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Text-Based Reminders: Pathways To Improve Hemoglobin A1C and Fasting Blood Glucose Levels of People with T2 Diabetes Mellitus

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ABSTRACT

TEXT-BASED REMINDERS: PATHWAY TO IMPROVE HEMOGLOBIN A1C AND FASTING BLOOD GLUCOSE LEVELS OF PEOPLE WITH T2 DIABETES MELLITUS

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ABSTRACT OF GRADUATE STUDENT RESEARCH

Scholarly Project

Andrews University

School of Nursing, College of Health & Human Services

Title: TEXT-BASED REMINDERS: PATHWAY TO IMPROVE HEMOGLOBIN A1C AND FASTING BLOOD GLUCOSE LEVELS OF PEOPLE WITH T2 DIABETES MELLITUS

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Date completed: February 2024

Background

Research studies have shown that self-monitoring blood glucose levels is a cornerstone in DM management. Various studies have shown that a text message intervention effectively reminds people with T2 Diabetes Mellitus (T2DM) to check their blood glucose levels at home. Text message reminders successfully encourage medication adherence, blood glucose self-monitoring, and lifestyle changes (Xiqian et al., 2019). Through the beneficial effects on HgbA1c and blood glucose, text-based

reminders have been demonstrated to improve blood glucose self-monitoring, essential to managing diabetes.

Purpose

This project aims to evaluate the effects of the 12-week text-based reminder intervention on the patient's blood sugar and HBA1C levels, and the frequency of glucose checks with text-based reminders compared to usual practice.

Methods

Standard data extraction and literature search were performed in PubMed, Medline, and EMBASE databases. A quantitative, quasi-experimental design was conducted. This prospective study used a pre/posttest design from a convenience sample. Participants with a HbA1c of 7% and over and FBG of 126 mg/dL or over were monitored for 12 weeks with text-based reminders. Participants were place in experimental and control groups. The experimental group received four text messages weekly reminding them to check pre-prandial glucose levels. Control group received the standard of care which did not include any text reminders.

Results

The total sample size was 107 subjects (experimental group 54 subjects and control group 53 subjects). For the experimental group, there was a positive mean difference for the blood group and HBA1C post-intervention, which was highly significant (P-value=<0.0001). The 12-week intervention improved blood glucose measurement at home with a median of 24 times (experimental group) vs six times (control), which was highly significant (P-value=<0.0001).

Conclusion

The outcome of this project has shown that text-based reminders improved home blood glucose monitoring and hold promise for improving diabetes outcomes of patient with T2DM. Improved self-care with blood glucose monitoring may help to decrease diabetic complications and healthcare costs among this population.

Keywords: Text message, fasting blood glucose, Hemoglobin A1C and T2DM

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A Scholarly Project

Presented in Partial Fulfillment

of the Requirements for the Degree

Doctor of Nursing Practice

By

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APPROVAL BY THE COMMITTEE

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	Date approved.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

ADA	American Diabetes Association
CDC	Centers for Disease Control and Prevention
EMR	Electronic Medical Record
FBG	Fasting Blood Glucose
HbA1C	Glycated Hemoglobin/Hemoglobin A1c/Glycosylated Hemoglobin
IDF	International Diabetes Foundation
SMS	Short Message Service
T2DM	Type 2 Diabetes Mellitus

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CHAPTER 1

INTRODUCTION

Type 2 diabetes (T2DM) has become a significant healthcare challenge worldwide, reaching epidemic levels in recent years. According to Amanat et al. (2020), T2DM prevalence globally has quadrupled within the last three decades. A report by the Centers for Disease Control and Prevention (CDC, 2022a) indicates that 11.3% of the entire United States (US) population has diabetes. A total of $237 billion is spent annually on direct medical costs. In addition, another $90 billion is incurred as a result of reduced productivity (CDC, 2022b). Diabetes mellitus accounts for over 90-95% of diabetes among adults (Borse et al., 2021). The rise and prevalence of T2DM has been primarily attributed to the modern sedentary lifestyle. With unhealthy diets these lifestyles often increase the body mass index (BMI), which raises the risk of T2DM (Amanat et al., 2020; Khan et al., 2020).

Despite the various treatment and intervention measures, diabetic patients develop multiple complications, including resistance to insulin action – a glucose-lowering hormone (Borse et al., 2021). Another widely acknowledged holistic intervention measure for managing diabetes is lifestyle modification, as advocated by the American Diabetes Association (ADA) (Davies et al., 2022). However, lifestyle modification is not always effective due to various factors such as time constraints, lack of friends and family support, low motivation or energy, and lack of resources or equipment (Othman et al., 2022). In addition, Pleus et al. (2022) indicated that one of the proven diabetes

management options is self-monitoring blood glucose levels. Nevertheless, self-monitoring of blood glucose faces various challenges, including frustration related to high blood glucose readings, stigma, inconvenience, and lack of motivation (Othman et al., 2022).

Background

Studies revealed that self-monitoring blood glucose levels is a cornerstone in diabetes Mellitus (DM) management (Pleus et al., 2022). Text-based reminders effectively improved blood glucose levels among adults with T2DM (Owolabi et al., 2019). The last decades have witnessed an increased incidence of diabetes globally. The incidence has reached epidemic proportions in New Jersey, especially in Passaic County.

Studies from various countries have shown that text message intervention effectively reminds people with T2DM to check their blood glucose levels at home. Numerous studies have shown the beneficial effects of text-based reminders on diabetic patients' HbA1c levels and blood glucose management. Text message reminders successfully encourage medication adherence, blood glucose self-monitoring, and lifestyle changes (Xiqian et al., 2019). Text-based reminders have been demonstrated to improve blood glucose self-monitoring, essential to managing diabetes. According to studies, timely reminders encouraged people to test their blood glucose levels more often, which improved glycemic management (Xiqian et al., 2019). People are more likely to consistently test and record their blood glucose levels if they get timely reminders. Better glycemic control may be achieved with the help of these reminders since they encourage regular self-monitoring. Because most adults utilize texting services daily, it is reasonable to believe that a text message program can improve glycemic control. Glucose

monitoring at home is a convenient test. It helps the patient's involvement in self-management decisions, lowers glucose levels, and decreases or delays long-term complications.

Significance

Diabetes is a chronic illness that requires regular monitoring of blood glucose. There is no cure for diabetes; blood glucose monitoring is one way to manage diabetes. A follow-up BG of patients with diabetes via text message reminder is necessary for the providers to know if the treatment or lifestyle strategies are effective. The providers and the patients have roles to play; text-message reminders from the clinic and patients checking and recording their blood glucose in the blood glucose logbook will help the patients reflect on their blood readings and know when to call their physician.

This quality improvement project will help the providers in the clinic find a better way to support their patients distantly. The text-based reminder intervention used in this project improved the participants' HbA1c and BG levels after 12 weeks. The outcome of this project motivated the providers to create a unique text-message line that will be used to text and remind attending patients with diabetes to check their blood glucose.

Context

According to the Diabetes Foundation (2023), uncontrolled blood sugar is silently destroying lives across the Garden State of New Jersey (NJ). According to the Centers for Disease Control and Prevention (2022a), the National Diabetes Statistics Report reaffirmed that approximately 11% of New Jerseyans are diabetic, 37% are prediabetic, and more than 50% of these prediabetic people are not even aware. American Diabetes Association (2022), approximately 10.5% of the adult population in NJ are diagnosed to

be diabetic, 34% of the adult population is prediabetic, and approximately 11% of the general population of New Jerseyans are diabetic but not aware.

In the GMed healthcare context, the majority of the patients between the ages of 45 and 64 are diagnosed with T2DM as a result of coming to the clinic with complaints of body weakness. Some of these patients do not have any prior self-monitoring blood glucose at home until they come to the clinic and have their blood glucose and HbA1c done, and the result is>140 mg/dL and 7%, respectively. Those with late diagnosis because of a lack of self-monitoring of blood glucose at home will result in complications like heart disease, stroke, amputation, end-stage kidney disease, blindness, and death.

This project was designed to promote patients' self-monitoring of blood glucose at home via text-based reminders from the provider. Text messaging will help the patient remember to check their blood glucose before breakfast and fast 8 to 10 hours before the blood glucose test in the morning. Patients understood how food, activity, and other things affect their blood sugar levels. For these reasons, patients could understand what made their glucose levels go up and down, like their food or physical exercise.

Problem Statement

Despite the high prevalence of diabetes and complications of T2DM, the project site, GMed Healthcare clinic, has no formal plan to remind patients attending the clinic to check their blood glucose at home. The project site sees about 40 to 50 patients with diabetes every week. Over 50% of these patients returned to the clinic within four weeks with uncontrolled blood glucose levels. Interaction with these patients proved that approximately 75% failed to check their blood glucose regularly at home. A more

significant number of patients check their blood glucose only when they feel weak or tired.

Therefore, implementing this quality improvement allowed the facility to support patients after leaving the clinic. One of the convenient options is text messaging the patients to check their blood glucose levels and record them in the blood glucose log that the clinic will provide. Studies have shown that text messaging and mobile phones are convenient ways of contacting and reminding patients outside the clinic (Dobson et al., 2018).

In this regard, implementing a quality improvement initiative at this selected outpatient primary care clinic will provide timely support that positively impacts the patient outcome, leads to better patient outcomes, and informs standard practice in managing T2DM.

Purpose Statement

This DNP quality improvement project aimed to implement 12-week text-based reminders of home glucose checks among adult patients with T2DM.

Objectives

To evaluate

- the effects of the 12-week text-based reminder intervention on the patient's blood sugar

HBA1C levels.

- The frequency of glucose checks with text-based reminders compared to usual practice.

Clinical/ Project Questions

The following PICOT question will guide the DNP project: Among adult outpatients with type 2 diabetes (P), does text-based reminders of blood glucose checks (I) compared to usual practice (C) improve HbA1c and blood glucose levels (O) within twelve weeks (T)?

Research Questions

-How does text-based WhatsApp reminder affect blood glucose and Hemoglobin A1C after 12-week intervention?

-What are the differences in HbA1c levels and frequency of glucose checks before and after using WhatsApp intervention for twelve weeks among patients with T2DM?

CHAPTER 2

LITERATURE REVIEW

A comprehensive literature review was conducted to identify evidence supporting the project. The following databases, PubMed, Cochrane, ScienceDirect, and Cumulative Index to Nursing and Allied Literature (CINAHL), were used to locate up-to-date literature. The clinical question guided the search. In addition, various key search terms, including type 2 diabetes, and text-based reminders were used to facilitate the search. The evidence used was level I for systemic reviews and randomized control trials, level II for quasi-experimental studies, and Level III for non-experimental studies. The articles reviewed showed convincing support for implementing text-based reminders among adult patients with type 2 diabetes (Hildebrand et al., 2020; Middleton et al., 2021; McDaniel et al., 2022; Magalhães et al., 2019).

Based on the literature review, text-based glucose check reminders were selected for this quality improvement project. Text-messaging people with diabetes at home to monitor their blood glucose at home effectively lowers blood glucose. However, the incidence of uncontrolled blood among the patients attending GMed clinics soared. Literature findings summarized evidence of improved health outcomes, which usually requires the patients to adopt various self-management practices as advised by the care provider. The recommended practices include a healthy diet, exercise, regular glucose monitoring, weight monitoring, and adherence to the prescribed medication (Karthik et

al., 2020; Maina et al., 2020). The interventions target several biomarkers, including fasting plasma glucose and hemoglobin A1c (HbA1c). The American Diabetes Association (ADA) sets the target HbAIc at <7% for diabetes patients, but current evidence demonstrates that many do not meet the target. Data gathered by the National Health and Nutrition Examination Survey (NHANES, 2009-2020) shows that only 25.2% of patients with type 2 diabetes mellitus with mealtime insulin (T2DM-MTI) and 12.3% of those with T2DM using basal-only insulin attain the <7% glycemic targets (Hankosky et al., 2023). The rates of attaining individualized glycemic targets are lower at 16.1% and 12.4% for T2DM basal-only and T2DM-MTI persons, respectively. Besides, around 63.9% of T2DM patients do not attain the self-monitoring frequencies ADA recommends (Xu et al., 2020). Effective interventions are necessary to improve blood glucose and HbA1c levels and enhance self-motoring among individuals with T2DM.

Telemedicine interventions have been applied in various settings to improve patients' adherence to self-management and monitoring practices, leading to desirable HbA1c and blood glucose levels. In a recent study, adopting Short Message Service (SMS) and phone-based interventions to facilitate two-way communication between patients and care providers reduced HbA1c by 1.17% for individuals in the intervention group (Xu et al., 2020). There was a corresponding decrease in fasting blood glucose (FBG) among 50% of the patients with baseline FBG >150 mg/dL and an 11% increase in patients reaching the target HbA1c<7%. Using the messaging and calls application was an affordable and accessible approach to improving glycemic control for T2DM patients by enhancing patient-provider engagement (Xu et al., 2020). Similarly, a messaging intervention implemented by Wang et al. (2020) showed significant improvements in the

intervention group compared to the control group for different outcome measures, among them FBG (1.5 vs. 0.4, $P = 0.011$), postprandial glucose (PPG) (5.8 vs. 4.2, $P = 0.009$) and control rate (9.4% vs. 33.3%, $P = 0.034$). The SMS intervention also yielded positive outcomes in self-management practices such as physical activity, healthy eating, and weight control (Wang et al., 2020). Improving in these areas promises positive health outcomes for T2DM patients.

The effectiveness of the text messaging intervention in improving blood glucose and HbA1c levels can be attributed to the ability to provide education and reminders for T2DM patients. Through this intervention, the patients can learn about glucose monitoring, receive reminders about medication, and be equipped with information that helps overcome certain social-cultural or medication-related complexities that derail T2DM self-management (Zhuang et al., 2020). Besides allowing care providers to send reminders and share information with T2DM patients, Nelson et al. (2021) note another strength of the text messaging intervention- the ability to initiate interactive conversations. Intervention is more impactful when the patients can give feedback and engage the care providers rather than receiving one-way content. Interactive text messages complement diabetes self-management, improving glycemic control, preventing diabetes-related complications, enhancing patients' quality of life, and reducing treatment costs (Edraki et al., 2020; Oluma et al., 2021). Improving the proposed project's blood glucose and HbA1c levels is a step toward positive health outcomes.

Operational definitions

- **ADA** American Diabetes Association

- **CDC** Centers for Disease Control and Prevention
- **EMR** Electronic Medical Record
- **FBG** Fasting Blood Glucose
- **HbA1C** Glycated Hemoglobin/Hemoglobin A1c/Glycosylated Hemoglobin
- **IDF** International Diabetes Foundation
- **SMS** Short Message Service
- **T2DM** Type 2 Diabetes Mellitus

Theoretical (conceptual)

Text-based reminders taught patients how to develop healthy dietary and exercise habits. Essentially, this training helped the patients to acknowledge and share their emotional challenges as they deal with type 2 diabetes. Given the individualized treatment goals for each patient, mixed messages were tailored to different areas of improvement, including the need and ways to lower the risk factors for the advancement of diabetes.

The participant's understanding of the appropriate glucose levels was necessary for this DNP project. The participants' understanding created an understanding of the possible triggers, symptoms, and risk of extreme variations in glucose levels among participants suffering from T2DM. Besides, the patients' efficacy in administering fasting blood sugar tests was progressively assessed as a baseline.

Theoretical or Conceptual Framework

Rosswurm and Larrabee's theoretical model guided this quality improvement initiative. The model is founded on research and theoretical literature linked to evidence-

based practice. The change model supports evidence-led practice changes by combining contextual evidence, qualitative and quantitative data, and clinical expertise (Rosswurm & Larrabee, 1999). Rosswurm and Larrabee's model comprise six significant elements.

The first element entails assessing the necessity for quality initiatives (Brewer et al., 2023). The phase involves engaging stakeholders, obtaining internal information concerning current practice, identifying/recognizing the practice issue, and comparing internal and external information (Jurns, 2019). In this phase, the project investigator defines the clinical question and categorizes the population, intervention(s), comparisons, expected outcome, and timeframe. The clinical questions help refine the practice issue and facilitate the literature search.

The second step involves linking clinical issues, interventions, and outcomes. This phase involves applying standardized language, identifying potential interventions, and selecting outcome indicators.

The third step comprises appraisal and synthesis of currently available evidence (Williamson, 2019). This entails searching for available evidence, reviewing critically, weighing strengths, synthesizing the ideal literature, and assessing the practice change's risks, benefits, and overall feasibility.

The fourth step involves designing change into practice. In this phase, the project team defines the proposed practice change, identifies needed resources, plans the pilot test evaluation, and develops an implementation strategy (Kaur & Kaur, 2020). Some implementation strategies include appointing change agents and opinion leaders, establishing a reminder system, providing educational resources, and obtaining feedback.

The fifth phase focuses on changing application and appraisal. The primary activities include pilot testing and evaluating costs, processes, and outcomes. Other tasks include creating suggestions and drawing conclusions.

The last step entails integrating and upholding change into routine practice (Rosswurm & Larrabee, 1999). Some notable activities in this phase include communicating the change proposals to the relevant stakeholders, incorporating new approaches into routine practice principles, observing processes and outcomes, and disseminating project results.

The model is broadly used to guide researchers through designing and integrating an evidence-based initiative into practice (Babalola et al., 2021; Fleming, 2020; Lower, 2022; Phillips et al., 2019; Salinas et al., 2021). For example, Babalola et al. (2021) applied Rosswurm and Larrabee's theoretical model to facilitate diabetes education among older Mexican American adults. In this project, Rosswurm and Larbee's theoretical model supported the evidence-practice change initiative to integrate text-based reminders to enhance patients' glucose levels and hemoglobin A1c. Key elements of the model were applied to support the project.

First, the project leaders assessed the internal clinical data to advocate for potential changes in educating diabetic patients. Secondly, the practice issue was linked to the possible intervention through an in-depth literature review and synthesis of evidence to support the implementation of counseling, education, and text-based reminders among patients with type 2 diabetes. The theoretical model was further applied to design the evidence-based practice change. The project leader identified team members and relevant resources to support the proposed quality improvement initiative. The

implementation phase entailed the providers educating patients and sending text reminders to patients with type 2 diabetes. The model was further offered to assess the project using pre-and post-test data. Lastly, the theoretical model facilitated integration and sustained the change in practice, which was realized by sharing the findings with providers and management and frequently monitoring process outcomes.

Application of Rosswurm and Larrabee's Theoretical Model

Rosswurm and Larrabee established a model to help nurses and other healthcare professionals implement evidence-based practice. The model provides six steps the care providers can follow to adopt changes in primary care, inpatient units, and other healthcare settings. The first step was assessing the need for change. Here, the practitioners identified a problem in the practice of GMed Healthcare by collecting internal and external data.

Stakeholders were invited for further discussions to clarify the issue. In the second step, the practitioners link the practice problem to specific interventions and outcomes using standardized classification systems and language. The third stage entails synthesizing the best evidence for the identified interventions and desired outcomes. Critically analyzing the available literature allows healthcare practitioners to assess the strengths and weaknesses of past studies and identify knowledge gaps that require attention. Care providers utilize the numerous electronic databases available, which provide vast literature about different health issues.

The first three steps outlined above have been completed and are relevant to the current project. First, the problem was identified as ineffective self-management practices for T2DM patients, leading to undesirable blood glucose and HbA1c levels. The project

leader evaluated relevant literature to identify suitable interventions and settled for a text-messaging intervention that has previously shown the potential to enhance medication adherence and improve glycemic control and disease self-management for individuals with poorly controlled T2DM (Alamer et al., 2020; Belete et al., 2023; Güner & Coşansu, 2020; Li et al., 2020). The intervention can help improve blood glucose and HbA1c levels among T2DM patients, contributing to positive health outcomes.

The other three steps of Rosswurm and Larrabee's theoretical model fell under the implementation phase of the practice change. In the fourth stage, the practitioners are expected to design the practice change by formulating a proposal outlining the expected change, the required resources, the implementation process, and the expected outcomes. A pilot test may be conducted for large hospitals targeting one or two units. The practitioners implement the intervention in the fourth stage and evaluate the outcomes. The change may be adopted or adapted in the healthcare setting or rejected depending on the project outcomes. The final stage involves integrating and maintaining the practice change. If there are positive outcomes, the new practice can be incorporated into the standards of care within the health facility. Integrating and maintaining change requires stakeholder support, adequate resources, open communication between the care providers and the stakeholders, feedback from nursing personnel, and continuing education (Albright et al., 2022; Ellis et al., 2023). Other internal or external factors may facilitate or hinder the adoption of the new practice.

In line with the steps mentioned above, a protocol will be established to show the planned change, details of the text-messaging intervention, and the expected outcomes. The change agent will then engage other nurse practitioners involved in the project,

conduct provider education on the intervention, collect pre-implementation data, and commence the implementation process. The text-messaging approach is expected to significantly improve the blood glucose and HbA1c levels of T2D patients. Improvements in these areas will indicate improved disease self-management, which is essential in enhancing the patient's health outcomes and overall quality of life (Robson & Hosseinzadeh, 2021). As the expected outcomes were attained, the practice change can be adopted at a larger scale at the healthcare facility or sustained to yield long-term benefits.

CHAPTER 3

METHODOLOGY

This quantitative, quasi-experimental quality improvement project aimed to determine whether the WhatsApp intervention will improve the hemoglobin A1c (HbA1c) and frequency of glucose check levels among adults with T2DM. A sample of adults with T2DM was gathered to use the WhatsApp intervention. Data was gathered prior to and after the intervention. Specifically, this project seeks to address the following questions:

- How do text-based WhatsApp reminders affect blood glucose and Hemoglobin A1C after a 12-week intervention?
- What are the differences in HbA1c levels and frequency of glucose checks before and after using WhatsApp intervention for twelve weeks among patients with T2DM?

Body Mass Index (BMI) was calculated using the following equation: weight (kg)/height (m^2). This value was then categorized using the BMI classification percentiles and cut-off points chart (Connor & Arif, 2023). Adults with a BMI value of ≥30kg/m2 were considered obese. Laboratory investigations were done, which included random blood glucose (mg/dl), glycosylated Hemoglobin (%), total cholesterol (mg/dl), and High-Density Lipoprotein (mg/dl) were also performed.

Category	BMI (kg/m^2)	
	from	to
Very severely underweight		15
Severely underweight	15	16
Underweight	16	18.5
Normal (healthy weight)	18.5	25
Overweight	25	30
Obese Class I (Moderately obese)	30	35
Obese Class II (Severely obese)	35	40
Obese Class III (Very severely obese)	40	

Figure 1. Body Mass Index chart.

American Heart Association (2023), we further categorized blood pressure into normal, elevated, Stage 1 hypertension, Stage 2 hypertension, and hypertensive crisis.

BLOOD PRESSURE CATEGORY	SYSTOLIC mm Hg (upper number)	and/or	DIASTOLIC mm Hg (lower number)
NORMAL	LESS THAN 120	and	LESS THAN 80
ELEVATED	120 – 129	and	LESS THAN 80
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 1	130 – 139	or	80 – 89
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 2	140 OR HIGHER	or	90 OR HIGHER
HYPERTENSIVE CRISIS (consult your doctor immediately)	HIGHER THAN 180	and/or	HIGHER THAN 120

Figure 2. Understanding Blood Pressure Readings | American Heart Association

This chapter will discuss the research method and design, population and samples, and sample size. This chapter will also discuss the research method and design, the intervention, instrumentation, data collection, and data analysis procedures. Finally, this chapter will summarize the critical points of the research methodology employed in this quality improvement project.

Research Method and Design

A quantitative methodology was applied in this quality improvement project. The quantitative method refers to an approach that emphasizes using numerical data and statistical analysis to conclude a particular phenomenon (Kim & Kim, 2020). The approach involved collecting data from a sample size and analyzing the data using statistical techniques to identify patterns and relationships between variables.

In the context of implementing text-based reminders of glucose checks and hemoglobin A1c among adult patients with T2DM, the quantitative methodology was used to measure the effectiveness of the intervention in terms of patient outcomes as measured using improved glucose control. The data collected included quantitative measures such as HbA1c levels and frequency of glucose checks. In addition, using quantitative methodology allowed the application of statistical analysis techniques to determine if there was a significant effect (Yang et al., 2019).

This project used pair t-tests to identify significant differences between the two groups of control and experimental. Then, a quasi-experimental research design was used to determine the effect of the intervention. A quasi-experimental research design helped evaluate interventions where it was not possible or ethical to have a control group or randomize participants (Conn et al., 2020). A quasi-experimental design was applied to this project because it compared the outcomes of the experimental (intervention) group (patients who receive text-based reminders) with those of a control group that did not receive text-based reminders.

Vinitha et al. (2019), based on a randomized controlled trial conducted in 2 states of India, the intervention group received customized text messages thrice a week. The

intervention group received four weekly text messages in this project, 48 in 12 weeks. During the project, each participant in the experimental group received four text messages each week and a total of 48 text messages for 12 weeks. The participants in the control group were asked to return their blood glucose log after three months, and there was no communication between the investigator and group members. This design allowed the investigator to determine if a text-based reminder protocol reduced fasting blood glucose and HgbA1c levels among patients with T2DM after three months.

Variables (Independent and Dependent)

In this project, the independent variable was the implementation of text-based reminders with the patients. Equally, the improvement in glucose levels and HbA1c constituted the dependent variable for this DNP project.

Target Population and Samples:

Population

The project took place at GMed Healthcare, NJ, an outpatient clinic with a total number of attending patients ranging from 180 to 250 patients/month. 95% of these patients are diagnosed with diabetes, while 90% are T2DM and are on insulin or Glucophage. The target population for this study included adult T2DM patients. A sample of T2DM patients was recruited from GMed Healthcare, a community clinic. GMed healthcare was the clinic that cared for adult patients with metabolic diseases such as diabetes.

The participants are confirmed outpatients with diabetes who have been attending GMed for many years. The practice in this clinic was that patients come for routine checkups every three months. Each time they report for a routine follow-up, a fingerstick

and an HbA1c, covered by insurance, are ordered. However, there is no follow-up between appointments to remind patients to check their blood glucose at home, which makes some patients return with uncontrolled blood glucose within four weeks.

All diabetic patients at this clinic can access glucose monitoring supplies such as glucometers, testing strips, and lancets through private or public insurance plans. For the uninsured, some use Mira, which is an affordable option for these patients. It costs $45/ month or $300 per year, covering laboratory tests for uninsured patients with diabetes and an 80 percent discount for medication. Diabetic patients at this clinic also receive diabetic education on monitoring their glucose levels.

Two recruitment methods were adopted: flyers and face-to-face to gather participants for the project. The participants were recruited at the clinic using an inclusion-exclusion criterion. Only adults who had been diagnosed with T2DM and those who had a smartphone and were able to read messages were included.

Inclusion Criteria

The inclusion criteria were adults' males and females between 45 and 64 years of age attending the proposed project site during the study. The reason for selecting this age range for this project was the increasing trend in the prevalence of diabetes, as reported by the CDC in a systematic review of relevant randomized control trials for a scientific audience. According to the Centers for Disease Control and Prevention (2020), the National Diabetes Statistics Report estimated the number of adults aged 18 years or older with diagnosed diabetes, undiagnosed diabetes, and total diabetes in the United States in 2018. The report indicates that 11.7 million adults between the ages of 45 and 65 were diagnosed with diabetes, compared to 3.6 million (ages 18 to 44) and 11.5 million (age 65

and over). Diabetes Research Institute Foundation (2022) reported that 90 to 95% of the adults diagnosed with diabetes have type 2 diabetes. The onset is typical among people between the ages of 45 to 64.

Exclusion Criteria

Persons with a diagnosis that affects their ability to function were excluded from the project. This was because health conditions affect a patient's ability to function optimally, difficulties in communication, poor judgment, and signing consent. Also, a patient who has another type of diabetes was excluded. The participants' eligibility was determined after permission to review their medical records, which were used to gather data about their ages, genders, family histories, current HbA1c values, and dates. A de-identified sample was used.

The project was discussed with the physicians in the clinic and the reception. Flyers were stationed in the consulting room with the physician's agreement, and the receptionist distributed them to the patient. The physicians showed them the flyer and how the study would benefit the willing participants. The reason for using consultation time was that many patients would be inquisitive about the flyer their primary care physician introduced. Finding the flyers in the doctor's room and the fact that the physician was introducing the flyers to the patients signified strong evidence to convince the patients to participate.

Interested participants contacted the investigator using the contact details in the recruitment flyer. The patients were included in the project upon giving consent, which was done by signing a consent form that outlined the project's purpose and the role of patients in achieving it. Next, the participants were invited to enroll in the study by

completing the questionnaire themselves after explaining how to fill it out. The investigator was in the room with the participants to answer any questions and provide clarifications as they completed the questionnaire form. After that, the investigator collected the completed questionnaire.

The project was set up to not cause the participants social, economic, or mental harm. Upon enrollment, participants were trained to ensure they could receive and read text messages with their mobile phones and record their glucose readings. On the first day of accepting to participate, questions about the participant's demographics, such as their gender, age, occupation, marital status, educational level, income, family history of diabetes, duration of diabetes, and medications, were completed in a private area of the facility. There was monetary compensation of $5 and $10 for eligible participants who completed pre- and post-tests.

Sample Size

A priori power analysis was conducted to determine the minimum number of samples necessary for the study. G*Power v3.1.0 was utilized for the power analysis. Several factors were considered before conducting the analysis. Considering a medium effect size of .50, a significance level of .05, a power of 80%, and a two-tailed dependent samples *t*-test, a minimum sample of 100 participants (50 for control and 50 for experimental) was necessary for the project.

The project was a quality improvement project performed at a New Jersey outpatient clinic. The clinic cared for about 180 to 250 patients monthly. Approximately 30 patients with diabetes were seen weekly, and 75% of these patients had T2DM. By the end of the project sample selection process, 107 participants were recruited. A total of 11

participants were lost to attrition (5 participants for the experimental group and 6 participants in the control group). Ninety-six (96) participants started and completed the process and were used in the analysis. I explored gender differences between the groups. Females represented 44%, while males represented 56% of our sample population.

Data Collection Instrument/Tool

After the consent was obtained and the consent form signed, participants were asked to complete the questionnaire that included questions about their previous practice of checking their blood glucose and their healthcare provider's instructions on how often to check their glucose levels. Participants recorded their blood glucose using the glucose (blood sugar) log template provided. Participants received a $5 (at pretest) and $10 (post-test) gift card for participating in the project.

The project investigator accessed the electronic medical record to obtain the participants' demographic and clinical data. Demographic data will include name, date of birth, sex, and the participant's phone number. Clinical data was recorded, including previous HgbA1c and blood glucose levels. The patient's identity was kept confidential by using a unique code in a file that was securely saved in a password-protected file stored on the project manager's computer. Only the project manager had the original name matching the code to record the blood result in a secure device compliant with the Health Insurance Portability and Accountability Act (HIPAA). All recruited participants were given numbers 1,2, 3, 4, etc., during enrollment; control and experimental groups were selected by numbers (all odd numbers will be categorized as the experimental group, and even numbers will be the control group).

Per the clinic's protocol, all participants were scheduled for a routine follow-up appointment. At this appointment, participants had their routine HgbA1c drawn and a glucose finger stick performed.

Intervention

WhatsApp, a free SMS-based application, was used for unidirectional communication. This text messaging app was free of charge (excluding standard messaging rates) on any network. Also, it was used to promote accessibility among low socioeconomic populations further. Only the experimental group received text-based reminders for 12 weeks. The project investigator sent messages four times weekly to remind the participants to fast for 8 hours, check fasting blood glucose, and record their results. The control group did not receive any text messages or reminders.

Text message intervention has been evaluated in several studies and has shown promise in improving glycemic control and self-management behaviors among adults with type 2 diabetes. For example, Kim and Kim (2020) evaluated an integrated digital self-care education program with the WhatsApp intervention. The intervention participants had significantly lower HbA1c levels and improved self-care behaviors compared to a control group at six months ($p < 0.05$). In another study, Wang et al. (2021) conducted a study on mobile phone app interventions for glycemic control in adults with type 2 diabetes. Again, the investigator found that the WhatsApp intervention will significantly improve HbA1c levels compared to usual care at six months ($p = 0.04$).

Content of the Text Message:

A Reminder Message and pictures are to be sent a day before the test. (see below).

Night Before the Blood Glucose Test (8 hours)

For 8 hours before checking your blood sugar.

Figure 3. No food or drink.

The morning of the Blood Glucose Test

A reminder message and the picture below will be texted to the participants the following morning: "Good morning. It is time to check your blood glucose and record it in the log. "

NB: Remember to record your reading in the log provided.

Figure 4. Check your glucose.

Data Collection Process

At the end of the 12-week intervention, the experimental and control groups came into the clinic as scheduled for a routine follow-up visit, including a lab draw and glucose fingerstick. Results were retrieved from the electronic medical record. Experimental group participants returned copies of their recorded blood glucose logs, had their blood drawn for HbA1c, and received the $10 gift card.

CHAPTER 4

DATA ANALYSIS AND RESULTS

Descriptive Data

For comparisons between the experimental and the control groups, continuous data were presented as mean (Standard Deviation) or median (interquartile range), while categorical data were presented as a frequency count (percentage).

Chi-square tests were used for nominal categorical variables, **Fischer's exact test,** where the **Chi-square** assumptions were not met, and **Kruskal-Wallis's test** was used for ordinal categorical variables.

Two sample student t-tests were used for continuous independent variables, while a paired t-test was used for the dependent continuous variables, which had two groups as appropriate.

A paired t-test is used to find the difference between two variables of the same subject. For example, in this project, the same people whose blood glucose and HbA1c levels were done for the pretest were those whose blood glucose and HbA1c levels were done for the post-test.

See the figure below.

VARIABLES (Continuous and Categorical).

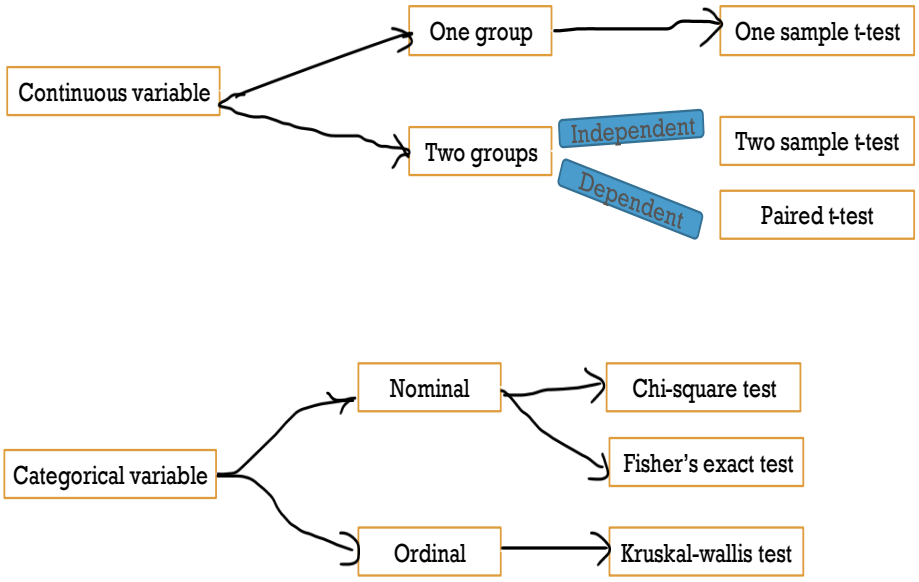

Figure 5. **Variables**

Results

The total sample size was 107 subjects. Ninety-six (96) participants were used in the analysis because 11 subjects were lost to attrition. The investigator explored gender differences between the groups. Females represented 44%, while males represented 56% of our sample population.

Observing if there was a difference in demographic, baseline characteristics, anthropometric, and laboratory variables between the experimental and control groups.

For the experimental group, the mean age was (52.57 years), slightly younger on average than the control group (52.94 years). In both groups, most of the patients fall into stage 2 hypertension, 64.8% for the experimental group and 72.2% for the control group. The most common race in the experimental group was white, representing 31.5% of the group, while the most common race in the control group was black, representing 43.4%.

The control group had a significantly higher weight than the experimental group (150.49 lbs. vs 157.02 lbs.) (p-value =0.050). The control group also had a significantly higher BMI than the experimental group (26.44 〖kg/m〗^2 vs 25.34 26.44 〖kg/m〗^2) (p-value = 0.05).

Table 1: *Characteristic table*

CHARACTERISTICS TABLE

VARIABLES	**EXPERIMENTAL GROUP**	**CONTROL GROUP**	**P-VALUE**
	Frequency (%) **Mean (±SD)** **Median [IQR]**	**Frequency (%)** **Mean (±SD)** **Median [IQR]**	
TOTAL SUBJECTS	**N=54**	**N=53**	
Age (years)	52.57 (±5.79)	52.94 (±5.07)	0.727[1]
Sex			0.835[2]
Female	21 (44.7%)	20 (42.6%)	

Male	26 (55.3%)	27 (57.4%)	
Blood pressure category			0.616[3]
Normal	12 (22.2%)	9 (18.4%)	
Elevated	7 (13.0%)	5 (9.4%)	
Stage 2 Hypertension	35 (64.8%)	39 (72.2%)	
Race			0.116[2]
White	17 (31.5%)	13 (24.5%)	
Black	13 (24.1%)	23 (43.4%)	
Hispanic	10 (18.5%)	4 (7.4%)	
Asian	14 (25.9%)	13 (24.1%)	

Table 2: *Anthropometrics and Laboratory tests*

ANTHROPOMETRICS			
Weight (pounds)	150.49 (±16.53)	157.02 (±17.58)	0.050[1]
Height (Feet and inches)	5”46 (±0.12)	5”46 (±2.97)	0.898[1]
Body mass index (kg/m2)	25.34 (±2.74)	26.44 (±2.97)	0.050[1]
BMI Category			0.076[3]
Normal	29 (53.7%)	17 (32.1%)	
Overweight	22 (40.1%)	31 (58.5%)	
Class 1 Obesity	3 (5.5%)	5 (9.4%)	

LABORATORY TESTS			
High-density lipoproteins (mg/dl)	56.67 (±10.85)	59.81 (±9.11)	0.529^{1}
Low-density lipoproteins (mg/dl)	131.41 (±6.72)	133.85 (±9.42)	0.584^{1}
Triglycerides (mg/dl)	199.67 (±17.38)	200.62 (±18.72)	0.137^{1}

From the Questionnaire:

The experimental group had a significantly higher number of blood glucose recorded at home (median of 24 vs 6) (p-value =<0.0001). The control group had a higher Dexcom use than the exp group, with a higher standard machine use. (4 Dexcom vs 0) (49 standard vs 54 standard) (p-value =<0.0001).

The experimental group had a higher home reminder than the control group (17 vs. 0) (p-value = <0.0001).

Table 3*: Questionnaire questions*

QUESTIONNAIRE QUESTIONS			
QUESTIONS	**EXPERIMENTAL GROUP**	**CONTROL GROUP**	**P-VALUE**
The number of times Blood sugar was recorded (At home during the 12 -week intervention)	24 [5,24]	6 [4,24]	< 0.0001[1]
Average Blood sugar recorded at home (mg/dl)	157.64 (±10.31)	161.90 (±12.0)	0.067[1]
The average time when recording blood sugar			<0.0001[1]
Type of Glucometer			0.040[4]
Dexcom	0 (0.0%)	4 (7.5%)	
Standard	54 (100.0%)	49 (92.5%)	
Reminder at home			< 0.0001[4]
Yes	17 (31.5%)	5 (9.4%)	
No	37 (68.5%)	48 (90.6%)	
Check blood sugar at home			0.572[2]
Yes	46 (85.2%)	43 (81.1%)	
No	8 (14.8%)	10 (18.9%)	
Finger-stick duration at home			0.440[2]
1 year	11 (20.4%)	6 (11.3%)	
2 years	29 (53.7%)	32 (60.4%)	
3 years	14 (25.9%)	15 (28.3%)	
Weekly frequency of blood sugar measurement at home			
Two sample t – test[1], Chi – square test[2], Kruskal – Wallis test[3], Fisher' exact test[4]			

Table 4. *Control and Experimental Groups*

Mean difference between the groups pre/post-intervention

TESTS	**CONTROL GROUP**			
	Pre-Intervention	**Post-Intervention**	Mean Difference	P-Value

Blood Glucose (mg/dl)	163.11 (±11.93)	162.23 (±11.00)	-0.60 (±0.90)	0.474^5
HBA1C (%)	7.53 (±0.31)	7.47 (±0.32)	0.02 (±0.15)	0.376^5
	EXPERIMENTAL GROUP			
	Pre-Intervention	**Post-Intervention**	Mean Difference	P-Value
Blood Glucose (mg/dl)	161.80 (±10.49)	152.12 (±9.31)	9.69 (±8.87)	$< 0.0001^5$
HBA1C (%)	7.50 (±0.28)	7.00 (±0.35)	0.49 (±0.34)	$< 0.0001^5$
Paired $t-test^5$				

CONTROL GROUP

Negative mean difference:

- There was a negative mean difference (-0.60mg/dl) between pre-intervention and post-intervention blood glucose, which was insignificant.

Slightly positive mean difference:

- There was a slightly positive mean difference (0.02%) between pre-intervention and post-intervention HBA1C, which was insignificant.

EXPERIMENTAL GROUP

Positive mean difference:

- There was a significant positive mean difference (9.69mg/dl) between pre-intervention and post-intervention blood glucose.
- There was a significant positive mean difference (0.49%) between pre-intervention and post-intervention HBA1C.

A scatter plot of time per patient was measured at home.

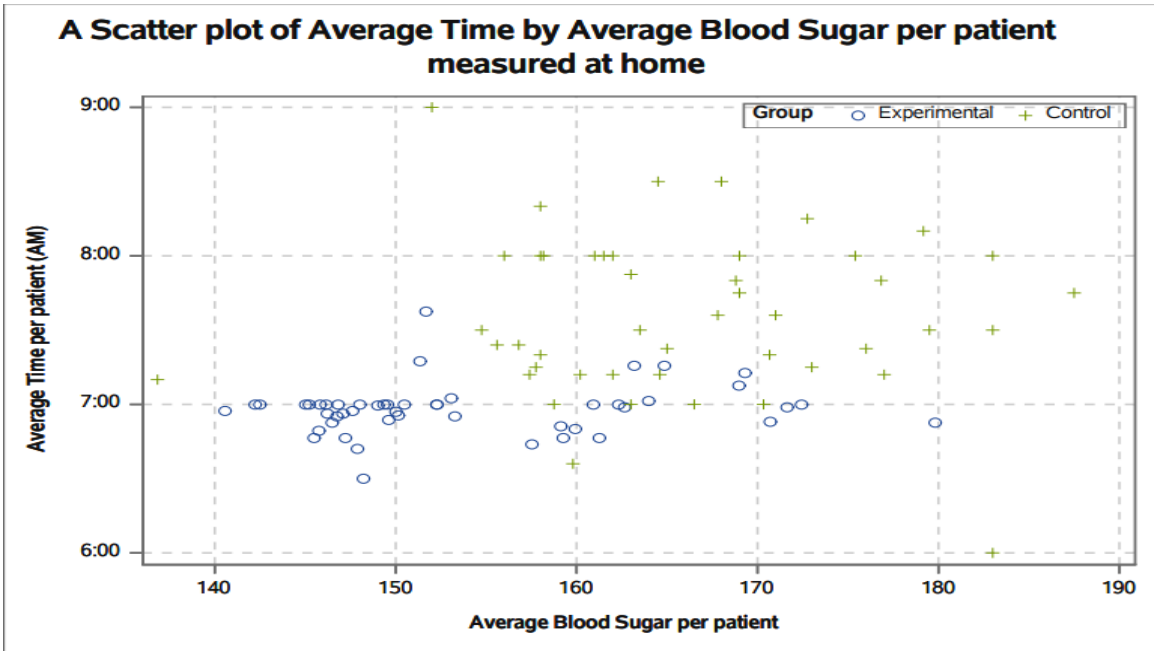

Figure 6. A scatter plot of time per patient was measured at home.

The scatter plot shows a cluster in time of measurement around 7 am for the experimental group, while that of the control group is scattered between 7 am and 8 am. The blood glucose measurement was between 140 and 160mg/dl from the experimental group, while that of the control group was scattered between 160 and 180 mg/dl.

The Survey from the Intervention Group

Instruction: Complete these questions below.

Please circle one of the three options of strongly agree/Agree, Not sure, and Disagree/Strongly

disagree

Fill out the following anonymous survey about your experiences with the text messaging service.

Participant's Statements/Response (%)	n
a). I am satisfied with the text-messaging service.	
Strongly agree/Agree (93)	40
Not Sure (0)	0
Disagree/Strongly disagree. (7)	3
b) I would like to continue receiving text messages.	
Strongly agree/Agree (88)	38
Not Sure (5)	2
Disagree/Strongly disagree. (2)	1

c). I find the early morning text messages disturbing.

Strongly agree/Agree (19)	8
Not Sure	0 (0)
Disagree/Strongly disagree. (65)	28

d). I find the evening text messages disturbing.

Strongly agree/Agree	1 (2)
Not Sure	0 (0)
Disagree/Strongly disagree. (93)	40

f). The text messages are clear and easy to understand.

Strongly agree/Agree (95)	41
Not Sure	1 (2)
Disagree/Strongly disagree.	0 (0)

g). The text messages help me better manage my blood glucose at home.

Strongly agree/Agree (95)	41
Not Sure	0 (0)
Disagree/Strongly disagree.	2 (5)

Figure 7. The survey from the Intervention Group

Conclusion

For the experimental group, there was a positive mean difference for the blood group and HBA1C post-intervention, which were highly significant (P-value=<0.0001).

The 12-week intervention improved blood glucose measurement at home with a median of 24 times (experimental group) vs six times (control), which was highly significant (P-value=<0.0001).

There was a significant difference in the type of glucometer between the experimental and control group (P-value=0.04). Meaning that the type of glucometer affected how often the patients measured their blood glucose.

Patients whom someone at home reminded to measure their blood glucose were more likely to do so (p-value =<0.0001).

Recommendations

It is recommended the clinic adopt a post-visit follow-up policy with customized text messages for patients at home. Providers should encourage patients to keep their daily blood glucose diary at home. Support patients with diabetes via text messages to check their blood glucose at home.

CHAPTER 5

DISCUSSION

Significance and Implication

The outcome of this project has shown the project site that: Text-based reminder improved home blood glucose monitoring and hold promise for improving diabetes outcomes of patient with T2DM. There will be a potential decrease in diabetic complications, and healthcare costs among this population.

Researchers have previously employed text messaging and other telemedicine approaches to improve glycemic control and disease self-management practices among T2DM patients. However, little attention has been paid to WhatsApp as a messaging application that can potentially transform provider-patient communication. The application, previously used in health systems research (Manji et al., 2021), allows individuals to share messages, including pictures and documents, and receive feedback. WhatsApp is free and easily accessible to many people, so exploring its benefits among T2DM patients can expand its applicability in the healthcare sector, improving healthcare delivery and positive outcomes.

Impact on Practice, Education, and Nursing

Improving the blood glucose and HbA1c levels for T2DM patients will have various implications on practice, education, and nursing. Related to practice, there will be

improved health outcomes as the patients develop better glycemic control, enhanced patient engagement through text messaging, and more efficient communication. Effective communication and patient engagement are further associated with patient satisfaction, a priority in healthcare delivery (Herath et al., 2023). In terms of education, the project may promote patient education and disease self-management. As patients acquire more knowledge and understanding of their condition, they can better adopt self-management strategies. Implementing the text-messaging intervention may also provide an avenue for the nurses' professional development as they utilize new communication approaches and realize tangible benefits in healthcare delivery. For nursing practice, the project is likely to contribute significantly to interdisciplinary collaboration associated with improved care quality and health outcomes (Bouton et al., 2023; Geese & Schmitt, 2023; Lee et al., 2021). Further evaluation and monitoring of the new practice may be necessary to sustain the positive impact in the long term.

Project Strengths

A notable strength of this DNP project is the easy access to mobile phones and text messaging applications. A past survey showed text messaging to be the most commonly used feature on smartphones, and this trend continues to date (Langford et al., 2019). Thus, text-messaging reminders were an accessible, cost-effective intervention to improve patients' blood glucose and hemoglobin AIc (HbAIc) levels among T2D patients.

In addition, the intervention is scalable and can reach large numbers of patients, as shown in a similar project conducted in Missouri (Xu et al., 2020). The health facility can extend the benefits of text-based reminders to a broader patient population using

minimal resources. In addition, text-based reminders offer an opportunity for personalization to meet patients' unique needs and health status. In addition, the intervention can be incorporated seamlessly into the patient's daily routine to produce desirable health outcomes.

Project Limitations

The sample size is a significant limitation of the project. A larger, more diverse patient sample is necessary to understand better the impact of text-based reminders on T2D patients' blood glucose and HbAIc levels. Focusing on a New Jersey healthcare facility also limits generalizability; a more significant effect may be attained by conducting the project on a larger scale.

However, as Burchett et al. (2020) note, limiting generalizability to the population or the setting may be insufficient. Future researchers may need to consider why and how the intervention was beneficial in the particular context to determine its possible application in other locations. Besides, there were some challenges in the follow-up process since some patients did not provide feedback about the text-based intervention. Effective follow-up could incorporate tailored feedback, keen monitoring of patient's health goals, and the provision of decision-making and problem-solving tips to maximize the benefits of the text messaging intervention (Dineen-Griffin et al., 2016). Despite these limitations, the text-based intervention significantly improves T2D patients' blood glucose and HbAIc levels.

Self-Professional Analysis

The DNP project allowed application to various skills and competencies as a DNP-prepared nurse. Leadership skills helped unite the project team and encouraged

them to dedicate time and effort to achieving the project goals. Effective communication aided in averting conflicts within the team and ensured seamless project implementation according to the initial plan. Besides, clinical competence accorded me adequate knowledge and understanding of T2DM and management techniques. The information was instrumental in tailoring the text messages to the patient's needs, including reminding them to monitor blood glucose and HbAIc levels at home and, after three months, take the prescribed medication, consume a healthy diet, and engage in physical activity. All these are evidence-based self-management practices for T2DM, which have in the past been associated with improved quality of life, positive health outcomes, and reduced healthcare costs (Edraki et al., 2020; Nelson et al., 2021; Oluma et al.,2021). Still, there is room for professional development to be established as a change agent in nursing practice.

DNP Essentials/Personal Analysis as a Scholar

The project was guided by the Essentials for Doctoral Education for Advanced Nursing Practice established by the American Association of Colleges of Nursing (AACN, 2006a).

Scientific Underpinnings for Practice (Essential 1): This essential prepares DNP graduates to create and evaluate new practice approaches based on theories from nursing and other disciplines (AACN, 2006). It employs scientific theories, principles, and concepts from nursing and other disciplines to transform health and healthcare delivery. In this regard, the DNP project exploited telemedicine, a known concept associated with improved self-management practices among patients with chronic diseases (Kirakalaprathapan & Oremus, 2022; Ma et al., 2022).

Organizational and Systems Leadership for Quality Improvement and Systems Thinking (Essential II): on organizational and systems leadership, the project leader focused on improving patient and healthcare outcomes by implementing an effective, cost-efficient intervention. The text-based intervention was automated to reach many patients at minimal cost, with additional cost savings from reduced diabetes-related complications, reduced rehospitalization risk, and better patient health outcomes.

Clinical Scholarship and Analytical Methods for Evidence-Based Practice (Essential III): was applied right from the beginning of the project by conducting in-depth research on T2DM to determine evidence-based strategies for maintaining appropriate blood glucose and HbAIc levels. As a DNP-prepared nurse, the project leader successfully appraised relevant literature to identify the best evidence for practice and then designed and implemented an evidence-based intervention to promote efficient and effective patient-centered care.

Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care (Essential IV): the DNP project was centered on technology. A text-based intervention reminded patients with T2DM about proper T2DM management practices to maintain appropriate blood glucose and HbAIc levels and promote positive health outcomes. The project investigator selected and utilized information technology to improve care delivery among individuals who could otherwise find it challenging to navigate diabetes self-management. By adopting text messaging intervention through WhatsApp, health practitioners can share critical information with the patients, including tips for proper glucose monitoring and other self-management practices to improve health outcomes.

Health Care Policy for Advocacy in Health Care (Essential V): Call for advocacy in healthcare with the understanding that the DNP graduate has the power to influence health policy and the more significant nursing profession. By influencing policy, the DNP nurse helps address critical issues in healthcare, including financing, care quality, and care access. The current project provided an alternative to face-to-face care delivery, improving healthcare access to people with chronic diseases. Implementing the project would not have been possible without the collaboration and support of different professionals.

Interprofessional Collaboration for Improving Patient and Population Health Outcomes (Essential VI): prepares DNP nurses to lead interprofessional teams, a responsibility that the project leader takes up during the project. The project leader brought together an interprofessional team and applied leadership and communication skills to ensure all members made valuable contributions to the project. Interprofessional collaboration has been a popular subject of discussion in the academic space, and in a recent study, the practice was associated with improvements in HbAIc levels (Lee et al., 2021). Besides encouragement from managers and leaders, medical practitioners must be willing to cooperate and communicate openly to work well with others (Schot et al., 2020). Thus, the project team members' willingness to collaborate was beneficial during implementation.

Clinical Prevention and Population Health for Improving the Nation's Health (Essential VII): a DNP-prepared nurse is expected to analyze different types of data relevant to individual and population health, synthesize healthcare-related concepts, implement interventions to prevent certain diseases, and improve healthcare access and

health outcomes. In line with this DNP domain, the project leader analyzed data and found that ineffective management of T2DM leads to undesirable blood glucose and HbAIc levels and contributes to adverse health outcomes. A text-based intervention was formulated to boost glycemic control and improve health outcomes.

Advanced Nursing Practice (Essential VIII): Designing and delivering evidence-based care was also influenced by Essential VIII, through which DNP nurses learn to promote optimal patient care (AACN, 2006a). The project leader understood the need for T2DM patients to monitor blood glucose and HbAIc levels and adopt suitable self-management practices.

Impact of the Project on the Community

Diabetes is an epidemic in the United States, and New Jersey is significantly affected. According to the American Diabetes Association (2022), around 760,249 individuals, accounting for 10.5% of New Jersey adults, have been diagnosed with diabetes. The medical expenses of the affected persons are around 2.3 times more than those of the general population. Productivity loss costs people an additional $2.5 billion. By promoting glycemic control, the project helps reduce diabetes-related complications in the community, rehospitalization risk, and the associated healthcare costs. Building a healthier population also reduces economic loss as the patients can still be productive community members. Besides, positive health outcomes improve the quality of life, contributing to a happier, more satisfied community.

Impact of the Project on the Clinic (Project site)

The project site is an outpatient clinic that delivers healthcare services to T2DM patients and other community members. Offering text reminders to T2DM patients to

improve their self-management practices complements the face-to-face interactions at the health facility and enhances the quality and reach of care. The potential outcomes include improved health outcomes, greater satisfaction with the care provided, and overall patient well-being, as demonstrated in past research (Kuipers et al., 2019). Patients appreciate health care that considers their unique needs and interests and a care delivery process that allows effective communication and beneficial relationships with healthcare practitioners (Kuipers et al., 2020). As patients become more satisfied with their care, they will become more trusting of the healthcare system and willing to embrace other strategies recommended by the care providers to enhance their health and well-being.

Impact on the Future of Professional Development

The project provided opportunities to apply leadership and communication skills, but there are other opportunities for professional development. For instance, there is the opportunity to acquire more knowledge about advanced technologies that could be exploited to transform the healthcare sector. As demonstrated in various studies (Liu et al., 2023; Victoria-Castro et al., 2022), technology will continue to be a significant part of healthcare delivery in pursuing quality, affordable, and accessible healthcare. Understanding these technologies will make incorporating them into the healthcare system easier. Continuous learning is essential to enhance leadership competencies to guide care delivery and initiate change initiatives. Besides, there is an opportunity to explore coaching and mentorship to help other nursing professionals contribute to quality improvement.

End Products (Deliverable)

The project evaluation will include clinical outcomes assessments for blood glucose and HbA1c. The outcomes of this project were statistically and clinically significant. An improvement in these measures indicates project success. Measuring patient engagement and satisfaction through surveys will also show their perspectives about the intervention and its role in their care experience and health outcomes; patient feedback will demonstrate whether they consider the intervention helpful and will continue using it to enhance their disease self-management practices. Furthermore, the project outcome was reported to the internal stakeholders, and the collaborating team reviewed the results. After that, the evaluation was obtained from the providers' perspectives through surveys.

Project Evaluation

The outcome measures for the project were blood glucose and HbAIc levels among T2DM patients receiving treatment at a healthcare facility and the patient's satisfaction with the text-messaging intervention. Blood glucose and HbAIc levels were measured before and after the intervention to determine the effectiveness of the text-based reminders. For all the participants involved (Experimental group), there were significant reductions in blood glucose and HbAIc levels, indicating that the reminders helped them adhere to self-management practices, including monitoring glucose and returning for HbAIc levels after three months, taking medicine on time, consuming a healthy diet, and engaging in physical activity.

Reduced blood glucose and HbAIc levels are the first signs of changes that will be attained with continued use of the text-based intervention. Utilizing reminders to make

positive changes in T2DM self-management promises improved health outcomes as the patients are unlikely to experience complications or require urgent medical attention. In addition, the patients save on medical expenses and lead more satisfactory and productive lives. However, the health facility must be willing to support the change initiative by providing adequate resources for the text messaging intervention and making schedules flexible enough for the assigned health practitioners to engage the patients through the platform. Leadership support is also essential to ensure continued support for T2DM patients.

Cost is often the first thing that strikes the mind when making any change, especially in the healthcare system. Then, what will benefit the facility is the next question. A project with increased quality of care at a low cost will be sustainable. This project, if properly implemented, will limit the problem of uncontrolled diabetes, promote patient self-monitoring of blood glucose, and minimize complications like cardiovascular disease, mortality, and morbidity rate.

Clepper (2018) states that project sustainability occurs when the project outcome becomes part of the clinic culture after implementation. A change may seem complicated, but persuasion and continuous follow-up will uphold a new development. Once sustained, it prevents project fatigue and engages the organization in promulgating a lasting safety culture. The investigator will work with the internal stakeholders in the clinic, like my mentor, nurses, physicians, and nurse practitioners, to formulate an acceptable plan.

The plan for sustaining the recommended change includes integrating the new approach into routine practice. Ensuring the clinic makes the text-messaging approach

part of their routine is essential. Engaging stakeholders to ensure the practitioners have adequate time and resources to continue the text-message intervention effectively will also help sustain the change. For example, the staff requires functioning technology and a support team to ensure seamless text messaging through WhatsApp to T2DM patients. Besides, continuous monitoring and evaluation are paramount to determine the intervention's effectiveness and adjust where necessary.

Impact on Nursing Practice

The project promotes patient-centered care tailored to patients' needs, values, and preferences. The patients participate in crucial decisions concerning their care and help formulate strategies that promote their physical and emotional well-being and health. Positive outcomes are expected because the patients control their Health and quality of life (Kuipers et al., 2019). In the current project, the patients received text-based reminders about T2DM self-management and provided feedback regarding the mobile application and other aspects of their care. The project investigator addressed any issues raised by the patients to maximize the benefits of the intervention among the T2DM patients. Patient-centered care increases patient satisfaction with the care provided, ensures resources are allocated appropriately, builds trust and confidence in the healthcare team, and enhances the clinician's morale.

Another contribution of the project to nursing practice is promoting patient engagement, which contributes to patient satisfaction and positive health outcomes. The text-based intervention provided an additional channel for the patients to communicate with the care providers and receive guidance about T2DM management. As the patients communicated and shared feedback with the health practitioners, they understood their

care better and took up practices that improved their health and well-being. Further, the project promotes interprofessional collaboration, a priority area in healthcare. With the growing complexity of health systems and diseases, healthcare practitioners must combine their skills, expertise, and experiences to ensure patients receive safe, quality care.

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APPENDICES

Appendix A: Blood Sugar Log

Date	Time	Glucose Level result (mg/dL)	Time last meal

Appendix B: Informed Consent

INFORMED CONSENT TO PARTICIPATE IN A RESEARCH PROJECT

Title: Text-Based Reminder: Pathway to Improve HbA1c and Fasting Blood Glucose of People with T2 Diabetes

Dear participants,

David Alao, a DNP student from Andrews University, requested that you participate in a project. After three months, this study will determine if text-based reminders reduce fasting blood glucose and HgbA1c levels.

This study will contribute to the researcher's completion of his project. The project consists of a questionnaire that will be administered to individual participants in this clinic. To be included in this project, participants must sign this consent.

This study will require 15 minutes of your time to complete a questionnaire. Participants may or may not receive text reminders twice weekly to check their glucose levels and record them in the log provided. After three months, participants must have their blood glucose level and HgbA1c level drawn at the clinic. There is no cost to participate in this project. Each participant will be compensated $5 after signing consent and $10 after the final lab draw. There are no anticipated risks associated with participating in this project. Your participation is voluntary, so you may withdraw from the project anytime.

De-identified data from this study may be shared with the research community to advance science and Health. Any personal information that could identify you will be removed or coded before files are shared with other researchers to ensure that, by current scientific standards and known methods, no one can identify you from the information shared.

Please ask any questions you have now. If you have questions later, contact David Alao at alao@andrews.edu or 914 512 6246. You will be given a copy of this form for your records.

I acknowledge that the research study described above has been explained to me. The information is well understood, and the investigator has explained the study in detail. I had the opportunity to ask questions about the study and a satisfactory answer was given. I now consent to participate and will be given a copy of this consent form.

_____ _____

Signature of Participant. Date/Time

_____

Print Name of the Participant.

_____ _____

Signature of the Researcher. Date/Time

_____

Print Name of Researcher.

The project manager will keep the original copy signed by the participants.

Appendix C: IRB Approval letter

Andrews University
Office of Research & Creative Scholarship

August 2, 2023

David Alao
Tel. 914-512-6246
Email: alao@andrews.edu

RE: APPLICATION FOR APPROVAL OF RESEARCH INVOLVING HUMAN SUBJECTS
IRB Protocol #:23-076 **Application Type:** Original **Dept.:** Nursing
Review Category: Exempt Action **Taken**: Approved Advisor**:** Melinda Nwanganga
Title: Text-based reminder: Pathway to improve HbA1c and fasting blood glucose of people with T2 diabetes.

Your IRB application for approval of research involving human subjects entitled*: ""Text based reminder: Pathway to improve HbA1c and fasting blood glucose of people with T2 diabetes""* IRB protocol # 23-076 has been evaluated and determined Exempt from IRB review under regulation CFR 46.104 (2)(i): Research that include survey procedures and in which information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subject. You may now proceed with your research.

Please note that any future changes made to the study design or informed consent form require prior approval from the IRB before such changes can be implemented. In case you need to make changes please use the attached report form.

While there appears to be no more than minimum risks with your study, should an incidence occur that results in a research-related adverse reaction or physical injury, this must be reported immediately in writing to the IRB. Any research-related physical injury must also be reported immediately to the University Physician, Dr. Katherine, by calling (269) 473-2222.

We ask that you reference the protocol number in any future correspondence regarding this study for easy retrieval of information.

Best wishes in your research.

Sincerely,

Mordekai Ongo, PhD.
Research Integrity and Compliance Officer

Institutional Review Board – 8488 E Campus Circle Dr Room 234 - Berrien Springs, MI 49104-0355
Tel: (269) 471-6361 E-mail: irb@andrews.edu
Appendix D: Questionnaire

Appendix D: Questionnaire

Instruction: Complete these questions below. Please circle Yes or No:

1). Do you have a glucometer at home? (Yes) (No)

2). Do you know how to use a glucometer? (Yes) (No)

3). Does anyone remind you at home to check your blood glucose? (Yes) (No)

4). Does anyone from the clinic make a follow-up call to know your blood glucose after the visit? (Yes) (No)

5). Do you check your blood glucose at home? (Yes) (No)

6). How often does your doctor instruct you to check your glucose level? _____

7). How long have you been doing fingerstick at home? _____

8). How many times a week do you check your blood glucose at home? _____

Appendix E: Survey from Intervention Group

5Instruction: Complete these questions below.

Please circle one of the three options of strongly agree/Agree, Not sure, and Disagree/Strongly

disagree

Fill out the following anonymous survey about your experiences with the text messaging service.

a) I am satisfied with the text messaging service.

Strongly agree/Agree, Not sure. Disagree/Strongly disagree.

b). I would like to continue receiving text messages.

Strongly agree/Agree, Not Sure, Disagree/Strongly disagree.

c). I find the early morning text-messages disturbing.

Strongly agree/Agree Not Sure Disagree/Strongly disagree.

d). I find the evening text-messages disturbing.

Strongly agree/Agree Not Sure Disagree/Strongly disagree.

f). The text messages are clear and easy to understand.

Strongly agree/Agree Not Sure Disagree/Strongly disagree.

g). The text-messages help me better manage my blood glucose at home.

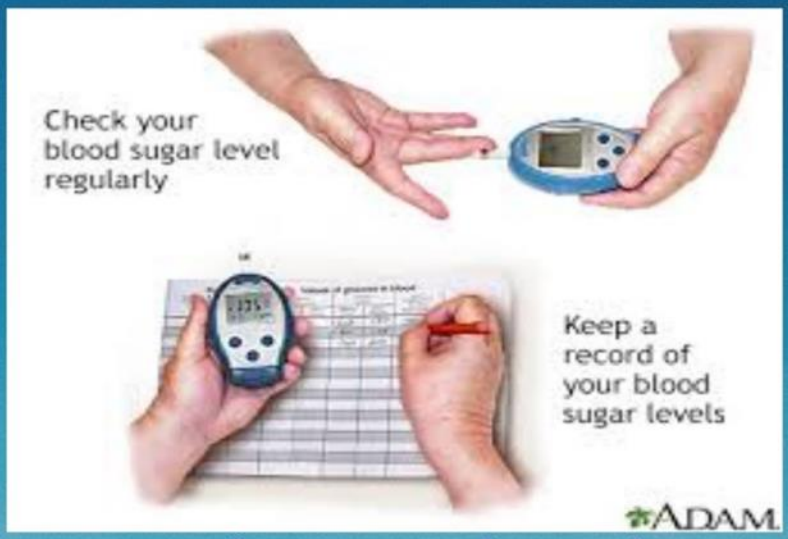
Strongly agree/Agree Not Sure Disagree/Strongly disagree.

Appendix F: Poster

Andrews University

Participants Needed for Research

Do you have difficulty controlling your blood glucose level?



Contact for More Information:

Research Location: 101 Berkshire Ave, Paterson, NJ 07502

PI: David Alao

Cell #: (914) 512 6246

Email: alao@andrews.edu

IRB #: 23-076

Appendix G: Authorization letter from the project site

GMED

VikramGupta, MD
RehanaRab, DPN
SharonPatibandla, PA

6/27/2023

To: Institutional Review Board
8488 E Campus Circle Dr. Buller Hall Room 234
Andrews University, Berrien Springs, MI 49104-0355

Letter of Authorization to Conduct a Project at GMed Healthcare

Dear Institutional Review Board,

Based on my review of the proposed quality improvement project by David Alao, I permit the study entitled "Text-based reminder: Pathway to improve HbA1c and fasting blood glucose levels in patient with T2DM" to be conducted within GMed Healthcare, New Jersey. I authorize David Alao to recruit participants after Andrews University IRB approval. We understand the project will include drawing blood samples for HbA1c and blood glucose levels. It is understood that the data collected will remain entirely confidential.

Therefore, permission has been granted to the extent of the procedures outlined in the IRB protocol we have reviewed. Individuals' participation will be voluntary and at their discretion. Therefore, David must obtain informed consent before the subjects' participation. However, David will be given the clinic patient with T2 diabetes and complete signing of the consent form.

We have many patients suffering from diabetes that can benefit from the project. We welcome him to conduct the project at GMed Healthcare and will provide David with the necessary support to make the data collection process successful.

Sincerely,

Rehana Rab DNP, APN-c

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