care services to community residents in Maryland. This facility was able to meet the healthcare needs of underserved individuals which made up the bulk of its patient population. The clinic was privately owned and run by two providers: a family nurse practitioner and a psychiatric mental health nurse practitioner, both board certified. By catering to both mental and medical care needs of such a diverse population, this practice was fully equipped to meet the challenging healthcare needs of its patients.

The practice site had an estimate of approximately 1200 to 1500 patients, of which 600 patients are estimated to be living with DM. There is a practice manager, who is a registered nurse (RN) and who is responsible for overseeing the day-to-day activities of the organization. Other staff members included a receptionist and two medical assistants. Staff members worked well together as a team to provide care and ensure that patients' needs were met in a timely fashion. This DNP project, which is a QI project, assessed the usefulness of utilizing smartphone technology (mobile app, digital health technology) to better engage type 2 diabetics in managing their health condition. The project team consisted of the family nurse practitioner as the project mentor, the practice manager (an RN), two medical assistants, who helped with the implementation of the project, and me.

Key stakeholders included: the organization's CEO who broadly supported the project and was given regular updates on the timeline and state of affairs; healthcare providers, including the mentor, who supported interventions that improved health outcomes in patients; the patients

themselves; and families and caregivers. The primary objective of the DNP project was to utilize Glucose Buddy, a mobile app to enhance PHE as measured by pre- and post-intervention PAM-13 scores in adults with T2DM.

Intervention(s)

Design and Setting

This project targeted the impact of using technology in the form of a mobile app called Glucose Buddy to better engage adult type 2 diabetics. Because this practice served a low-income community that faced numerous health disparities, adequate PHE was needed to reduce the disease burden of DM and to improve the quality of life for all persons who have DM. This project was conducted in an out-patient care setting and lasted a duration of six weeks. Patients with T2DM who regularly attend the clinic and lack the self-care skills required for proper management of their health condition will be participating in this project.

Inclusion and Exclusion Criteria

This was a qualitative project, prospective in nature, conducted among adult T2DM patients who regularly received care at the primary care clinic. The clinical site had over 600 patients with diabetes, including T1DM and T2DM. This number was eventually screened down to include approximately 90 patients with T2DM who were willing to participate in the project. The recruitment process was completed on a face-to-face basis with 90 patients assessed for eligibility. Patients who met the required criteria were as follows: adults, 18 years of age and older, who had T2DM for a duration of at least two years. These patients were smartphone owners with reliable wi-fi at home for efficient communication. English speaking patients were selected. Exclusion criteria included the following: patients with T1DM, those on insulin treatment, women who were pregnant, and those who had a presence of complications, such as

the need for dialysis and cognitive impairment (Sahin et al., 2019). As a result, 30 participants met the criteria and were selected for the project.

The Project Team

The goal of the project was to have the healthcare team interact with the participants via the Glucose Buddy app (the independent variable) to achieve an improvement in PHE (dependent variable). The project team consists of the mentor, who is a family nurse practitioner, the office manager, who is an RN, two medical assistants who volunteered to be part of the project, and me. The mentor taught and provided guidance with clinical decision-making during patient encounters. Engagement included having the healthcare team send reminders and messages via Glucose Buddy regularly to the patients for better DM management. The provider logged into the app and reviewed the responses and gave feedback to patients in real time, without having to schedule an office visit, as demonstrated in the 2019 study by Jeffrey et al.

DNP Student's Role

My role as the leader of this project involved planning, developing, and executing tasks. I introduced the concept of the mobile app intervention to patients and families, clarified questions, and downloaded the Glucose Buddy app onto patients' smartphones during clinic visits. Other roles included assisting staff to obtain baseline measurements from patients during the start of the project: weight, height, blood sugar levels, blood pressure, and BMI levels. I also distributed survey test questionnaires during routine clinic visits to the participants and encouraged staff to send frequent reminders to patients via Glucose Buddy as Chao et al. (2019) recommended. Lastly, I evaluated the skills and knowledge patients acquired from using the mobile app, interpreted results, drew conclusions, and disseminated findings from the project.

Study of the Interventions

The initiative for this DNP project first commenced during the fall of 2021. During that time, the concept of using mobile apps to engage patients was discussed with the CEO to gain approval and support. With a positive response from the CEO, the concept was then introduced to the healthcare team, and then finally to family and patients. The use of digital technology in general, such as the Glucose Buddy app has been proven to yield positive health outcomes for diabetic patients (Sami et al., 2017). However, one major challenge remained—that there is no standard approach for assessing the impact of the app intervention. How is PHE measured? How does the healthcare team determine whether the Glucose Buddy app is working for patients or not?

Patient activation is a key concept which refers to people's willingness and capacity to take on the role of managing their own health and care (Kearns et al., 2020). Most aspects related to human behavior cannot be measured directly (Kearns et al., 2020). There is no single objective measure for PHE, other than using a patient's (subjective) response as depicted by the PAM-13 score (See Appendix C). Therefore, the PAM-13 score was used in this project as a tool to assess patients' knowledge, skill, and confidence level for PHE (Chew et al., 2018). Messages were sent via the app to the participants twice a day to remind them to take medications, eat healthy, and engage in physical activity, respectively (See Appendix G). The communication via mobile app further established and maintained a reliable patient-provider relationship. The more the interaction between the patients and the team, via reminders and messages, the better prepared the patients became at following instructions to improve their health. Any positive changes in these behaviors meant the app was engaging these patients better than through a traditional approach (Struwe et al., 2020).

In keeping with the CCM framework (Jeon & Park, 2019), DM is a complex disease that can last a lifetime. By continuously motivating and encouraging patients via the mobile app, collaborating with other healthcare professionals, recognizing each patient's unique role in decision making, and recommending patients to utilize community resources, patients are trained and empowered to manage their health (Yasmin et al., 2020). The approaches implemented to develop PHE within this project were aligned with the ADA's clinical practice guideline on DM self-care management (ADA, 2018).

Measures

PHE is a major outcome measure for this QI project. PHE measures included the following: (a) medication adherence, (b) dietary compliance, (c) physical activity, and (d) scheduled appointment attendance. This project sought to determine whether there was any change or improvement in the above behaviors with mobile app usage. It was important to recognize other relevant measures, such as patients' race, gender, age, marital status, level of education, employment status, duration of DM, and health insurance status. Considering the underserved population's use of clinic services and poor socioeconomic status, it became relevant to analyze patients' race, level of education, and employment status. Most of these patients were low-income earners without health insurance, which affects accessibility to adequate healthcare. Marriage is a protective factor that ensures that patients, especially males, eat a healthy diet at home, adhere to medications, avoid a sedentary life by staying active, and attend scheduled health appointments. Therefore, marital status and gender were also assessed in the project as shown on the survey questionnaire (see Appendix B).

Timeline

The following steps were taken to implement this project during spring of 2022:

- **Step 1: Early January:** I explained the purpose of the project to selected participants, obtained informed consent, distributed pre-test survey and PAM-13 score questionnaires, then collected responses. These were the pre-intervention data.
- **Step 2: Late January:** At different clinic visits, I downloaded the Glucose Buddy app onto patients' smartphones.
- **Step 3: Early February:** The healthcare team interacted with patients for six weeks by sending reminders and messages to patients via the Glucose Buddy app to determine if patients were maintaining scheduled appointments, adhering to medications, making healthy food selection, or increasing physical activity (see Appendix G)
- **Step 4: Late March:** I distributed post-test survey and PAM score questionnaires after six weeks of Glucose Buddy use. These were the post-intervention data.
- **Step 5: April/May:** Data/responses were collected from participants by the project team.
- **Step 6: Early to Mid-June:** Analysis of data were completed using SPSS software.
- **Step 7: Late June/July:** Results of the project were interpreted; manuscript was edited, and findings of the project were disseminated.

Data Accuracy

Methods utilized to assess completeness and accuracy of data collected included the following: (a) providing early education, (b) getting full support and interest of all staff members prior to starting the project, (c) clarifying questions posed by staff, and (d) planning to avoid rush and mistakes. Other methods for accuracy of data included the following: (a) making sure patients were eligible to participate, (b) ensuring patients had reliable home wi-fi, and (c) distributing and retrieving questionnaires from participants. Other teamwork efforts included downloading the correct app for patients, sending continuous reminders to patients, and

encouraging prompt feedback from healthcare providers. Chronic diseases last a lifetime and in QI projects, responses from patients are ideal for determining the effectiveness of an intervention (O'Neill et al., 2021). The most reliable way to assess outcome measures that occurred with mobile app interventions was to analyze the pre- and post-intervention data collected from patients and then to draw conclusions.

Analysis

Types of Data

Responses collected from patients contained both quantitative and qualitative data used to assess the impact of mobile app usage on PHE. The quantitative data included baseline data such as patients' weight, height, and age, as well as the number of years the patient had been diagnosed with DM. Qualitative data included the patient's race, gender, marital status, employment status, education level, health insurance, medication adherence, dietary compliance, physical activity, and attendance at scheduled appointments.

Ratio data included patients' age in years, and duration of DM. Nominal data were the patients' race, gender, marital status, employment status, education level, health insurance, medication adherence, dietary compliance, physical activity, and attendance at scheduled appointment. These variables were coded accordingly for ease of analysis by SPSS statistical software. All data collected from the survey questionnaires were analyzed by SPSS statistical software.

Budget

Applicable Expenses and Income

The budget for this project was under three hundred dollars. The labor for the staff who participated in the project was not impacted as the healthcare team already worked in the practice

and volunteered their services for free to the project. Some of the instruments used for the project, such as the weight scale, were already in use at the practice and did not need to be purchased. Three additional glucometers at $35 each were purchased to speed up blood glucose monitoring. Even though blood glucose level was not a variable studied by the project, it was important to attain baseline data, considering participants were type 2 diabetics. Test strips were purchased at $25 each. Office supplies, like printer paper and ink supplies totaled one hundred dollars.

Project Funding

The ability of the mobile app to modify patient self-care behavior was the criteria under assessment in this project. There was no funding for this project because costs were kept to a minimum. Selected participants were already smartphone owners; subsequently, no new phones needed to be purchased. The standard version of the Glucose Buddy app, which is free, was downloaded onto participants' phones as an affordable way to save costs for patients.

Ethical Considerations

Every aspect of the ethical principles was met by this DNP project. The safety of the patients was the highest priority. The participants were informed about the mobile app intervention and its potential to improve health engagement. Benefits and risks were presented, and questions were answered. There were no risks incurred. Participants understood that they were free to withdraw from the project at any time. There was confidentiality of all data information. Informed consent was obtained prior to beginning the research. Participants' questionnaire responses and demographic information were kept confidential. Codes were substituted for participants' identifying information. A volunteer RN staff retrieved the questionnaires from the participants. Survey data were stored on password-secured and

encrypted digital files. Only I have access to these electronic files. Data will be protected on a computer for at least three years past completion of the project and then destroyed, rendering the data unusable and unrecoverable.

HSRC Approval from Wilmington University

A Human Subject Review Committee (HSRC) approval form was completed for this project, approved by the project advisor, and then sent to Wilmington University's Institutional Review Board (IRB) for approval. Some organizations have IRBs, and it may be necessary to obtain formal approvals from these IRBs. In other cases, a document from an appropriate organizational executive, specifically approving the DNP project, would be sufficient. I was responsible for determining what type of approval was required and for obtaining the approval. For this DNP project, an IRB approval was not needed, and an exempt was granted (see Appendix F). All the Collaborative Institutional Training Initiative (CITI) training modules and accompanying quizzes were completed by me (see Appendix E).

Chapter Summary

Chapter three described the DNP project design, the Glucose Buddy digital health intervention, and the project team members' roles. Project measures and rationale for selection were described. Ethical aspects related to the project were also explained. Chapter four will provide results of this EBP.

CHAPTER FOUR

RESULTS

Sample Characteristics

Thirty participants (*N* = 30), 20 males and 10 females, completed all components of the survey and PAM score questionnaires with no missing data. The participants had been living with T2DM for an average duration of five years (*SD* = 2.0) and reported no complications. The sample had an average age of 55.6 years with a standard deviation (*SD* = 6.9). The sample was predominantly male (66.7%; *n* = 20), then female (33.7%; *n* = 10). The major race was Black (50%; *n* = 15), followed by Latino (20%; *n* = 6), Asian (16.7%; *n* = 5), White (10%; *n* = 3), and lastly, Alaska native (3.3%; *n* = 1) as shown on Table 1. The most common marital status among the participants was married (46.7%; *n* =1 4), and the least was widowed (6.7%; *n* = 2). Approximately 66.7% (*n* = 20) of the participants were employed, whereas 20% (*n* = 6) were retired, and 13.3% (*n* = 4) were unemployed. Most of the participants had completed some community college education (30%; *n* = 9), followed by vocational school education (26.7%; *n* = 8), with the least being graduate degree holders (6.7%; *n* = 2) (see Table 1).

Table 1 shows that few participants (13.3%; *n* = 4) reported no health insurance coverage, whereas the majority (16.7%; *n* = 5) were covered by CareSource.

At the beginning of the project, questionnaires were distributed before the Glucose Buddy app was downloaded on participants' smartphones (see Appendices B and C). Responses from these questionnaires were considered pre-intervention data. Questions assessed knowledge, attitude, and ability to engage in self-care. During the six weeks of the project, project staff members sent numerous app messages as reminders to engage the patients (see Appendix G). The participants engaged on the app and responded accordingly, even though some responses

were delayed and not as prompt as others. First-time users of the mobile app expressed some difficulty with navigation which gradually subsided over time. The providers also provided feedback on the app as deemed necessary for each patient.

At the end of six weeks, questionnaires were distributed and collected by the project team. Results served as post-intervention data. The team also observed participants during clinic sessions, asked them questions, and clarified any immediate concerns. Results showed that over half of the participants (53%; *n* =16) indicated high use of the Glucose Buddy app to help improve their knowledge and self-care skills (see Table 1).

Table 1

Descriptive Statistics, Frequencies, and Percentages of Demographic Characteristics

Variable	Total (n = 30)
Age	
Mean	55.6
SD	6.92
Minimum	45
Maximum	69
Years with Diabetes	
Mean	5.0
SD	2.05
Minimum	2
Maximum	10
Gender*	
Female	10 (33.3%)
Male	20 (66.7%)

Table 1 (continued)

Variable	Total (n = 30)
Race*	
Black	15 (50%)
Latino	6 (20%)
Asian	5 (16.7%)
White	3 (10%)
Other	1 (3.3%)
Marital Status*	
Single	5 (16.7%)
Married	14 (46.7%)
Divorced	3 (10%)
Separated	6 (20%)
Widowed	2 (6.7%)
Work Status*	
Employed	20 (66.7%)
Unemployed	4 (13.3%)
Retired	6 (20%)
Education*	
GED	6 (20%)
Vocational School	8 (26.7%)
College Degree	9 (30%)
Undergraduate Degree	5 (16.7%)
Graduate Degree	2 (6.7%)
Frequency of App Use*	
Low	5 (16.7%)
Moderate	9 (30%)
High	16 (53.3%)

Table 1 (continued)

Variable	Total (n = 30)
Insurance*	
CareSource	5 (16.7%)
Molina	4 (13.3%)
VA	4 (13.3%)
Medicaid	3 (10%)
Anthem	2 (6.7%)
Humana	3 (10%)
United	2 (6.7%)
Medicare	3 (10%)
None	4 (13.3%)

Note. *Format is *n* (%).

Results

This project was designed to evaluate the effectiveness of a digital health intervention in improving PHE in adults with T2DM who were attending a primary care clinic. Instruments used for this qualitative project included a demographic survey and PAM score questionnaires, which were distributed pre- and post-intervention. The following is an explanation of the variables of interest:

- **Age** in years is described by the variable age.
- **Race** is a nominal variable that identifies a participant's race.
- **Marital Status** is an attribute that identifies whether the participants are single, married, divorced, widowed, or separated.
- **Gender** is a nominal variable that categorizes the participant's gender into female or male.

- **Work Status** is a variable that categorizes a participant's employment level as either employed, unemployed, or retired.
- **Mobile App Use** describes the frequency of use of the mobile app intervention by a participant.
- **Education Level** describes the level of education attained by participants.
- **Health Insurance** describes the various types of health insurance possessed by participants.
- **Pre-Med Adherence** is a variable that describes a participant's adherence to medications pre-intervention.
- **Post-Med Adherence** is a variable that describes a participant's medication adherence post-intervention.
- **Pre-Activity Levels** refer to the activity level of a participant pre-intervention.
- **Post-Activity Levels** describe a participant's level of physical activity post-intervention.
- **Pre-Diet** describes a participant's dietary choices pre-intervention.
- **Post-Diet** describes a participant's dietary choices post-intervention.
- **Pre-Appointment Scheduling** describes a participant's attendance at scheduled appointments pre-intervention.
- **Post-Appointment Scheduling** describes a participant's attendance at scheduled appointments post-intervention.
- **Pre-PAM Scores** describe a participant's overall PAM scores pre-intervention.
- **Post-PAM Scores** describe a participant's overall PAM scores post-intervention.

Table 2 shows that prior to the intervention, 60% of the participants reported poor medication adherence; 47% reported no physical activity; and 53% indicated low physical

activity. Fifty-three percent reported poor dietary choices, and 60% reported low attendance at scheduled appointments. Post-intervention, 50% reported moderate medication adherence, with 46.7% reporting intense medication adherence. Regarding physical activity levels, 46.7% of the participants reported vigorous exercise, and 53% reported average exercise, a drastic improvement considering there were zero participants reporting no exercise post-intervention. Furthermore, all participants reported moderate (46.7%; $n = 14$) or intense (53.3%; $n = 16$) shifts to healthy dietary choices, and 29 participants (96.7%) reported moderate to high attendance at scheduled appointments.

Table 2

Descriptive Statistics for Survey Items Pre- and Post-intervention

	Pre-test ($n = 30$)	Post-test ($n = 30$)
Patient Activation Measure		
Mean	25.7	28.5
SD	5.43	5.36
Median	25.5	28.5
Minimum	16	19
Maximum	35	38
Medication Adherence*		
Low	18 (60%)	1 (3.3%)
Moderate	12 (40%)	15 (50%)
Intense	0 (0%)	14 (46.7%)
Activity Level*		
None	14 (46.7%)	0 (0%)
Low	16 (53.3%)	0 (0%)
Average	5 (16.7%)	16 (53.3%)
Vigorous	3 (10%)	14 (46.7%)

Table 2 (continued)

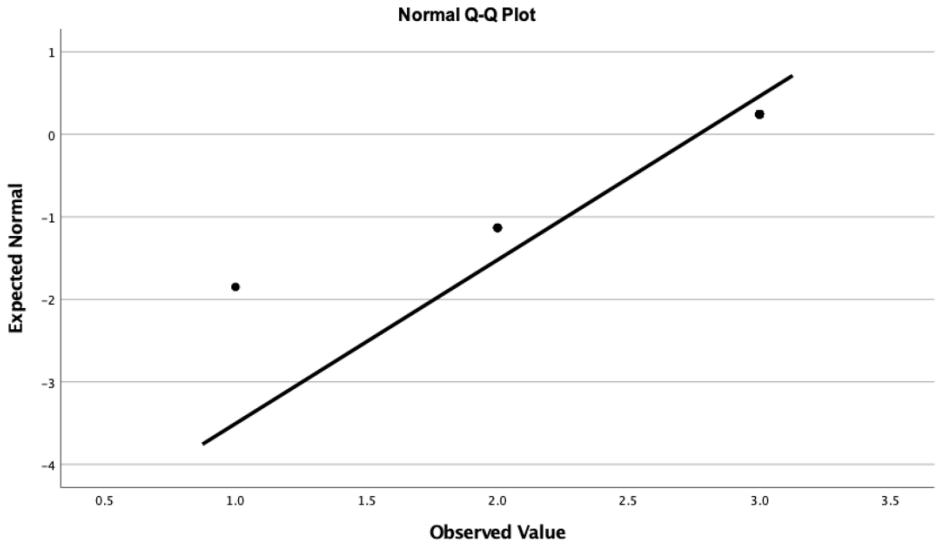
	Pre-test (n = 30)	Post-test (n = 30)
Diet*		
Poor	16 (53.3%)	0 (0%)
Moderate	14 (46.7%)	14 (46.7%)
Intense	0 (0%)	16 (53.3%)
Appointment Scheduling*		
Never	8 (26.7%)	0 (0%)
Low	18 (60%)	1 (3.3%)
Moderate	4 (13.3%)	15 (50%)
High	0 (0%)	14 (46.7%)

Note. *Format is *n* (%).

The latest version of the SPSS 27.0 was used for all statistical analysis. The data analysis plan was conducted in two phases. First, all study variables were presented using descriptive statistics including means, standard deviation for continuous variables at the interval, and ratio level, as well as frequencies and percentages for categorical variables at the nominal or ordinal level. The second phase of the analysis included bivariate analysis including a Wilcoxon signed-rank test. Test assumptions related to parametric testing revealed significant problems within the data to continue with parametric testing. Difference scores were examined between pre- and post-test continuous scoring on the PAM tool as recommended for related samples. The assumption of normality was violated according to the Shapiro-Wilk's test ($p < .05$), and the assumption of linearity was violated per examination of the Q-Q plot as shown in the line graph depicted in Figure 1.

Figure 1

SPSS Normal Q-Q Plot Indicating Violation of Normality

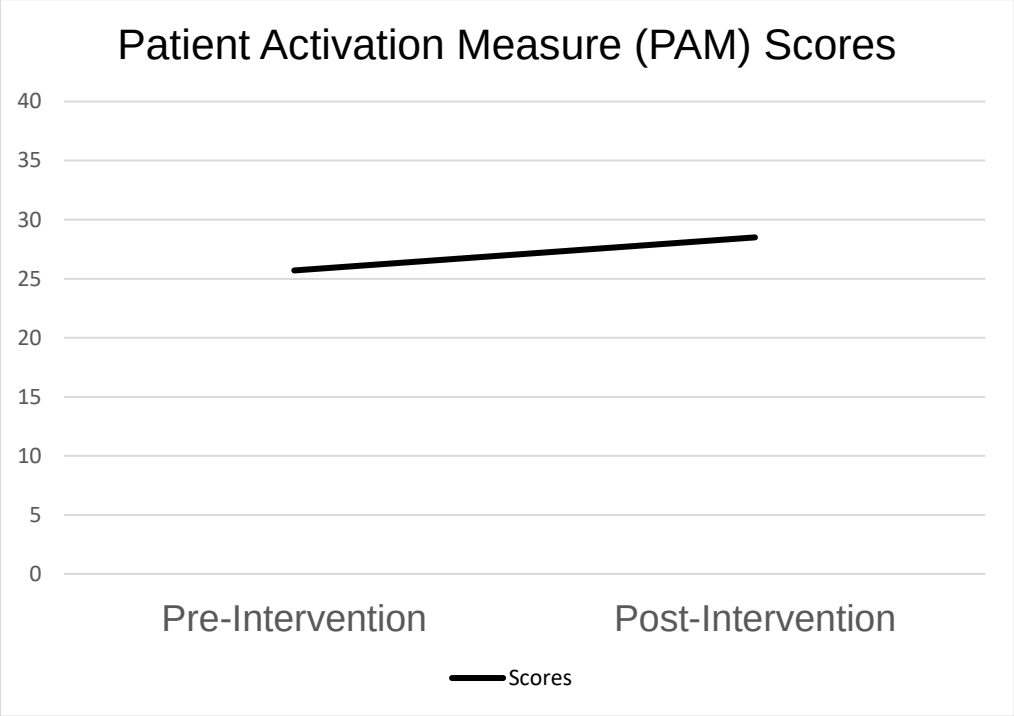


In addition, there were extreme outliers with a small range of differences. Therefore, nonparametric testing, Wilcoxon test was used for inferential analysis.

The PAM score for this project was a Likert-scale score with 13 questions. The raw scores were converted into activation levels. A score of less than 20 points depicted an inactive state and a belief that activation is not important. Lack of knowledge and confidence to act towards self-care were also included. An active state was reflected in a score range of 20-30 points. A very active state showed in a high score of 30-40, indicating adequate patient activation and a competence for self-care. A single point change in PAM-13 score was valuable. Each point increase in PAM-13 score correlated to a 2% increase in medication adherence and a 2% decrease in hospital admissions. Pre-intervention, the average (Mean) PAM-13 score for the participants was 25.7 (*SD* = 5.4; MIN/MAX = 16-35). Post-intervention, the average (Mean) PAM-13 score was 28.5 (*SD* = 5.4; MIN/MAX = 19-28) (see Figure 2).

Figure 2

Patient Activation Measure (PAM)-13 Scores Pre- and Post-intervention



The median scores were 25.5 pre-intervention and 28.5 post-intervention. A Wilcoxon signed-rank test was run on median scores to examine the difference on PAM scores from pre-intervention to post-intervention. There was a statistically significant median increase in PAM scores (3.0 points) from pre-intervention (*Md* = 25.5 points) to post-intervention (*Md* = 28.5 points), $z = 5.1$, $p < .001$. This finding strongly supports improvement in PHE with the use of a digital health intervention, such as a mobile app.

A side-by-side comparison of PAM-13 scores depicted in Table 3 showed that prior to the use of the Glucose Buddy app, the PAM-13 scores for participants ranged from 16-35 points, with a mean score of 25.7, median score of 25.5, and a standard deviation (*SD)* of 5.4. Post-intervention, the PAM-13 scores ranged from 19-38 points, with a mean of 28.5 points, median score of 28.5 and *SD* of 5.4 (see Table 3). A single point change in PAM score is valuable, hence

the three-point median increase in PAM score is significant and supports an improvement in PHE.

Table 3

A Side-by-Side Comparison of Pre- and Post-PAM-13 Scores

	N	Minimum	Maximum	Mean	Median *(Md)*	*SD*
Pre-PAM Scores	30	16	35	25.73	25.5	5.43
Post-PAM Scores	30	19	38	28.50	28.5	5.36
N	30					

Histograms illustrating pre- and post-PAM-13 scores are depicted in Figures 3 and 4, respectively.

Figure 3

Participants' Pre-intervention PAM-13 Scores

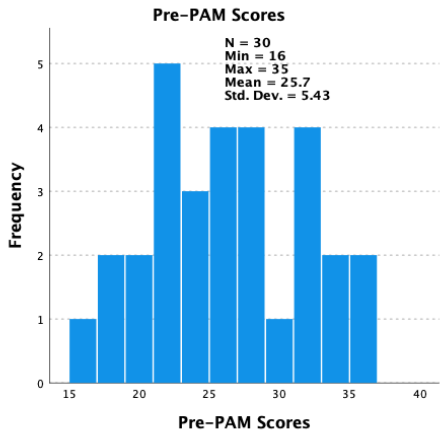
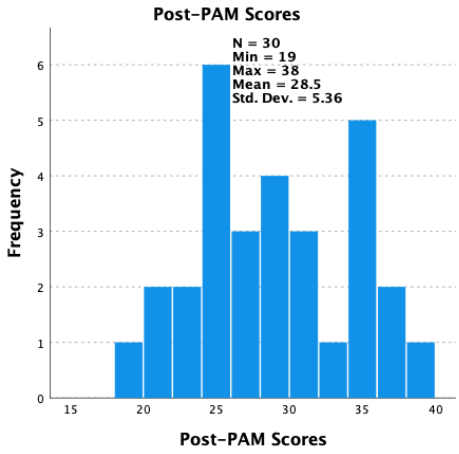


Figure 4

Participants' Post-intervention PAM-13 Scores



For this project, both pre- and post-survey questionnaires (see Appendix B) were distributed to the participants to help with data collection and responses interpreted accordingly. The PAM-13 score questionnaire (see Appendix C) was applied to determine the ability of Glucose Buddy, a digital health intervention, to better engage type 2 diabetics. Even though the practice has no set benchmark data, patient health information retrieved from the electronic health records offered a baseline, which helped to determine the efficacy of Glucose Buddy as an intervention to engage patients compared to the traditional approach. A positive outcome with app use manifested as an increase in certain behaviors, such as medication adherence, dietary compliance, and physical activity among the patients.

Strengths of the project included a team that worked tirelessly to create improved communication between the healthcare team and the participants via the mobile app. This flow of information increased interaction, created a trusting relationship, and helped to identify problems early. The continuous support from the management team was also valuable. Team spirit among the project's staff was foundational for inter-professional collaboration between

other disciplines whenever needed. The providers and the mentor gave required feedback to patients via the app in real time. According to the participants, feedback via Glucose Buddy was encouraging and rewarding.

Funding and travelling were not required for the project. The project was cost beneficial for the clinic and the patients. Participants were able to use their personal smartphone for this project, and the free downloadable Glucose Buddy app was readily available. Clinic staff volunteered their time and expertise; hence, no expenses were incurred on staff payment. The project team worked together to answer questions and to retrieve all questionnaires from participants; there were no missing data. Participants who had used mobile apps in the past expressed ease of use of the Glucose Buddy app, whereas first-time app users, voiced concerns about app navigation, which improved over time.

The participants felt the six-week project duration was too short and would have preferred a longer time, such as three-to-six-month timeframe to experience more effects of the intervention. Most, if not all participants, liked the app and attributed behavioral changes to its use. Satisfaction was expressed with the intervention; participants said Glucose Buddy provided continuous (24-hour) care to patients irrespective of location and time. Participants expressed a desire to continue using the app and mentioned that they would recommend Glucose Buddy to friends, family, and co-workers.

This EBP project, promoted cultural sensitivity by incorporating and not overlooking patients' request in the care plan.

Chapter Summary

Chapter four described the sample characteristics using descriptive statistics. Analysis of results were presented. Tables and graphs were used to illustrate the data and to also draw

comparisons with baseline data. Chapter five will discuss the limitations, implications for advanced nursing practice and plans for sustainability.

CHAPTER FIVE

DISCUSSION AND IMPLICATIONS

Interpretation

In the United States, poor management of chronic diseases such as T2DM has been associated with inadequate PHE, which is a preventable cause of death (Kim et al., 2021). The traditional or standard care of practice continues to fail patients and does not have much impact on health outcomes (Jeon & Park, 2019). Digital technology is playing an important role in everyone's daily lives; however, being innovative by incorporating its use to modify patient behaviors may be most rewarding (Yasmin et al., 2020). There were four patient outcomes under study in this DNP project: (a) adhering to medication, (b) increasing physical activity, (c) changing diet, and (d) attending scheduled appointments. The Glucose Buddy app was used to engage patients over a six-week period. The healthcare team sent messages twice daily via the app for interaction and to monitor patients' responses (see Appendix G). The text messages were reminders, which helped minimize weaknesses and promoted participants' strengths (Hou et al., 2018).

With the daily reminders, participants improved the following behaviors:

- took medications on time as scheduled,
- participated in family menus and ate healthier meals,
- increased their physical activity, and
- remembered to attend scheduled appointments.

These findings were supported by results of previous evidence-based studies such as the 2021 study by Nkhoma et al. on type 2 diabetics who used mobile apps, proved effective in increasing medication adherence and self-care potential in these patients. Jeffrey et al.'s (2019) research on

type 2 diabetics yielded positive experiences for app users, leading to improved knowledge, self-motivation, and satisfaction. Chao et al.'s (2019) investigation further supported PHE with app use, leading to healthy eating, being active, and overall adherence to treatment plans.

Participants in this project expressed better engagement and overall satisfaction with the use of the Glucose Buddy app than the standard care. Participants felt the app served as 24-hour care and acted like a clinic outside the practice setting. Patients felt safe and reassured knowing that their health activities were being monitored continuously and not just in the clinic during scheduled appointments. Socioeconomic factors can determine one's ability to cope with a chronic illness. Having a job, a means of livelihood, and financial stability can also determine one's ability to buy health insurance and take care of his/her health (Rangraz-Jeddi et al., 2020). Staying in a reliable relationship, being married, and eating healthy family meals may also provide support and help patients manage and cope better with chronic health problems (Sami et al., 2017). Generally speaking, Torbjornsen et al. (2019) reported that diabetic patients who were employed and those with good health insurance coverage were more likely to fully participate and take ownership of self-care management compared to uninsured patients. The innovative nature of Glucose Buddy app enables it to fully engage patients, by bridging the gaps and providing continuous support necessary to cope with health challenges, thereby enabling T2DM patients to manage their chronic condition.

Other evidence-based studies in support of the impact of digital health technology on self-care improvement in T2DM include Kim et al.'s (2021) study which demonstrated that mobile app usage was useful for setting goals, monitoring goals, and maintaining health habits. The mobile app used in Kim et al.'s 2021 study motivated patients to adhere to treatment plans just like the Glucose Buddy app utilized in this DNP project. According to Wang et al. (2019),

mobile app use in T2DM enhances self-care abilities, increases disease awareness, and decreases hospital readmissions and healthcare costs. The CDC (2017) statistical report mentioned that diabetics spend twice as much money on healthcare expenditure than non-diabetics. An affordable tool, such as a free mobile app can be used to engage, bridge the gap, and restore self-management behaviors and efficacy.

Limitations

There was initial resistance to change by some of the healthcare team members; the medical assistants initially opposed the use of the Glucose Buddy app as a new strategy. Constant communication on the digital health mobile app was viewed by these staff members as complex and time consuming, especially having the obligation to send reminders twice daily to patients (Elsabrout, 2018). With education and explanation of potential benefits to patients, these staff members saw the benefits of the mobile app, and eventually, everyone was on board with its use. Limited financial resources were another barrier; however, using the free, standard version of the Glucose Buddy app was a way to lower cost and improve accessibility of app usage to all participants. The qualitative nature of the project suggested responses from participants may not remain the same and could change over time, thus posing a challenge to reproduce similar results in future projects or studies. Six weeks may also be a short time to see significant results; a longer duration may be warranted.

A final limitation was the participants' diverse population and subsequent financial challenges. For example, some participants experienced poor wi-fi accessibility at home. This barrier was overcome by reaching out to certain companies that offered support to patients and low-income families in need of internet access. Additionally, the high cost of a healthy diet, which required incorporating several daily servings of fruits and vegetables was inaccessible for

many of the participants who were unable to afford the cost. Many times, in managing chronic conditions, patients want stability and would rather stick to a diet that is affordable (Sami et al., 2017). However, modification of other lifestyle choices made up for participants' poor diet.

Implications for Advanced Nursing Practice

Using digital technology in nursing practice for managing chronic diseases has created improvement in the level of care and quality of life accessible to patients with T2DM (Jeon & Park, 2019). Digital technology has successfully, advanced nursing practice by promoting the delivery and monitoring of care to patients in remote areas (Struwe et al., 2020). Managing T2DM requires advanced practicing registered nurses (APRNs) to treat, monitor, educate, and counsel patients, families, and caregivers. Recently, besides face-to face consultation, the previously mentioned goals are successfully achieved through digital technology, such as mobile applications (Chao et al., 2019). The implementation of follow-up care (continuity of care) is likewise essential for preventing and slowing long-term complications, and mobile apps have made it possible for providers to connect with patients 24 hours a day and at any location to deliver required care (Hou et al., 2018).

Successful diabetes management involves a team effort to help patients attain and set goals. Mobile apps also support collaboration with multidisciplinary teams to achieve diabetes management (Nkhoma et al., 2012). It has been shown that when specialists in other fields, such as podiatrists and ophthalmologists communicate, set a care plan, and mutually agree on treatment goals, it motivates and empowers the patients to adhere to treatment plans (Hou et al., 2018). Diabetes management via mobile app can achieve similar results.

In healthcare, the growing global application of digital technology means the nursing profession is not excluded, has embraced it, and must keep pace with the advancement. Digital

technology has expanded nursing investment in informatics, which requires financial backing (Shaw et al., 2020). Other challenges associated with using mobile apps include breach of patient data, hence apps with secure systems are highly recommended (Shaw et al., 2020). Procuring services that are secure is expensive, which could make the mobile app unaffordable and inaccessible for specific patient populations (Hou et al., 2018). In general, the use of digital technology has caused a reduction in healthcare costs for the practice and for the healthcare community (Wang et al., 2019).

Plan for Sustainability

It is very important to adopt strategies that will promote and ensure the use of the mobile app intervention for PHE following completion of the project. The patients liked the Glucose-Buddy app, have expressed interest to continue using it, and would highly recommend its use to friends and family. Consequently, I will continue to build enthusiasm among staff members by sharing the results of this project to show how effective the Glucose Buddy app was at engaging patients. For example, it will be important to specifically share the following: (a) patients now regularly attend their scheduled appointments; (b) patients' have increased their physical activity and exercise; (c) patients have improved in medication adherence; and (d) patients have incorporated more healthy meals to their diet. Sustainability can also be encouraged by placing an emphasis on quality improvement. It is important to share with the practice staff how engagement with the use of Glucose Buddy app has lowered and kept HBA1C levels for patients with T2DM within the normal range. The overall outcome of using the mobile app is healthier patients, which is an achievement for the practice, thereby creating potential to yield higher revenue for the organization.

It was also observed that the twice daily messages sent on the app helped to keep the staff busy; fewer staff were idle, and more patient-related work was completed. Finally, the power of the results of this project can be used to enhance marketing for the Glucose Buddy app, which may increase public relations. By contacting the manufacturer of Glucose Buddy, discussions can be made on expanding its use. Other suggestions include enhancing features on the app based on user experience.

Application of the AACN DNP Essentials

Essential 1: Scientific Underpinnings for Practice

Several meetings were held at different points in time with stakeholders for updates, progress, and the latest strategies on using the mobile app intervention during various stages of the project. Potential project barriers, such as lack of reliable wi-fi at the participant's home was brought to the attention of the committee. Finding ways to bridge the gap and possible solutions to overcome the barrier were discussed, including contacting companies that provide wi-fi to families with low income.

I attended a diabetic seminar on improving self-care skills for type 2 diabetics. The mentor and I encouraged behavioral changes, such as an increase in physical activities and smoking cessation to decrease short- and long-term DM complications. The participants were counseled on the benefits of medication adherence and being physically active. Families and caregivers were educated on the benefits of consuming a healthy diet, such as incorporating plenty of fruits and vegetables in daily meals. The project team spoke with and interviewed the participants at varied points throughout the project, pre- and post-intervention.

Essential II: Organizational and Systems Leadership for Quality Improvement and Systems Thinking

Collaboration in this project included meeting with patients, families, and caregivers to discuss health challenges that diabetics encounter on daily basis. The project team worked at the clinical site under the mentor's approval to assess baseline parameters such as weight, height, BMI, and blood glucose levels of the participants. Available information and evidence, as well as clinical practice recommendations were used to tailor needs and to develop care plans for the participants. Afterwards, it was possible to determine appropriate lifestyle modifications beneficial for type 2 diabetics. The ADA clinical practice guidelines were incorporated to maintain quality improvement in T2DM. Behavioral modifications were encouraged such as increasing physical activity and eating a healthy diet to help manage weight.

The project team heavily emphasized the usefulness and benefits of blood sugar monitoring for T2DM. I shadowed and continued to observe the mentor at the clinical site. Participants expressed continued interest in using the Glucose Buddy app to better manage their diabetes as team members executed the project and finalized plans.

Essential III: Clinical Scholarship and Analytical Methods for Evidence-Based Practice

The project team and I incorporated patients' preferences, values, and needs in managing T2DM. At the clinic, I retrieved and interpreted participants' lab results accordingly. The clinic sent out requests for imaging tests such as EKG whenever needed, and results were retrieved on time from the radiologists.

The effects of cardiovascular disease on diabetes as well as benefits of maintaining a healthy weight were discussed with the patients. A detailed discussion was held with the

dietician about incorporating small, portioned meals of no more than 1400 calories/day into the diet plan. Some of the participants interested in exercise were observed by the project team during routine workouts at the gym. The team members distributed the survey and PAM-13 score questionnaires to participants. Furthermore, BMI was calculated by the project team from available data to support clinical decision making.

Essential IV: Information Systems/Technology for Patient Health Improvement

There is no doubt that mobile apps are an innovative way to improve PHE in T2DM. At the beginning of the project, a teaching session was held to introduce the mobile app to patients and families to demonstrate how to navigate it. Staff were educated about the importance of establishing adequate communication with patients via the app. The healthcare team sent early reminders and messages, and timely responses were expected in return from participants. The project team also documented critical information about patients, such as height, weight, BMI, blood pressure, and blood sugar on their electronic health records. If there were changes to participants' weight, blood pressure, or blood sugar, these were further documented on their electronic health records.

The project team met with participants during clinic visits and downloaded the Glucose Buddy app onto their smartphones. The project team then held several sessions with type 2 diabetics and their families when they requested follow-up demonstrations. The team further clarified questions of concern to patients, families, and caregivers.

Essential V: Healthcare Policy for Advocacy in Healthcare

The importance of advocacy in healthcare cannot be overemphasized. For this project, insurance companies were contacted, urging for type 2 diabetics to receive annual checkups with ophthalmologists. The importance of consistent primary care visits once or twice a year with a

primary care physician was also emphasized for type 2 diabetics in this project. The mentor and I further advocated for prescription cost reduction for all patients with their insurance companies. I continued to shadow the mentor and attend clinic sessions. The provider team made recommendations and arranged follow-up care for type 2 diabetics with chest pain, such as cardiology referral for thorough evaluation.

After attending a virtual seminar, I acquired new knowledge and skills to help manage challenges that type 2 diabetics encounter, which can improve health outcomes. There was a teaching session held for patients and families to demonstrate strategies and to answer questions on how best to help prevent or delay short- and long-term DM complications.

Essential VI: Interprofessional Collaboration for Improving Patient and Population Health Outcomes.

I attended two conferences: One was a virtual conference on new advances in diabetic care management, and another was the ADA conference with a focus on the dietary management of T2DM. The practice collaborated with a dietician to recommend healthy choices and food portions for T2DM. The discussion between the dietician and patients involved aiming for the consumption of small, portioned meals, of no more than 1400 calories/day. Meetings were scheduled with patients and their families to discuss home meal planning and incorporate several servings of fruits and vegetables in daily meals.

The provider team sent eye and foot referrals for patients to be required specialties to decrease the onset of DM complications. The practice also partnered with a physical therapist, who occasionally visited the clinic to assess patients.

Essential VII: Clinical Prevention and Population Health for Improving the Nation's Health.

Gaps in health promotion for type 2 diabetics were identified, including obesity and high cholesterol diet. Consequently, I assessed the needs of the participants and determined that the mobile app would assist in making a change, close the gap, and promote required behavioral change. Healthy habits to lower blood sugar and cholesterol levels were introduced, such as incorporating a low-calorie diet and encouraging weight loss.

After identifying selfcare deficits in type 2 diabetics and ways to stimulate motivation, the healthcare team was encouraged to send frequent reminders and messages to increase adherence to each participant's treatment plan. App interaction was between the healthcare team and patients was assessed to determine changes in PHE. Key operational challenges associated with effecting change within healthcare organizations were also assessed. Type 2 diabetics were encouraged to use available community resources.

Essential VIII: Advanced Nursing Practice

A major role of APRNs as healthcare providers is to educate and counsel patients and their families as they face the challenges that come with managing a chronic illness like T2DM. It is integral that the patient and family be educated in all aspects of the treatment plan. Therefore, I applied an EBP approach in caring for T2DM and carried out a comprehensive assessment on these patients with the help of the healthcare team. As a conceptual framework, the CCM approach of establishment of good rapport was implemented in managing these patients (Jeon & Park, 2019).

This writer attended virtual conferences and attained knowledge on diabetic care. Based on patients' needs and preferences, specific diabetics were enrolled in counselling sessions to

cope with anxiety. Additionally, I participated in various support group meetings for type 2 diabetics, especially those with obesity, then recommended available community resources to maintain functioning and reduce health declines in these patients. I also encouraged patients to communicate and socialize with other peers who have T2DM as a way to boost confidence. Lastly, I gained knowledge as a leader and an educator, examined modalities of healthcare financing impacting type 2 diabetics and advanced nursing practice as a profession.

Conclusion

T2DM is a chronic debilitating disease. Patients living with this disease face challenges on a daily basis, stemming from poor knowledge and inadequate self-care skills. Successful diabetes management involves a team effort to achieve treatment goals. Continuity of care is essential, and the goal of treatment is to prevent or slow chronic complications. In the past, the standard care approach failed patients and lacked the engagement required to achieve desired goals. Digital technology introduced an innovative solution to lack of PHE by encouraging new behavior for developing skills necessary to lower morbidity and mortality in this group.

PAM-13 score questionnaire was used as a tool to assess health engagement among the participants. The four outcomes in this project depicting PHE were: (a) medication adherence, (b) dietary compliance, (c) physical activity, and (d) scheduled appointment attendance; each were successfully improved by use of the mobile app, Glucose Buddy. This digital app intervention was beneficial to the patients and the practice. Glucose Buddy empowered T2DM to fully participate and better manage their health condition. Financially, the mobile app usage decreased overall healthcare costs for the patients and the practice. The use of app messages and reminders proved better than the standard care approach in promoting PHE. The app reminders

were used to restore self-care skills which ultimately improved compliance to treatment plan (Jeon & Park, 2019).

It is recommended that providers should continue to use the Glucose Buddy app with all T2DM patients who attend the clinic. Results of this project was shared at a local conference, as a way for the information to reach a larger audience and to encourage patients to utilize the mobile app to boost PHE. Finally, it is important to address using digital technology to manage multiple chronic conditions that may occur either alone or as co-morbidities in T2DM such as hypertension, heart disease, mood disorders, cancer, peripheral vascular disease, and chronic kidney disease.

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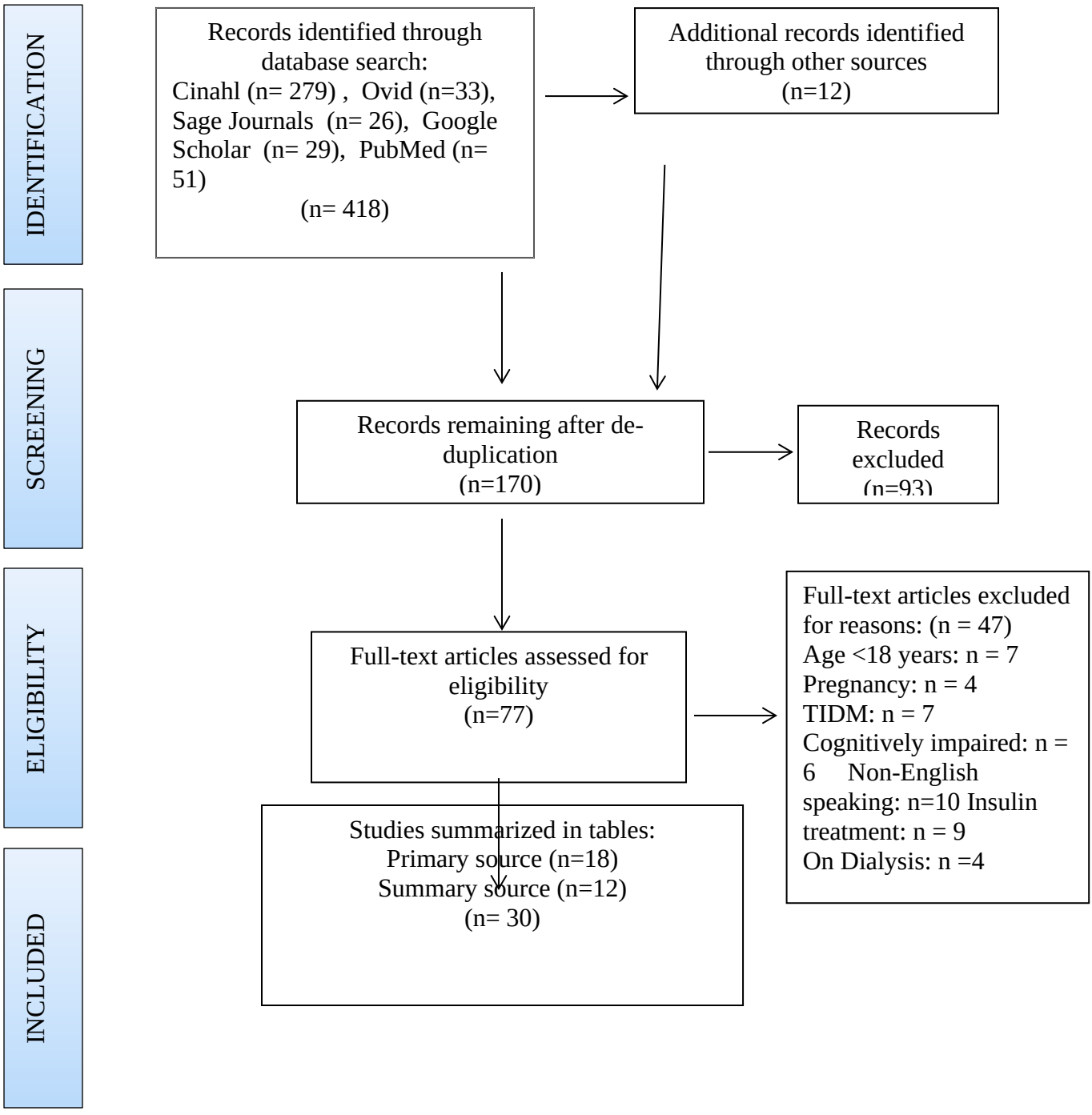
Appendix A

Search Strategy

PICOT Question: In Adults with type 2 diabetes mellitus, how does utilization of a mobile app (digital health) compared to standard care, affect patient health engagement over a six-week period?
Keywords: adults, type 2 diabetes mellitus, mobile app, self-care, health engagement.
Date Range searched: Jan 2010 to Jan 2021.



Appendix B

Project Survey Questionnaire

SURVEY TODAY'S DATE ----------

Participants Name ----------

Cell Phone number ----------

Age (years) ---------- Height -------- Weight ---------- BMI ----------

Gender ❒Male ❒Female

Race/Ethnicity ❒White ❒Black ❒Asian ❒Hispanic ❒Alaska Native

Employment Status ❒Employed ❒Unemployed ❒Retired

Marital Status ❒Single ❒Married ❒Widowed ❒Separated ❒Divorced

Education ❒K-8 ❒GED/HS Diploma ❒Vocational School ❒College Degree

❒Undergraduate Degree ❒Masters/Doctoral Degree

Do you have Type 2 Diabetes Mellitus ? ❒Yes ❒No ❒Not sure

If yes, how long have you had it ? ----------

Physical Activity Level: ❒Low ❒Average ❒Vigorous

On a Scale of 1 to 10 , with 1 being the least and 10 being the most attention, how closely do you monitor your dietary choices; ----------

Do you own a smart phone ❒Yes ❒No

Do you have reliable Wi-Fi at home ❒Yes ❒No

How many times did you use the Mobile App ----------

On a Scale of 1 to 10, with 1 being the least and 10 being the best, Can you rate your attendance at scheduled Appointments; ----------

On a scale of 1 to 10, with 1 being the least and 10 being the most, how strictly do you adhere to your prescription medications ----------

Do you have any DM Complications or had a referral to a specialist for Eye checkup, Kidney disease or foot care ❒Yes ❒No

Appendix C

PAM-13 Score Questionnaire

PATIENT ACTIVATION MEASURE (PAM)

PAM measures a person's underlying self-management ability or activation

Below are some statements that people sometimes make when they talk about their health. Please indicate how much you agree or disagree with each statement as it applies to you personally by circling your answer. If the statement does not apply to you, circle N/A.

1. I am the person who is responsible for taking care of my health.	Disagree Strongly	Disagree	Agree	Agree Strongly	N/A
2. Taking an active role in my own healthcare is the most important thing that affects my health.	Disagree Strongly	Disagree	Agree	Agree Strongly	N/A
3. I am confident I can help prevent or reduce problems associated with my health.	Disagree Strongly	Disagree	Agree	Agree Strongly	N/A
4. I know what each of my prescribed medications do.	Disagree Strongly	Disagree	Agree	Agree strongly	N/A
5. I am confident that I can tell a doctor or nurse concerns I have even when he or she does not ask.	Disagree Strongly	Disagree	Agree	Agree Strongly	N/A
6. I am confident that I can carry out medical treatments I may need to do at home.	Disagree Strongly	Disagree	Agree	Agree Strongly	N/A
7. I have been able to maintain lifestyle changes, like healthy eating or exercising.	Disagree Strongly	Disagree	Agree	Agree Strongly	N/A
8. I know how to prevent problems with my health	Disagree Strongly	Disagree	Agree	Agree Strongly	N/A
9. I am confident I can work out solutions when new problems arise with my health.	Disagree Strongly	Disagree	Agree	Agree Strongly	N/A
10. I am confident that I can maintain lifestyle changes, like healthy eating and exercising, even during times of stress.	Disagree Strongly	Disagree	Agree	Agree Strongly	N/A
11 I am confident that I can tell whether I need to go to the doctor or whether I can take care of a health Problem myself.	Disagree Strongly	Disagree	Agree	Agree Strongly	N/A

12 I understand my health problems and what causes them .	Disagree strongly	Disagree	Agree	Agree Strongly	N/A
13 I know what treatments are available for my health Problems.	Disagree Strongly	Disagree	Agree	Agree Strongly	N/A

Appendix D

HSRC Approval from WU

(DNP) PROJECT

Student: EJINAKA (Last) NJIDEKA (First) J (Middle Initial)

Student ID: W00345646

DNP Project Chair: Dr Anne Lara

RECORD AND REVIEW OF DOCTOR OF NURSING PRACTICE

Academic Level

☒ 1. DNP Project

Forms Check List

☒ 1. DNP Project Protocol

☒ 2. CITI Training Certificate*

* Check with the DNP Program Chair for training requirements
* Training certificate cannot be older than 3 years

☒ 3. Instrument(s) *(as needed)*

☒ 4. Other Clinic Approval Letter

This section is to be completed by the HSR Committee

Archive Number: Click here to enter text.

DNP Category: Choose an item.

Final Approval Date: Click here to enter a date.

Complete This Worksheet Prior to Completing This Form

Purpose: The purpose of this worksheet is to provide support for making Quality Improvement Project determinations when there is uncertainty regarding whether the quality activity contains Human Subjects.

Directions: For a proposed DNP project to be classified as containing only Quality Improvement activities—which permits use of the DNP HSRC form—answers to all of the questions in the worksheet must be 'TRUE' for each activity proposed in the DNP project. If one or more answers is 'FALSE', the project requires completion of the HSRC standard form and committee review.

TRUE	FALSE	
☒	☐	The intent of the proposed activity is to assess and/or improve the quality of a practice, product, or program to ensure established educational, clinical or program service standards are met, or best evidentiary practices attained.
☒	☐	No activity proposed provides less than standard of care, services, or instruction to participants.
☒	☐	No practice, product or program changes proposed are experimental and no test interventions or research questions are added that go beyond established or evidentiary best practice.
☒	☐	The proposed activity does not: (1) include a 'control group' in whom care, products, services or educational instruction are intentionally withheld to allow an assessment of its efficacy or (2) assign participants to receive different procedures, therapies or educational instruction based on a pre-determined plan such as randomization.
☒	☐	The proposed activity does not involve the prospective evaluation of a drug, procedure or device that is not currently approved by the FDA for general use (including "off-label" indications).
☒	☐	The proposed activity does not test an intervention or add research questions that go beyond established evidentiary best practice and/or are intended to generate generalizable knowledge.
☒	☐	The proposed activity would not increase harm—physical, psychological, social, or economic—than would normally be encountered by the individual if s/he was not participating in this activity.
☒	☐	The lead person on the project has organizational responsibility and authority to recommend or impose a corrective action plan based on the outcome(s) of the activity, as applicable.
☒	☐	Interpretation of the data or any feedback to those who would benefit from the findings will not be deliberately delayed.

☒	☐	The proposed activity has merit and will likely be conducted regardless of any possibility of publication or presentation that may result from it.

Adapted from Rutgers HRP-309 (2017) with permission from Judith Neubauer, PhD.

DNP Project Information

Title of DNP Project (12 to 15 words maximum):

Click here to enter text.
An Advanced Practice Nurse Led Initiative to Evaluate the Effect of the Use of Digital Health Technology on Patient Health Engagement in Adults with Type 2 Diabetes.

Problem Description:
Provide a short summary of the clinical practice problem you will address with your DNP project. What is the gap in practice and what evidence will you be translating to practice?

For this DNP project, I will be working with Type 2 Diabetics at my practice site. There are over 34 million Americans living with Diabetes and 90-95% of them have T2DM (Centers for Disease Control and Prevention [CDC], 2020). The physiological and economic impact of managing T2DM is financially disabling to most individuals (CDC, 2020). As a result, patients must be encouraged to become more involved with managing their own care to slow and prevent the early onset of complications (Elsabrout, 2018).

A change in practice is needed because these diabetics lack adequate selfcare skills, lack motivation for behavioral change, and fail to meet set goals for proper management of their Diabetes. Appointment data reveals failure to keep to scheduled appointments with high no-show numbers despite all the education, non-adherence to medication therapy with blood glucose numbers that are extremely out of range, and a personal disclosure of engaging in fast food diet. The traditional (standard model) of care delivery, which includes a face-to-face interaction between patients and a healthcare provider, may not be engaging enough, and yields limited impact on patient outcomes (Jeffrey et al, 2019). Evidence based studies have shown that lack of patient engagement is a major contributor to preventable deaths (Sahin et al., 2019). It is estimated that 40% of deaths in the United States are caused by modifiable behavioral issues; including smoking, obesity, alcoholism, inadequate exercise, medication non-adherence, and neglect in attending follow-up medical appointments (CDC, 2020). Utilization of digital health technology is an innovative way for the healthcare team to promote patient engagement and deliver continuous care to patients outside the clinical setting (Chao et al., 2019; Elsabrout, 2018).

Mobile apps like Glucose Buddy, is embraced as a tool to enhance patient engagement, improve quality of care, support health care safety, and provide cost-effective health services for patients (Chao et al., 2019). Frequent, real-time communication and feedback are essential in supporting health behavioral change and patient empowerment (Sahin et al., 2019). Glucose Buddy will enhance patient health engagement by reminding patients to take their medications, serve as a guide for healthy food selection, recommend an increase in physical activity, encourage follow-up visits, promote a positive and proactive attitude towards DM self-management (Enricho-Nkhoma et al., 2021). The best way to reduce health risks associated with poorly controlled DM is through prevention achievable via patient engagement (Elsabrout, 2018). Evidence based research shows that giving patients access to their clinical information via digital technology empowers them to increase engagement which ultimately improves health outcomes (Jeon & Park, 2019).

Patient activation is a key concept which refers to people's willingness and capacity to take on the role of managing their own health and care. Most things related to human behavior cannot be measured directly. There is no single objective measure for this, other than using a patients (subjective) response as depicted by the PAM score. For my DNP project, I will be using the Patient Activation Measure (PAM) score. PAM score is a 13 item questionnaire that assesses the level of activation of patients towards their care management. Evidence based research shows that highly activated individuals are more likely to engage in positive health behaviors and to have better health outcomes (Jeffrey et al ., 2019).

Insignia health is the only firm that can authorize a PAM research license. I have applied to secure a license from Insignia Health, I communicated with them and got a discount code.

References

Centers for Disease Control and Prevention [CDC]. (2021). National Diabetes Statistics report 2021: Estimates of Diabetes and Its Burden in the United States. Retrieved from https://www.cdc.gov/diabetes/data/statistics-report/index.html

Chao, D.Y., Lin, T. M., & Ma, W. (2019). Enhanced Self-Efficacy and Behavioral Changes Among Patients With Diabetes: Cloud-Based Mobile Health Platform and Mobile App Service. *Journal of Medical Internet Research on Diabetes, 4*(2):e11017 https://diabetes.jmir.org/2019/2/e11017

Elsabrout K. (2018). Increasing diabetic patient engagement and self-reported medication adherence using a web-based multimedia program. *Journal of the American Association of Nurse Practitioners*, *30*(5), 293–298. https://doi.org/10.1097/JXX.0000000000000045

Jeffrey, B., Bagala, M., Creighton, A., Leavey, T., Nicholls, S., Wood, C., Longman, J., Barker, J., & Pit, S. (2019). Mobile phone applications and their use in the self-management of Type 2 Diabetes Mellitus: a qualitative study among app users and non-app users. *Diabetology & metabolic syndrome*, *11*(1), 1-17. https://doi-org.mylibrary.wilmu.edu/10.1186/s13098-019-0480-4

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Nkhoma, D. E., Soko, C. J., Banda, K. J., Greenfield, D., Li, Y. C. J., & Iqbal, U. (2021). Impact of DSMES app interventions on medication adherence in type 2 diabetes mellitus: Systematic review and meta-analysis. *British Medical Journal Health & Care Informatics*, *28*(1), e100291. https://doi-org.mylibrary.wilmu.edu/10.1136/bmjhci-2020-10091

Sahin, C., Courtney, K. L., Naylor, P. J., & E Rhodes, R. (2019). Tailored mobile text messaging interventions targeting type 2 diabetes self-management: A systematic review and a meta-analysis. *Digital health*, *5*, 2055207619845279. https://doi-org.mylibrary.wilmu.edu/10.1177/2055207619845279

External Projects

If the DNP project will involve other organizations, it may be necessary to obtain permission from these organizations prior to collecting data. Some organizations have Institutional Review Boards (IRBs), and it may be necessary to obtain formal approvals from these IRBs. In other cases, a document from an appropriate organizational executive specifically approving the DNP project would be sufficient. The DNP student is responsible for determining what type of approval is required and obtaining the approval.

In cases where approval from Wilmington University's HSRC is required as a precondition to obtaining approval from another organization, the HRSC's approval will be provisional, requiring the additional step of obtaining DNP project approval documents from other organizations before receiving full approval from Wilmington University's HSRC.

If the DNP project involves other organizations, please answer these questions.

	YES	NO
Do these organizations require approval by their IRBs?	☐	☒
Has IRB approval been obtained? If **YES**, please attach the approval to this submission	☐	☒
Have other permission documents been obtained? If **YES**, please attach the approvals to this submission.	☒	☐

Other relevant information or comments:

Click here to enter text.
I am attaching a Letter of Approval to my Application. The signer is a cofounder of the practice and also a Healthcare provider.

Population Information

Population: Gender, All Age ≥18years Race/ethnicity(ies) All

PICOT Question:
Include the PICOT Question in a complete sentence and then break down each section, Population -; Intervention -; Comparison -; Outcome -; Time -. Include sufficient detail so that someone unfamiliar with the project would understand all aspects of the proposed DNP project.

PICOT Question: In Adults with Type 2 Diabetes, how does utilization of a mobile App compared to standard care affect patient health engagement over a six week period?
Population: Adults with T2DM
Intervention: Mobile App usage
Comparison: Standard care (Adults with T2DM not using Mobile App)
Outcome: Patient Health Engagement
Time: Six weeks

How many participants (patients, providers, etc.) are anticipated for the DNP project?

Projected number of Participants = 30 patients

How will participants be selected for participation? (from PICOT question)

About 30 participants are selected for this project.

Inclusion criteria for eligibility include; Age ≥ 18 years, T2DM, must speak, read, and write English, owns a smartphone.

Exclusion criteria: minors, T1DM, pregnancy, cognitive impairment, complications such as nephropathy requiring dialysis.

What are the procedures that the participants will undergo in the proposed DNP project including the physical location and duration of participation? Provide a step-by-step outline of the project from start to finish. **Attach a copy of all DNP instruments, e.g., surveys, questionnaires, interview questions, etc. (if being utilized):**

This DNP project will take place at a primary care clinic in Greenbelt, MD and will last a period of six weeks. The participants are Adult type 2 diabetics, smartphone owners who can communicate well in English language.

Step 1: The objective of the project is to determine the effect of mobile app usage in engaging T2DM patients to improve their overall health.

Step 2: Explain purpose of project to all participants, distribute Paper surveys and PAM Score. Responses will be collected and electronically transcribed for statistical analysis (Pre-intervention data).

Step 3: At a different clinic visit, download Glucose Buddy App on patients smartphones. I plan to use the standard version of this app which is free.

Step 4: Healthcare team will interact with patients for six weeks using the Glucose Buddy App. Data will be collected on the number of times participants used Glucose Buddy App, attendance at scheduled appointments, medication adherence, making healthy food selection, engaging in physical activity.

Step 6: At six weeks, distribute paper Survey and PAM score to participants at the clinic. Data will be collected for analysis. This is the post-intervention data. Information will be stored in secured digital files.

Confidentiality and Security

Select **YES** to certify that:

	YES	**N/A**
Procedures have been taken to ensure that individuals cannot be identified via names, digital identifiers (e.g., email address, IP address), images or detailed demographic information.	☒	☐
Code to name association data/information is securely and separately stored. (Participants are given codes and the codes are securely stored separately from their answers.)	☒	☐
All data is maintained in encrypted and/or password protected digital/electronic files.	☒	☐

Individually identifiable information will be securely maintained for three years past the completion of the research, and then destroyed rendering the data unusable and unrecoverable.	☒	☐

Describe the procedures you are taking to maintain anonymity, confidentiality, or information security.

A volunteer RN support staff will collect the paper sheets. The DNP student will enter the data into the spreadsheet for statistical analysis. The participants will be provided with a code instead of their names. Survey data will be stored on a password secured and encrypted digital files. Only the DNP student will have access to these electronic files. The data will be protected on a computer for at least 3 years past completion of the project and then destroyed rendering the data unusable and unrecoverable.

DNP Protocol

Does this DNP project involve?	YES	NO
Prisoners, probationers, pregnant women (if there is a medical procedure or special risk relating to pregnancy), fetuses, the seriously ill or mentally or cognitively compromised adults, or minors (under 18 years) as participants	☐	☒
The collection of information regarding sensitive aspects of the participants behavior (e.g., drug, or alcohol use, illegal conduct, sexual behavior)	☐	☒
The collection or recording of behavior which, if known outside the research, could place the participants at risk of criminal or civil liability or could be damaging to the participant's financial standing, employability, insurability, or reputation	☐	☒
Procedures to be employed that present more than minimal risk[1] to participants	☐	☒
Deception	☐	☒
Possible or perceived coercion (e.g., a concern in power relationships such as teacher/student, employer/employee, senior/subordinate)	☐	☒
Benefits or compensation to participants (beyond the general benefits of the knowledge to be gained or small gifts/lottery prizes)	☐	☒
A conflict of interest (e.g., the researcher's material or other interests may bias collection, interpretation, or use of data)	☐	☒

If you answered "**NO"** to all of the questions, please proceed to the next page.

If you answered "**YES"** to any of the questions, provide evidence that you have taken the training module or modules that relate to this risk and discuss what you learned about reducing the risk from the training in the textbox below and/or by attaching the evidence to this document.

Click here to enter text.

[1] Minimal risk means that the probability and magnitude of harm or discomfort anticipated in the proposed research are not greater than those ordinarily encountered in everyday life or during the performance of routine physical or psychological examinations or tests

Obligations of DNP Student

Any substantive changes made to the DNP protocol must be reported to and reviewed by your college's HSRC representative(s) prior to implementation of such change. Any complications, adverse reactions, or changes in the original estimates of risks must be reported at once to the HRSC chairperson before continuing the project.

Select **YES** to certify that:

	YES
DNP data will be retained for a minimum of three years past the completion of the project in accordance with federal regulations	☒
The DNP student will submit document and form revisions and updates, as appropriate	☒
The DNP student will submit a renewal petition if the data collection has not been completed within one year of the most recent HSRC approval*	☒

* **Note**: HSRC approval expires after one year, requiring renewal of the HSRC Protocol

The DNP student's signature below certifies that he/she has (a) read and understands the obligations as a DNP student, (b) DNP project approval expires one year after the final approval date shown on page 1, and (c) that the information contained in and submitted with this HSRC protocol is accurate and complete.

***DNP Student*:**

Print name: Njideka Ejinaka

Signature: *Njideka Ejinaka* Date: 10/25/2021

Obligations of the DNP Project Chair

The DNP Project Chair has two major obligations. First, the DNP Project Chair must ensure the DNP Student completes all relevant training courses. Second, the DNP Project Chair must ensure the DNP Student submits all document and form revisions and updates, as appropriate for the research.

The DNP Project Chair's signature below certifies that he/she has (a) read and understands the obligations as a DNP Project Chair and (b) that the information contained in and submitted with this HSRC protocol is accurate and complete.

DNP Project Chair:

Print name: Anne E. Lara

Signature: *Dr. Anne Lara* Date: 10/23/2021

PROTOCOL REVIEW

This section is to be completed by the HSR Committee.

DNP Student: Njideka Ejinaka

Date Submitted: 10/25/2021

The protocol and attachments were reviewed:

The proposed DNP project is approved as:

☒ Exempt ☐ Expedited ☐ Full Committee ☐ Provisional (see External Projects section)

The proposed DNP project was approved pending the following changes:

☐ See attached letter

☐ Resubmit changes to the HSRC chairperson

The proposed DNP project was disapproved:

☐ See attached letter for more information.

	YES	N/A
The HSRC representative sent a copy of the HSRC Protocol to the VP of Academic Affairs for research requiring access to Wilmington University students, employees, or data.	☐	☐

HSRC Chair
or Representative Angela Herman
Printed Name

Angela Herman, DNP, RN
Signature Date 11/8/2021

HSRC Chair
or Representative Click here to enter text.
Printed Name

Signature Date Click here to enter a date.

Appendix E

CITI Training

CITI PROGRAM

Completion Date 31Au-
Expiration Date 30Au- 2021
Record ID 4457432 9

This is to certify that:

Njideka Ejinaka

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

Human Subjects Research

Curriculum group)

Health Professions - Human Subjects Research

(Course Learner Group

1 - Basic

(Stage

Under requirements set by:

Wilmington University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w0c13e1c8-ae71-42a4-9244-cc6069 2bfd7b-4457432

Appendix F

IRB Exempt

November 16, 2021

Njideka Ejinaka

Dear Njideka,

Wilmington University's Human Subjects Review Committee (HSRC) is pleased to inform you that your Doctor of Nursing Practice project proposal ***Development and Evaluation of a Nurse Practitioner-Directed Digital Health Technology Initiative for Adults with Type 2 Diabetes in a Primary Care Practice*** was reviewed on ***November 8, 2021***. The project was categorized as ***Exempt*** and meeting the requirements of a quality improvement intervention. Your signed HSRC form is attached. Now that your DNP project has been approved by the HSRC, there are multiple elements with which you must comply.
Wilmington University adheres strictly to these regulations:

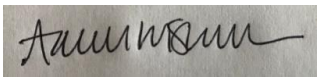
1. You must conduct your DNP project exactly as it was approved by the HSRC.
2. Any additions or changes in procedures must be approved by the HSRC before they are implemented.
3. You must notify the HSRC promptly of any events that affect the safety or well-being of subjects.
4. You must notify the HSRC promptly of any modifications to your DNP project or other responses that are necessitated by any events reported in items 2 or 3.
5. Your approval is provisional if you require Institutional Review Board approval from your organization. Once organizational approval has been obtained, please submit your signed approval and completed IRB application to DNP Administrative Assistant via email.

The HSRC may review or audit your project at random or for cause. In accordance with Wilmington University policy, the HSRC may suspend or terminate your DNP project if your project has not been conducted as approved and/or if other difficulties are detected.

While not under the purview of the HSRC, DNP students are responsible for adhering to US copyright law when using existing scales, survey items, and other works in the conduct of research/DNP projects.

In conclusion, you have developed an interesting evidence-based practice project aligned with the AACN DNP Essentials (2006). This is an important project for healthcare practices now and in the future. Best wishes for continued success.

Sincerely,



Aaron Sebach, PhD, DNP, MBA, AGACNP-BC, FNP-BC, NP-C, CLNC, CNE, CNEcl, SFHM
Chair, DNP Program
Associate Professor
College of Health Professions

Angela Herman, DNP, RN
HSRC Committee Representative
Chair, Health Sciences Program
Assistant Professor
College of Health Professions

COLLEGE OF HEALTH PROFESSIONS

31 Reads Way, New Castle, Delaware 19720

Appendix G

Mobile App Messages