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Hypertension Management: Improving Medication Adherence Through the Use of Daily Text Messages

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HYPERTENSION MANAGEMENT: IMPROVING MEDICATION ADHERENCE THROUGH THE USE OF DAILY TEXT MESSAGES

by

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DEDICATION

To my parents, thank you for the sacrifices made. Your prayers and continued support throughout my entire education did not go unnoticed. Dad thank you for instilling in me the value of education and being yourself a great example. Thank you, mom, for your unconditional love.

To my siblings, Anne, Eric, Dieuleveut, and Grace, thank you for your words of encouragement, your love, and your patience. Thank you for always being the loudest people cheering me up.

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ABSTRACT

Hypertension (HTN) is the leading cause of hospitalization and is responsible for approximately 50% of cardiovascular and cerebrovascular events (Al-Noumani, et al., 2018). Uncontrolled HTN can lead to comorbidities including ischemic heart disease, renal disease, or life-threatening arrythmias (World Health Organization [WHO], 2019). The leading cause of HTN is medication non-compliance (Varleta, et al., 2017). The purpose of this evidence-based practice project was to determine the effectiveness of daily text messages on antihypertensive medication adherence. A comprehensive review of literature generated ten high-level evidence studies demonstrating that daily text messages near each medication dosing time is best practice for improving medication adherence. Participants included 21 adult primary care patients with HTN, ages 31-73 taking a minimum of one antihypertensive medication at the time of recruitment. During a six weeks' timeframe participants received daily text messages at medication dosing times and every three days they received educational text messages on HTN and the benefits of medication adherence. The outcome was of this project an increase in medication adherence. Data was analyzed using a paired t-test to compare the pre-implementation data to the post-implementation data. There were significant difference at baseline medication adherence rate to post intervention medication adherence rate (0.05, $t(10) = -3.08$, $p = .012$). Findings from this EBP project demonstrated that the use of daily text message as reminders improved medication adherence, which has been shown to prevent complications related to uncontrolled hypertension and improve patients' health.

CHAPTER 1

INTRODUCTION

Background

The Centers for Disease Control and Prevention (CDC, 2020a) defines hypertension (HTN) as blood pressure at ≥ 130/80 mmHg. HTN affects populations worldwide. According to Oh and Cho (2020), HTN is “the single most important contributor to mortality and morbidity” (p. 1). More than 7.5 million deaths each year are attributable to uncontrolled high blood pressure (BP). Uncontrolled high BP can lead to comorbid conditions such as renal diseases, ischemic heart disease, and irregular heartbeat that may result in sudden death (World Health Organization [WHO], 2019). Furthermore, uncontrolled HTN increases the risk of myocardial infarction, and causes structural and functional changes to the heart that can ultimately lead to heart failure, increasing mortality and morbidity. According to WHO, a review of current trends shows that the number of adults with HTN increased from 594 million in 1975, to 1.13 billion in 2015, affecting 40.3% of adults globally.

However, among patients treated for hypertension in the United States (US), only 40–74% take their medications as prescribed (CDC, 2019). The leading cause of poor BP control is a lack of adherence to antihypertensive medication therapy (Varleta et al., 2017). Medication adherence is defined as “the extent to which a patient’s behavior corresponds with the prescribed medication dosing regimen, including time, dosing and interval of medication intake” (p.2). Despite the high clinical efficacy of antihypertensive agents in preventing the harmful effects of elevated BP, nonadherence to the treatment regimen constitutes a principal barrier to controlling the disease and the prevention of its progression. In the United States, more than half of all hypertensive patients do not adhere to their treatment regimens (Rash et al., 2014).

Data from the Literature Supporting the Need for this Project

As of 2018, HTN is the leading cause of hospitalizations and is responsible for approximately 50% of all cardiovascular and cerebrovascular events (Al-Noumani et al., 2018). Nonadherence to antihypertensive medications is a risk for elevated and uncontrolled BP, which increase health risks, such as cardiovascular disease, that are still on the rise in health care delivery (Checchi et al., 2014).

Adherence is the extent to which patient behavior, which include taking medication, aligns with agreed clinical decisions and recommendations from the provider (Morrissey et al., 2016). Adherence is of particular concern regarding hypertensive patients, as 34–78% of patients prescribed antihypertensive medication cease taking it within a year (Varleta et al., 2017; WHO, 2019). Medication adherence has a more direct impact on health outcomes than medications. In the United States, nonadherence accounts for up to 50% of treatment failures, leading to approximately 125,000 deaths, and up to 25% of hospitalizations each year (Kim et al., 2018). Studies have demonstrated that adherence rates of 80% or more are required for optimal patient health outcomes. However, for people with chronic diseases, it is estimated that the adherence rate is around 50% (Kim et al., 2018). This represents a challenge for healthcare providers, as quality care depends on medication adherence.

Non-adherence or poor adherence to medication can severely compromise the effectiveness of treatments, making this a critical issue in population health from the perspectives of both quality of life and health economics (WHO, 2003). Adherence to treatment can be influenced by various factors. Healthcare providers are responsible for recognizing barriers to antihypertensive medication adherence, which is crucial for the successful management of HTN and the prevention of complications. Improved adherence could prevent mortality and possibly improve quality of life and increase lifespan for patients. Thus, this project involved implementing a clinical change in a primary care setting for adults diagnosed with hypertension and prescribed antihypertensive medications, using text messaging to influence antihypertensive medication adherence.

Data from the Clinical Agency Supporting the Need for this Project

This project was implemented in a family practice clinic situated in Indianapolis, IN. The site is a part of a larger organization. Currently, there are seven providers—giving care to various patients in the clinic. Seven medical assistants aid each provider. Data regarding medication adherence with hypertensive patients were gained after spending over 200 clinical hours assessing the organization's current practices and speaking with the site facilitator, who is also one of the family medicine physicians at this clinic.

The clinic has employed multiple methods of monitoring patients' BP, including electronic medical records (EMR), BP cards, and self-monitoring. However, the organization does not have a system or protocol in place to track medication adherence. Although the staff interact with patients via telephone or electronic correspondence to answer any questions or concerns regarding treatment, the staff do not collect data about medication adherence. There is also no indication that the staff have endeavored to focus on identifying barriers to HTN adherence during their interactions with patients (S, Williams, personal communication, May 23, 2020).

Moreover, patients are required to submit their home BP readings periodically, but not all patients were engaged in BP self-monitoring (personal communication, May 23, 2020). It is noted in the literature that hypertensive patients with high degrees of adherence to antihypertensive agents have been associated with better odds of BP control (Chang et al., 2018). In this site, medication adherence is assessed during hypertensive patients' follow-up visits via self-reporting, but patients were more likely to report being adherent to their treatment despite evidence of poor or worsening BP control (personal communication, May 23, 2020). It was, therefore, crucial to proceed with further assessment to promote health among hypertensive patients, since some of them still did not have a controlled BP. Providers were well trained and positioned to identify many of these barriers to adherence and help patients in minimizing or removing them (Chang et al., 2018).

Additionally, there was no comprehensive program in place to educate patients about the importance of adhering to the treatment regimen (personal communication, May 23, 2020). Also, due to the number of patients seen per day in the clinic, providers are often overwhelmed and plans of care are often discussed only briefly between providers and patients (S, Williams, personal communication, May 23, 2020). Based on the high risk of CVD associated with poor BP control and medication non-adherence, it was determined that there is a need for an intervention to improve medication adherence in the clinic. The project was successfully implemented as a result of collaboration between all stakeholders.

Purpose of the Evidence-Based Practice Project

Evidence has demonstrated that medication adherence constitutes a principal barrier to controlling high blood pressure. The purpose of this evidence-based project (EBP) project sought to improve medication adherence rates of hypertensive adults using antihypertensive medications through the use of mobile text messaging in a primary care setting. A program was developed for the providers in this clinic to properly improve medication adherence in patients who were prescribed antihypertensive agents. The project titled, The Effective Management of High Blood Pressure by Improving Medication Adherence, incorporated a high level of quality and evidence as a result of a thorough systematic search to identify the best practice for the improvement of medication adherence in adult patients. The clinical question that initiated this EBP project was as follows: What is the effect of daily reminders in improving medication adherence?

It was anticipated that the participants who received daily text message reminders would have improved outcomes related to medication adherence. Secondary outcomes that were anticipated included a decrease in BP.

PICOT Question

Specifically, this EBP project will address the PICOT question: “In primary care setting, in adults, male or female, aged more than 18 years with a diagnosis of hypertension and who are taking hypertensive medications (P), does receipt of daily text messages (I) compared to education provided during each office visit (C) influence medication adherence (O) over a six-week time period (T)”?

Significance of the EBP Project

In patients diagnosed with hypertension, medication adherence is often key in controlling BP and preventing the risk of ischemic heart disease and stroke (Chang et al., 2018). High BP is among the leading causes of stroke in the United States, killing one person every four minutes; therefore, interventions are warranted to better control BP (CDC, 2020b). Medication adherence can have a more direct impact on patient outcomes than specific treatments (WHO, 2003). Improving adherence can ultimately generate substantial clinical results. Therefore, this project sought to improve medication compliance in patients on antihypertensive medications through the use of text messaging. It was anticipated that successful implementation of this intervention would reduce or prevent morbidity and mortality associated with uncontrolled BP due to non-adherence.

CHAPTER 2

EBP MODEL AND REVIEW OF LITERATURE

In this chapter, the EBP model used to guide the practice change and current evidence supporting the project implementation will be reviewed in detail.

Adherence to medication is influenced by multiple factors related to the patient, healthcare providers, healthcare system, and treatment. After completing a comprehensive assessment, the Doctor of Nursing Practice (DNP) student noted that most hypertensive patients at clinic X forgot to take their antihypertensive medication as prescribed. The DNP student believed that through implementing this project, patients diagnosed with hypertension, who take at least one antihypertensive medication will be adherent to medication intake. The incorporation of daily text messages in addition to the education they receive at the clinic, could assist in preventing forgetfulness and enhance knowledge about hypertension treatment.

The PICOT question that guided this EBP project reads, “In primary care setting, in adults, male or female, aged more than 18 years with a diagnosis of hypertension and who are taking hypertensive medications (P), does receipt of daily text messages (I) compared to education provided during each office visit (C) influence medication adherence (O) over a six-week time period (T)?”

The Iowa Model Revised Evidence-based Practice

To successfully guide changes in practice, the DNP student selected the Revised Iowa Model of Evidence-Based Practice. The model is described as follows.

Overview of EBP Model

The Iowa Model of Evidence-Based Practice was first developed and implemented in 1994, by Marita G. Titler, PhD, RN, FAAN, and her colleagues at University of Iowa Hospitals and Clinics, Iowa City. Rooted in the diffusion of innovations theory and the quality assurance

model, the Iowa model considers the entire healthcare system, which includes healthcare providers, patients, and the clinical setting, using research within these contexts to guide the implementation of research into clinical practice (Hanrahan, 2019). The Iowa Model was created to guide nurses and other healthcare providers to implement change in practice for improvement of patient care and health outcomes (Titler et al., 2001). From 1994 to 2001, multiple revisions were performed on the original model based on feedback from healthcare providers who utilized it.

In 2017, the Iowa Model Collaborative was formed to revise and validate the Iowa Model in order to promote excellence in healthcare. The revisions and validations were conducted in two phases. The first consisted of an extensive literature review, while the second involved the validation and refinement of the revised model, based on feedback from participants of the 22nd National Evidence-Based Practice Conference, leading to the development of the Iowa Model Revised (Iowa Model Collaborative, 2017).

To facilitate the identification of a problem and the development of a solution, 10 steps have been developed for the Iowa revised model:

1. Identify triggering issues/opportunities
2. State the purpose or question
3. Prioritize topics
4. Form a team
5. Assemble, appraise, and synthesize the body of evidence
6. Acquire sufficient evidence
7. Design and pilot the change in practice
8. Decide if the change is appropriate for practice
9. Integrate and sustain practice
10. Disseminate results (Melnyk & Fineout-Overholt, 2019)

The first step of the Iowa model revised is to identify triggering issues/opportunities for change and establish a clear purpose (Titler et al., 2001). Clinical problems or opportunities can be identified through new research or literature, within an organization through risk management data, patient-identified problems, etc. Once a clinical problem has been identified, a clinical question using the PICOT format question was formulated. PICOT is a mnemonic used to describe a good clinical question.

P- Population refers to the sample of subjects of interest, intervention refers to the treatment that will be provided to subjects enrolled in your study.

I - Intervention refers to the intervention that will be implemented to subjects during the study

C- Comparison refers to a reference or comparison group used to compare your intervention with

O- Outcomes refers to the result that will be measured to evaluate the effectiveness of the intervention.

T- Time represents the duration of data collection (Riva et al.,2012).

After formulating a good clinical question, clinicians/leaders must determine if the problem at hand is a priority for the organization, department, or practice. A team is then formed to develop, evaluate, and implement the EBP change via a literature review of current evidence (Iowa Collaborative Model, 2017). The team should be made up of representatives both within and outside the nursing profession to allow for interdisciplinary stakeholders to better evaluate and implement the change. The team will critique and synthesize the evidence discovered during the literature search and ensure that there is sufficient evidence to implement the change. The team will then consider resources, constraints, and approval, prepare materials that clinicians/leaders will use, collect baseline data, create an evaluation plan, develop an implementation plan, promote adoption, and collect and report post-pilot data (Brown, 2014).

The team will implement the change in a pilot program and evaluate the results to ensure improved outcomes. If the change is appropriate for full adoption within the organization, department, or practice, the team will introduce the change and continue to observe, evaluate, and analyze the results. To ensure successful integration and sustainability of the EBP in clinical settings, the team will identify and engage with key personnel, and monitor quality improvement (Iowa Collaborative Model, 2017).

One example of how the Revised Iowa Model of Evidence-Based Practice was used to implement change involves a clinical change conducted by Hanrahan and her colleagues (2019) to allow patients' family members to be present during the recovery period at a designated post-anesthesia area at University of Iowa Hospitals and Clinics. The model was used to ensure that the best and latest research evidence was appropriately incorporated into practice.

Identifying the triggering issues and opportunities. The University of Iowa Stead Family Children's Hospital was building a post anesthesia recovery. The initial plan was to include an area where parents can be present during their children's recovery after a procedure. As the building process was progressing, the anesthesia department revised the initial plan and requested parents of children who received general anesthesia to no longer be present during admission to first stage recovery. This decision raised concerns from nurses and other healthcare professionals who saw an opportunity to address this issue by applying the Iowa Model Revised.

Stating the question or purpose. The purpose of this project was to offer parents the opportunity to be present after a procedure in first stage post anesthesia recovery and during nurse handoff.

Topic priority. Selection of this project was based on patient preferences, safety practices and increased satisfaction, which made it a priority for the organization.

Form a team. An interprofessional team was formed including nurses and anesthesia providers.

Assemble, appraise, and synthesize bodies of evidence. A thorough search of multiple databases was conducted with the assistance of a health science librarian. The team assembled and appraised the body of evidence.

Sufficient evidence. The review of the literature supported that parents who received education and preparation could safely be present with their child post-procedure.

Design and pilot practice change. Prior to the initiation of pilot testing, the team continued to have opposite viewpoints for legal issues, parent interference/distraction, increased risk for complication and comfort with hand-off in front of parents. A compromise was then reached and change in the nurses' workflow was made to allow handoff to occur in the procedure room while parents would wait in their child's room. The team also suggested the use of a second nurse who will be preparing and educating the parents while the other one will be receiving handoff. This change will also increase patient safety.

Determining project appropriateness for adoption. The project is currently still in the pilot phase and the team is collecting and evaluating data. If the evaluation of data results in positive outcomes, the next step will be to integrate the change and disseminate the outcomes. If the team deems the change not appropriate for adoption, feedback loops in the Iowa Model Revised suggest redesign, re-assembly or identify other triggers.

Application of EBP Model to DNP Project

This EBP project arose following an increasing sense of urgency identified during the Spring 2020 clinical rotation in a primary care clinic. Prior to this project, the clinic was using cards to track the blood pressure of patients on antihypertensive medications during each visit. Patients were asked to fill out a card daily, preferably twice per day. The card included each patient's height, weight, Body Mass Index (BMI), allergies, and blood pressure (BP) goal. The majority of patients would come back for their follow-up appointments with an increase in blood pressure or only a minimal decrease. Aside from the patient education provided during each visit, the clinic did not have a protocol in place for ensuring that patients were adhering to their

medication regimens. During their encounters, the majority of hypertensive patients reported not taking or forgetting to take their medications as prescribed. Thus, it became evident to the DNP student that change was needed to improve patients' compliance, which would have a direct effect on their health conditions and prevent risks related to uncontrolled blood pressure.

The following describes in detail how the Iowa Model Revised was used to address the clinical problem identified in this project (Melnyk & Fineout-Overholt, 2019).

Step II, after the trigger was identified, utilizing the PICOT format, a clinical question for this project was stated as follows; In primary care setting, in adults, male or female, aged more than 18 years with a diagnosis of hypertension and who are taking hypertensive medications (P), does receipt of daily text messages (I) compared to education provided during each office visit (C) influence medication adherence (O) over a six-week time period (T)?

Step III, the third step of the Iowa Model Revised is to determine if the project is a priority for the organization, supporting that a successful project implementation is influenced by the organization viewpoints (Iowa Collaborative Model, 2017). Prior to the initiation of this project, the DNP student exchanged with two providers and three Medical assistants (MA) at the clinic to determine if the interventions will benefit hypertensive patients. The EBP project topic was identified by the stakeholders as a priority.

Step IV, an interdisciplinary team was formed consisting of the DNP student/ project leader, one project advisor, one librarian, two MAs, and two physicians. The team composition was important for a successful designing, implementation, and evaluation of the EBP Project (Iowa Collaborative Model, 2017). The DNP student met with each member to explain in greater details the purpose of the EBP project, clarified the role and expectation of each member, and ensured their interest for being a member.

Step V, this step of the Iowa Model Revised is the evidence retrieval (Iowa Collaborative Model, 2017). An exhaustive literature search of multiple databases was conducted and active brainstorming with team members was done to identify resources available to support the EBP

project. The DNP student critically appraised all pieces of evidence that was obtained for quality and leveled. Literature was then synthesized and the best intervention to guide the project was identified.

Step VI, in this stage of the Iowa Model Revised, the team determined whether or not there was sufficient evidence to pursue with the project (Iowa Collaborative Model, 2017). Ten pieces of evidence were deemed to provide substantial validity and strength to the use of text messages as the best intervention to improve medication adherence. Melnyk & Fineout-Overholt's appraisal tools were used to appraise the evidence. The body of the literature included three high-level and high-quality evidence (Level I), six others were Level II, and one piece of evidence was considered as Level V. The review of the literature supported the existence of sufficient evidence to continue forward the practice change.

Step VII, this step consists of designing and piloting the practice change (Iowa Collaborative Model, 2017). The DNP student met with the team prior to initiating the change to review to review the literature and gather data that will serve as a baseline to evaluate the intervention. Piloting the evidence-based change necessitate the implication of all team member to: (1) obtain patients' manual blood pressure, (2) review and confirm antihypertensive medications from the Electronic Medical Record (EMR), (3) administer the MMAS-8 scale via telephone call, (4) provide daily text messages through a secured software, *Textedly. Textedly is a* text message marketing software. It offers a variety of helpful text message marketing tools including, the ability to schedule a single text message or a group of
text messages in advance, and a comprehensive analytics system that displays to the subscriber interactive graphs and performance metrics.

Step VII, evaluation of the intervention was to determine the effectiveness of text messages in improving medication adherence. Adopting the practice change was based upon the outcome of the intervention (Titler et al., 2001). After the EBP project has been piloted, the DNP student evaluated data using the MMAS-8 scale to determine if there was an improvement

in medication adherence and compared participants' BP readings taken prior to and after the intervention.

Step IX, this step of the Iowa Model Revised consists of integrating and sustaining the project change (Iowa Collaborative Model, 2017). During this step, the DNP student communicated the result of the EBP project to the team and continued to monitor the change and quality improvement. Key indicators that the team monitored included self-report medication adherence and BP.

Step X, the dissemination of the results is the final step to the Iowa Model Revised (Iowa Collaborative Model, 2017). This step involves sharing the results of the implementation of evidence-based interventions and the knowledge obtained from the experience. Feedback was shared with the organization and the team. The DNP student shared the results of the intervention in an oral presentation at Valparaiso University as a course requirement.

Strengths and Limitations of EBP Model for DNP Project

The Revised Iowa Model of Evidence-Based Practice is an excellent model widely used to develop and sustain EBP change. The model was utilized for this EBP project to assist the team in implementing the best practice recommendations for improving medication adherence using daily text messages.

Strengths of the Revised Iowa Model of Evidence-Based Practice include the incorporation of a feedback loop that provides clinicians with multiple opportunities to pause and review the patient's progress as they are implementing the change. The model requires clinicians/leaders to identify the importance of the topic to the organization before initiating the implementation of the change. The model also facilitates garnering the support needed to implement projects by considering how the project will fit in the organization and how likely the organization is willing to invest in the project before piloting the project for change. Furthermore, the Revised Iowa Model of Evidence-Based Practice encourages a collaborative approach. The

team is composed of stakeholders who actively work together to ensure the project is successfully addressed and implemented (Iowa Collaborative Model, 2017; Melnyk & Fineout-Overholt, 2019; Titler et al., 2001).

Limitation of the Revised Iowa Model of Evidence-Based Practice noted included lack of ease of use by one clinician. The model was designed to be used by a team committed to practicing the implementation of change. In a small practice or office that utilizes a ratio of one provider to one medical assistant, a lack of resources can prevent the formation of an interdisciplinary team. Another limitation is the lack of commitment by one member can impact the team culture and destabilize the implementation process.

Table 2.1

The Iowa Model Revised

Step	Application
1: Identify triggering issues /opportunities	An increasing sense of urgency identified during clinical rotations in this site.
2: State purpose or question	Improve medication compliance in patients on antihypertensive medications through the use of text messaging.
3: Topic priority	Project leader and project facilitator meet to discuss the needs of the project in the clinic.
4: Form a team	Project leader, project advisor, librarian, project facilitator, and medical assistant are selected to form a team.
5: Assemble, appraise, and synthesize body of evidence	Literature search approved by the librarian. Literature review and synthesis completed by project leader and reviewed by project advisor. Evidence synthesized in the body of paper.
6: Sufficient evidence	Melnyk & Fineout-Overholt appraisal tools used to appraise the evidence. Three pieces of evidence selected are of the highest level (Level I), six others are Level II, and one piece is Level V.

7: Design and pilot practice change	Daily text messages delivered to patients
8: Decide if change is appropriate for practice	Pre-intervention and post-intervention data analyzed to determine if there is an improvement in medication adherence.
9: Integrate and sustain practice	Communicate results to key personnel and continue to monitor the change and quality improvement.
10: Disseminate results	DNP presentation on April 16, 2021

Literature Search

A successful implementation of change into practice requires a thorough review and analysis of the best available evidence. The following section will review the search process of gathering and analyzing supportive evidence used to improve medication adherence among adults who take antihypertensive medications.

Sources Examined for Relevant Evidence

Under the guidance of a research librarian, an extensive evidence search was conducted using major databases, including Joanna Briggs Institute (JBI), the Cochrane Library, the Cumulative Index to Nursing and Allied Health Literature (CINAHL, 2014–02/20/2020), PUBMED (2014-2/20/2020), and TRIP (2014-2020). To maximize the acquisition of evidence in JBI and Cochrane, no restrictions were imposed pertaining to age, or country of origin. Multiple key terms were tested to generate abundant evidence, including best approach, best method, best strategy, medication adherence, medication compliance, hypertension, high blood pressure, primary healthcare, and family practice. In addition to the database searches, citation chasing from the reference pages of eligible evidence was also conducted.

The final keywords employed in conducting the search in CINAHL included (*MH "Hypertension")* AND (*improv* OR promot* OR enhac* OR increas**) AND ("*medication compliance" OR "medication adherence" OR "medication concordance*") AND *("primary care" or "primary health care" or "primary healthcare"*). PUBMED included (*hypertension AND "medication adherence" OR "medication compliance").* The final keywords used in TRIP were (*hypertension OR "high blood pressure*") AND *("medication adherence" OR "medication compliance"*) AND (*improv* OR increas*)*. Additionally, the search terms for JBI and Cochrane library were kept simple. Searches in JBI included *(Medication adherence) AND hypertension*,

and *("medication adherence" OR "medication compliance") AND hypertension OR (high blood pressure) OR (elevated blood pressure)* in Cochrane.

The eligibility criteria included (a) articles published between 2014 and 2020, (b) studies describing text messaging interventions relevant to improving medication adherence in adults, (c) studies conducted in primary care settings, and (d) scholarly or peer reviewed journals. The exclusion criteria included (a) studies with goals that were not relevant to the clinical problem, (b) studies in facilities where medication is administered to patients, (c) patients who did not have cell phones to receive related text-messages; (d) patients who were illiterate or unable to read text-messages.

Levels of Evidence

The *Melnyk and Fineout-Overholt Hierarchy of Evidence* was selected in assigning levels to 10 pieces of evidence included in the literature review (Melnyk & Fineout-Overholt, 2019). The *Melnyk and Fineout-Overholt Hierarchy of Evidence* tool includes seven levels of evidence ranging from Level I, to Level VII. The highest level of evidence, Level I, consists of a systematic review or meta-analysis in which all studies included are randomized controlled trials (RCTs). Level II includes evidence from well-designed RCTs. Next in rank is Level III, which includes controlled trials without randomization. Level IV encompasses evidence from a cohort and case-control studies. Level V includes a systematic review of descriptive and qualitative studies, whereas single descriptive or qualitative studies are considered Level VI. Finally, the lowest level of evidence is Level VII, which is composed of the opinions and guidelines of experts or authorities.

A total of 10 pieces of evidence were selected to be included in the review of literature of this EBP project, including three level I, six level II, and one level V pieces of evidence.

Table 2.2

Levels of Evidence

Level	Included	Design
I	3	Systematic Review and Meta-Analysis
II	6	RCT
V	1	Qualitative

Level I Evidence

Three pieces of evidence (Andre et al., 2019; Thakkar et al.,2016 & Wald & Butt, 2015) included in this project are level I. All these pieces of evidence were deemed very good quality using Melnyk and Fineout-Overholt's Rapid Critical Appraisal tool (RCA).

Andre et al. (2019) performed a systematic review evaluating the efficacy of mobile phone-based interventions in promoting medication adherence in patients with hypertension. The systematic review included seven studies: two systematic reviews and five clinical trials, published between 2013 and 2018. A literature search was performed in three databases: Cochrane Library, ProQuest, and PubMed. Pieces of evidence were appraised based on the critical appraisal guideline by Centre for Evidence-Based Medicine (CEBM). Various interventions were included in the reviews: conventional text messages (SMS), smartphone applications, and sophisticated methods that involved an external monitoring device. These mobile-based interventions were examined for their effectiveness in increasing adherence to medications. Smartphone applications (apps) were used to provide educational information about high blood pressure, medication intake, and clinic visit reminders. Another study utilized a smartphone application to send reminders to take medications every three days. Additionally, two studies utilized text messaging: one of them used daily text messages to motivate and remind patients to take their medication along with providing education about hypertension and the importance of adhering to its treatment. The other study also used text messages as a reminder system, but also included features such as education about the importance of medication intake and adherence, educational information about healthy diet, and also antihypertensive medication schedule (Andre et al., 2019).

Medication adherence, defined as the degree to which a patient follows the prescribed dosage, frequency, and timing of drug intake, was the primary outcome of the study (Andre et al., 2019). Medication adherence was measured using the (1) Morisky Medication Adherence Scale (MMAS-8), a verified and validated tool used to measure non-adherence and has proved

to be effective in addressing issues related to adherence, such as forgetfulness or discontinuation of medication (Morisky Widget, 2020); (2) the timing of medication container opening, and (3) blood pressure measurements. Another outcome of interest was blood pressure changes as a result of medication adherence.

The studies included in the review were different in the frequency of sending medication reminders: every day, at every dosing time, and every 12 to 14 days. Consequently, Andre et al. (2019) could not provide a fair comparison. However, all studies that used mobile phone-based interventions to send reminders had a tendency to increase medication adherence levels in hypertensive patients. Mobile phone-based interventions were divided into two groups for better evaluation: text messages and smartphone apps. Both interventions played similar roles of providing medication and appointment reminders. Andre et al. (2019) found that patients who received reminders (either every day regardless of dosing time, or at every dosing time) had better blood pressure control. Additionally, patients who were non adherent at baseline benefit more from the mobile-based intervention with an increase in adherence percentage from 22.8% to 49.4%, in comparison to adherent patients who had an increase in adherence from 71.1% to 75.7%.

Thakkar et al. (2016) conducted a meta-analysis including 16 RCTs with an overall sample of 2,742 subjects examined. All trials investigated the use of mobile telephone text messaging for improving medication adherence in patients diagnosed with HIV, cardiovascular disease, asthma, diabetes mellitus, allergic rhinitis, or epilepsy. The main objective of the meta-analysis was to assess the effect of mobile telephone text messaging on medication adherence of patients with chronic disease. A literature search was conducted from five database inception to January 15th, 2015. Database searches included MEDLINE, EMBASE, Cochrane Central Register of Controlled Trials, PsycINFO, and CINAHL. Inclusion criteria included studies that included adult patients over 18 years with chronic disease who received a mobile telephone text message intervention designed to promote medication adherence, with at least four weeks

follow-up. Also, studies were included if they reported quantitative measures of the effect of text messaging on medication adherence (Thakkar et al., 2016). Studies were excluded if the primary intervention was not text messages if they did not report medication adherence or only focused on disease management or education.

The meta-analysis noted a variation in the text message intervention characteristics: 15 studies sent text messages at a fixed predetermined frequency, one study used real-time medication monitoring and sent text message reminders to only participants who failed to open the medication dispenser. The content of the message included in the review was predominantly medication reminders; however, five studies added medical educational information and three studies included non- medical general content such as jokes, Bible verses, humor. Daily text message was the most common pattern used, followed by a weekly text message. Four studies correlated the text messages with the time of patients' medication doses. All studies used automated or computer programs to deliver text messages to participants. The most common method used to assess medication adherence included self-report using the MMAS-8 scale, pill count, and data from the medication monitoring devices.

The study revealed that text message interventions significantly improved medication adherence (OR, 2.11; 95% CI, 1.52-2.93; $P < .001$). Additionally, adherence to medication improved from 50% at the baseline in the intervention group to 67.8%, suggesting that text message benefits to medication adherence. The study determined that text messages sent to remind patients to take their medication improved medication adherence.

Wald & Butt (2015) stated there are more than 160 different mobile-based interventions designed to improve medication adherence and all using 1-way rather than 2-way messaging. The authors performed a meta-analysis of eight RCTs, with an overall sample of 1994 patients, to compare the difference between a 1-way text messaging (text message reminders sent but no reply requested) and a 2-way text messaging (text message reminders sent, and participants were asked to reply as to whether or not they took their medications as prescribed) used on

medication adherence. Five studies were conducted on patients receiving treatment for human immunodeficiency infection, two studies were performed on patients receiving blood pressure or lipid-lowering agents, and one study was conducted on individuals receiving malaria treatment prophylaxis.

The authors searched four databases, including PubMed, Embase, Ovid, and Cochrane Library for studies that evaluated the effectiveness of text messaging interventions in improving medication adherence on patients receiving treatment for human immunodeficiency infection, high blood pressure or lipid, and on malaria treatment. Participants were characterized as adherent or nonadherent to medication if the percentage of doses taken exceeded 80%. Medication adherence was measured using data from the Medication Event Monitoring System (MEMS), self-reporting, and pill counts. Although there was no trial directly comparing 1-way with 2-way messaging in a single study, the analysis revealed that patients are more likely to adhere to medication if a 2-way messaging was utilized (95% confidence interval, P= .007); however, 1-way messaging (reminder only) was also associated with an increase in medication adherence.

Level II Evidence

The project included six randomized controlled trials (RCTs) (Kassavou et al., 2020; Khonsari et al.,2015; Varleta et al., 2017; Buis et al., 2017; Park et al.,2014 & Bobrow et al., 2016) were used for this project. All these pieces were assessed with the Melnyk and Fineout-Overholt's RCA and assessed as good quality.

Kassavou et al.'s (2020) RCT evaluated the efficacy of tailored text and voice messaging intervention in improving medication adherence among patients with either or both hypertension and type 2 diabetes in primary care settings. The study included 135 participants who were randomized into two groups: intervention (n=79) or control (n=56) group. Participants were selected from eight primary care practices in highly deprived areas in the East of England. The inclusion criteria included patients who were 18 years or older, who had a diagnosis of

hypertension, type 2 diabetes mellitus, or both health conditions, took at least one antihypertensive medication or glucose-lowering agent, and who had either or both poorly controlled blood pressure and glucose levels. Patients were excluded from the study if they were taking part in another medication adherence or if they had a health condition that could impair their participation in the study (Kassavou et al., 2020). Participants in the intervention group received tailored text messages for 12 weeks starting from the day their repeat prescription was due for pick-up. Seventy-three percent of the participants in the intervention group chose to receive one message per day and 27% selected to receive two messages per day. The majority of the participants selected to receive text messages around the time they took their medications. The content of the text messages varied based on participants selection. The themes included: awareness of the importance to take medications as prescribed, awareness of the benefits to keep taking medications as prescribed and potential risks when not taking medications, medications reminders, and social support. Each text message provided participants with options to change delivery options (e.g., decrease or increase the frequency of messages or stop the messages). Participants' medication adherence was measured using the MMAS-8 scale in addition to face-to-face, in-depth interviews conducted to assess the acceptability of the delivery mode.

The study demonstrated a statistically significant difference in prescription adherence (t116=2.27; P=.02; mean 0.99 [SD 0.11] for the intervention group vs 0.92 [SD 0.21] for the control group), in days of adherence (t112=2.37; P=.02; mean 6.85 [SD 0.47] vs 6.36 [SD 1.59]). In addition, the majority of the participants 73% (51/70) stated that the intervention was easy to use. Overall, 76% of the participants (53/70) were satisfied with the experience with the intervention and would recommend it to people who take medications for a long-term health condition. Furthermore, participants who received text messages

designed to increase awareness about medication adherence and the risk and benefits of maintaining adherence to prescribed medications, social support, and reminders to take medications reported they were highly effective.

Buis et al. (2017) conducted an RCT to evaluate the effectiveness of an automated text messaging intervention designed to improve medication adherence among African Americans diagnosed with uncontrolled BP. The authors recruited a total of 123 participants recruited from primary care settings (n=58) and emergency departments (n=65 for ED). Buis et al. (2017) developed software called *BPMED* to deliver daily automated text message medication reminders before every medication intake to assist African Americans patients to better control their blood pressure in remembering to take medications. Each week, participants also received two educational messages about hypertension management from the American Heart Association. The inclusion criteria included African American patients, aged 18 years or older, who had a diagnosis of hypertension (clinic systolic blood pressure [SBP] >140 mm Hg and diastolic blood pressure [DBP] >90 mm Hg or SBP >130 mm Hg and DBP >80 mm Hg for those with diabetes or kidney disease), who owned a cell phone with text messaging, who took at least one antihypertensive medication, and spoke English. Participants BPs were measured using an automated device, with the participant seated or lying supine. The exclusion criteria included participants with a diagnosis of resistant hypertension, who were undergoing hemodialysis, who had a history of substance/alcohol abuse, and/or any other health issues that would prevent authors to follow-up on the intervention.

Participants were randomized to receive either text messaging via a secured software called BPMED or usual care for one month. The primary outcome measure was medication adherence as quantified by MMAS-8. Participants were invited to complete the MMAS-8 questionnaire at the beginning and the end of the intervention. The results showed a greater improvement in medication adherence among BPMED participants compared to those who received usual care (mean change 0.9, SD 2.0 vs mean change 0.5, SD 1.5; *P*=.26). The study

suggests that the use of text message reminders to improve the quality of medication management through improving medication adherence in African Americans with uncontrolled HTN is a feasible and acceptable approach.

Varleta et al. (2017) conducted a RCT including 314 patients recruited from 12 different primary care centers in Santiago**,** Chile. The study's goal was to evaluate the effect of a mobile phone text messaging intervention compared to no text messaging in improving self-reported antihypertensive drug adherence in hypertensive patients in primary care offices. The inclusion criteria for the study included patients ages 30 to 80 years, with a confirmed medical diagnosis of arterial hypertension, who had been prescribed their first antihypertensive medication within the previous one to six months, and who owned a mobile phone with access to SMS text messaging. Participants were excluded from the study if they had a history of myocardial infarction, stroke, heart failure, and/or renal failure on dialysis, and with an inability to receive SMS text messages secondary to mental disabilities and/or patients who were unable to read (Varleta et al., 2017).

At the baseline visit, patients' education levels were determined, as well as their demographics, antihypertensive medications, cardiovascular risk factors, and dietary habits. Additionally, antihypertensive medication adherence was also measured using the validated Spanish version of the Morisky-Green-Levine questionnaire. During a 6-month period, 163 patients were randomly assigned to receive text messages every 10 to 14 days, which contained educational information about a healthy diet, salt intake, antihypertensive medication scheduling, and the importance of medication intake and compliance. A confirmation call was made every four weeks to track the delivery of text messages. No other information was requested except confirmation of text messages receipt.

After six months of follow up, the study revealed an increase in antihypertensive medication adherence rates from 54% and 57% in the intervention group and a decrease for the control group from 59.3% to 51.4%. Overall, there was a significant improvement in medication

adherence in the SMS text message group from 49% to 62.3% (*P*=.01). Varleta et al. (2017) reported that the SMS intervention improved antihypertensive medication adherence by 30% (RR, 1.3; 95% confidence interval, 1.0-1.6, P <.05).

Bobrow et al. (2016) conducted a three-group RCT to assess the effect of text messages on decreasing blood pressure and improving medication adherence. The study involved 1215 participants with hypertension selected at a primary care clinic in Cape Town, South Africa. Participants were randomly assigned to an information-only SMS text messages group (n=457), an interactive SMS text messages group (n=458), and the control group, where participants received usual care (n=457). Participants were enrolled if they were over the age of 21, who had a diagnosis of hypertension, (SBP) <220 mmHg and a diastolic blood pressure <120 mmHg, and a diastolic blood pressure <120 mmHg), prescribed at least one blood pressure-lowering medication at enrollment. Participants also were included if they were able to receive and send SMS text messages. The exclusion criteria included patients who were hospitalized to receive special care for their hypertension. Women who were pregnant or within three months postpartum were also excluded from the study.

Participants in the information-only message and interactive message group received personalized SMS text messages at weekly intervals from a web-based electronic medical record system (OpenMRS). Participants in the information-only message group were sent text messages to motivate them to collect their medicines at the pharmacy, to take their medicines, and they were educated about hypertension and its treatment. Participants in the interactive message group received the same messages as the information-only group but they had an option to reply to selected messages by texting back “please call me.” By doing so an automated series of responses were generated offering a number of options, including changing or canceling an appointment and changing the language and timing of the text messages (Bobrow et al., 2016). Text messages were also automatically tracked to ensure they were delivered to participants, and in case a message was undelivered, participants’ friends or

relatives were reached by a research assistant blinded to group allocation to obtain a new mobile phone number.

The study showed a reduction in mean SBP in the intervention group receiving information-only text messages compared with the control group (MD –2.2 mmHg, 95% CI –4.4 to 0.00; P = 0.046). A visual analogue scale was used to measure adherence. For the 12-month period of the intervention, Bobrow et al. (2016) reported a 62.8% of medication adherence for the information-only message group, 59.7% for the interactive message group, and 49.4% for the control group (P<0.001).

Khonsari et al. (2015) conducted an RCT to examine the effect of automated text messaging reminders on optimizing medication adherence among acute coronary syndrome (ACS) patients in Kuala, Lumpur. Patients were selected from a teaching hospital during an admission following ACS. The authors introduced the automated SMS-based reminder system intervention to the potential participants prior to discharge, and they were enrolled in the study based on their acceptance. The exclusion criteria included patients who had a cognitive impairment, were illiterate, unable to operate a mobile phone, who were being transferred to another facility. The sample consisted of 62 ACS participants who were randomly divided into two equally sized groups that each received either an automated text message before every medication intake or standard care. Patients in the intervention group received daily text messages before every medication intake. Khonsari et. al (2015) stated that it was crucial to maintain the length and number of characters in the SMS had to be short to ensure that the message would be simple, practical and easy to understand. The following template was used: ‘‘[Mr./Ms.] [Patient’s Name], please take [Medication Quantity] tablet of [Medication Name] at [Time]’’.

In addition, once every two weeks, participants in the SMS group received follow-up telephone calls to confirm the delivery of the text messages and evaluate whether or not participants needed to be readmitted or visit a provider. Medication adherence was measured using the MMAS-8 scale. The study reported an increase in medication adherence of 65% among participants who received SMS reminders to take their medications compared to only 13% among participants who received the usual care. (RR =4.09, 95% CI 1.82–9.18). The study suggests that the use of text messages to remind patients can be advantageous in improving medication adherence.

Park et al. (2014) examined the effect of mobile health (mhealth) on medication adherence among patients with coronary heart disease (CHD) and explored patients' satisfaction with text messages used to improve medication adherence. Ninety patients with CHD participated in the study and were randomly divided into three groups: (a) patients who received text message reminders for medication adherence and health education (n=30), (b) patients who received text messages about health education (n=30), and (c) patients who received usual care (no text messages, n=30). The inclusion criteria for the study included patients over 21 years of age, hospitalized for non-ST elevation MI, ST-elevation MI, or PCI, prescribed an antiplatelet medication and/or a statin medication, and who owned a mobile phone with text messaging capability. Participants were excluded if they had a cognitive impairment, were unable to understand English and could not operate a mobile phone.

At the beginning of the study, participants completed the socio-demographic survey, the Morisky Medication Adherence Survey (MMAS-8), the Manage Disease in General Scale (MDGS), the Self-Efficacy for Appropriate Medication Use Scale (SEAMS), the Social Support Survey, and the Beck Depression Inventory to collect their baseline data. The interventions consisted of sending text messages at times that correlated with patients' medication schedule.

Additionally, three times per week patients receive educational text messages about their disease (Monday, Wednesday, and Friday at 2 PM). The purpose of educational text messages was to determine whether or not it would enhance medication adherence compared to direct medication reminders. Patients in the intervention groups were asked to respond to each text message to indicate receipt. Participants' adherence to medication was assessed using the MMAS-8 and by reviewing the medication event monitoring system (MEMS). Patients' satisfaction was assessed by successful completion of the intervention and their participation, and by the Mobile Phone Use Questionnaire.

Although the total mean scores of the MMAS-8 scale reported no significant differences in medication adherence between participants who received text message and those who did not at either baseline or 30 days ($F(2, 0.44) = 0.10$, $p = 0.91$), Park et al.'s (2014) reported a higher percentage of correct doses and antiplatelet medications taken on time among participants who received reminders and educational text messages as opposed to the control group [$t(36) = 2.5$, $p = 0.02$; $t(37) = 2.6$, $p = 0.01$, respectively]. Furthermore, both intervention groups (text messages reminders + text messages reminders and education) had a higher percentage of correct doses taken and percentage of prescribed doses taken on schedule compared to the control group [$t(36) = 2.5$, $p = 0.02$; $t(37) = 2.6$, $p = 0.01$, respectively]. The study revealed that patients who received text messages for medication reminders and/or education had better adherence to their medication therapy in comparison to patients who did not receive text messages and/or education.

Level V Evidence

Leon et al. 's (2015) qualitative study had the aim to explore patients' experience on the use of SMS-text messages as a way to improve adherence to medications. The authors used a combination of convenience and purposive sampling to recruit 15 participants from a primary care clinic in Cape Town, South Africa. The clinic provides care, free of charge, for approximately 100,000 socio-economically deprived people each year. The general criteria for

the study included a diversity of age, ethnicity, and language. A focus group with 22 participants (16 females and 6 males, with an age range of 36 to 78 years old), and 15 individual in-depth interviews (8 females and 7 males, with an age range of 45 to 78 years) were conducted using a single semi-structured questionnaire to explore participants' experience and perception of their chronic illness, their adherence behavior, and the effectiveness of text messaging on their adherence behavior, health and wellbeing. Leon et al. 's (2015) gathered data between March and May 2014 when data saturation was reached. All interviews were recorded and transcribed.

Most patients reported a positive experience receiving weekly text messages reminders designed to improve medication and adherence behavior. The content within the text messages was based on techniques of goals and planning, repetition and substitution, social support, and natural consequences, which participants selected at the beginning of the study. Patients reported that the use of text messages as a reminder system was highly beneficial. Participants reported that text messages improved their attitude to their health condition and enhanced adherence behavior and health. This piece of evidence was also deemed good quality by Melnyk and Fineout-Overholt’s RCA.

Table 2.3

Synthesis Paper Evidence Table

Citation (APA)	Purpose	Design	Sample	Measurement/ Outcomes	Results/Findings	Level/ Quality
Thakkar J, Kurup R, Laba T, et al. (2016). Mobile telephone text messaging for medication adherence in chronic disease: A meta-analysis. *JAMA Intern Med, 176*(3):340–349. doi:10.1001/jamainternmed.2015.7667 00000001260	"…to assess the effect of mobile telephone text messaging on medication adherence in chronic disease" (p. 340).	Meta-analysis	-16 RCTs that investigate the use of mobile telephone text messaging on improving medication adherence in patients diagnosed with HIV, cardiovascular disease, asthma, diabetes mellitus, allergic rhinitis, and epilepsy. (published between 2004-2015) n=2742 total participants	Medication adherence was the primary outcome. self-recall, data from the medication monitoring devices, and pill count were the most common ways used to assess adherence	Text message interventions significantly improved medication adherence (OR, 2.11; 95% CL, 1.52-2.93; P trend <.001). adherence rates increased from 50% at the baseline to 67.8%, suggesting that text messages improve medication adherence in patients with chronic diseases.	Level I Very Good

Varleta, P., Acevedo, M., Akel, C., Salinas, C., Navarrete, C., García, A., Echegoyen, C., Rodriguez, D., Gramusset, L., Leon, S., Cofré, P., Retamal, R., Romero, K., Acevedo, M., García, A., & Cofré, P. (2017). Mobile phone text messaging improves antihypertensive drug adherence in the community. *Journal of Clinical Hypertension, 19*(12), 1276–1284. doi:10.1111/jch.13098.	"…to evaluate the effect of a mobile phone text messaging intervention vs no text messaging in improving self-reported antihypertensive drug adherence in patients with hypertension in primary care offices" (p.127).	RCT	n= 314 patients n=163 intervention group n=151 control group	**Primary outcome:** Medication adherence measured using the validated Spanish version of the Morisky-Green-Levine (MGL) questionnaire. **Secondary outcome:** BP changes	Overall: Baseline: 54% After IV: 57% After 6 months: Control Group: Baseline: 59.3% After IV: 51.4% Experimental Group: Baseline: 49% After IV: 62.3% RR, 1.3; 95% confidence interval, 1.0-1.6, P <.05). - The baseline mean BPs in the experimental and nonexperimental groups, respectively, was 142/81 and 140/78. compared with 134/77 and 136/78, respectively, at the end of the intervention.	Level II good

Andre, N., Wibawanti, R., & Siswanto, B. B. (2019). Mobile Phone-Based Intervention in Hypertension Management. *International Journal of Hypertension, 1*–7. doi 10.1155/2019/9021017	…"to critically appraise whether mobile phone-based interventions are effective in increasing adherence in hypertensive patients" (p. 2).	SR	7 studies: 5 clinical trials, reporting on 1729 participants and 2 systematic reviews examining the interventions designed to improve medication adherence and blood pressure outcome (published between 2013-2018).	**primary outcome** Medication adherence measured using the MMAS-8, data from the MEMS, and independent blood pressure measurements **Secondary outcome** blood pressure changes	Non-adherent participants, at baseline, had an increase in adherence from 22.8% to 49.4%. Adherent participants at baseline had an increase in adherence from 71.1% to 75.7%. participants who were given reminders had better blood pressure control	Level I Very good
Khonsari, S., Subramanian, P., Chinna, K., Latif, L. A., Ling, L. W., & Gholami, O. (2015). Effect of a reminder system using an automated short message service on medication adherence following acute coronary syndrome. *European Journal of Cardiovascular Nursing, 14*(2), 170–179.doi: 10.1177/1474515114521910	...to assess the effect of automated short message service (SMS)-based reminders on post-discharge medication adherence among acute coronary syndrome (ACS) patients	RCT	n=62 participants n=31 intervention group n=31 control group	medication adherence, measured by the MMAS-8 scale	The study reported an increase of 65% among participants who received SMS reminders to take their medications compared to only 13% among participants who received the usual care. (RR =4.09, 95% CI 1.82–9.18)	Level II good

Bobrow K, Farmer AJ, Springer D, Shanyinde M, Yu LM, Brennan T, et al. (2016). Mobile phone text messages to support treatment adherence in adults with high blood pressure (SMS- Text Adherence Support [StAR]): a single-blind, randomized trial. *Circulation 133*(6):592-600. doi: 10.1161/.115.017 530]	...assess the effectiveness of automated treatment adherence support delivered via mobile phone short message system (SMS) text messages on blood pressure	RCT	n=1372 participants n=457 information only text messages group n=458 interactive text messages group n=457 control group	**primary outcome:** change in SBP **Medication adherence** -self-reported adherence to medication measured with a visual analogue scale	In the information-only group, the mean adjusted change in SBP compared with usual care was −2.2 mmHg (95% confidence interval, −4.4 to −0.04) and −1.6 mmHg (95% confidence interval, −3.7 to 0.6) in the interactive group. 62.8% of medication adherence for the information-only message group, 59.7% for the interactive message group, and 49.4% for the control group (P<0.001).	level II good
Park, L.G, Howie-Esquivel J, Chung ML, Dracup K. (2014). A text messaging intervention to promote medication adherence for patients with coronary heart disease: a randomized	...examine the effectiveness of text messages (TM)reminders and/or health education on medication adherence	RCT	n=90 participants n=30 TM Reminders + TM Education group allocated n=30 TM Education Alone group allocated	Medication adherence assessed using the MMAS-8 and MEMS	"TM Reminders + TM Education group had a higher percentage of correct doses taken and percentage of prescribed doses taken on schedule compared to	Level II Very good

controlled trial. *Patient Educ Couns 94*(2):261-268			n=30 no TM		the No TM group for antiplatelet medications [t(36) = 2.5, p = 0.02; t(37) = 2.6, p = 0.01, respectively]"(p .263).	
Kassavou, A., Mirzaei, V., Brimicombe, J., Edwards, S., Massou, E., Prevost, A. T., Griffin, S., & Sutton, S. (2020). A Highly Tailored Text and Voice Messaging Intervention to Improve Medication Adherence in Patients With Either or Both Hypertension and Type 2 Diabetes in a UK Primary Care Setting: Feasibility Randomized Controlled Trial of Clinical Effectiveness. *Journal of Medical Internet Research, 22*(5), N.PAG. doi: 10.2196/16629	...to evaluate if the efficacy of tailored text and voice messaging intervention to improve medication adherence among patients with either or both hypertensio n and type 2 diabetes.	RCT	n=135 participants randomized to 2 groups: intervention (n=79) or control (n=56) group.	Medication adherence measured with MMAS scale. Intentional nonadherence was measured with the MMAS-(4-items) and nonintentional nonadherence with the MMAS-(1-item)	prescription adherence (t116=2.27; P=.02; mean 0.99 [SD 0.11] for the intervention group vs 0.92 [SD 0.21] for the control group), days of adherence (t112=2.37; P=.02; mean 6.85 [SD 0.47] vs 6.36 [SD 1.59]), Medication Event Monitoring System (t10=4.04; P<.001; mean 6.05 [SD 2.29] vs 3.5 [SD 4.94])	Level II Good
Leon, N., Surender, R., Bobrow, K., Muller, J., & Farmer, A. (2015). Improving treatment adherence for blood pressure lowering via mobile phone	...to explore patients' experience on the use of SMS-text messages as a way to improve adherence to medications.	qualitativ e study	n=15 participants	perceptions of SMS-text messages as a way to improve adherence Interviews and focus groups were conducted	The use of SMS-text messages was reported to be positive and helpful.	Level V good

SMS-messages in South Africa: a qualitative evaluation of the SMS-text Adherence SuppoRt (StAR) trial. *BMC Family Practice, 16*(1), 80–89. doi: 10.1186/s12875-015-0289-7						
Wald, D.S., Butt, S., Bestwick, J.P. (2015). One-way versus two-way text messaging on improving medication adherence: meta-analysis of randomized trials. *Am J Med. 128(*10): 1139.e1-1139.e11395. doi: 10.1016/j.amjmed.2015.05.035	… to examine the different between 1-way text messaging compared with 2-way SMS on improving medication adherence	meta-analysis	8 RCT n= 1994 total participants	Medication adherence, measured using the MEMS, self-reporting, and pill counts	The study revealed that patients are more likely to adhere to medication if a 2-way messaging is utilized (95% confidence interval, P= .007).	Level I very good

Buis, L., Hirzel, L., Dawood, R. M., Dawood, K. L., Nichols, L. P., Artinian, N. T., Schwiebert, L., Yarandi, H. N., Roberson, D. N., Plegue, M. A., Mango, L. C., & Levy, P. D. (2017). Text messaging to improve hypertension medication adherence in African Americans from primary care and emergency department settings: Results from two randomized feasibility studies. *JMIR mHealth and uHealth, 5*(2), e9. doi.org/10.2196/mhealth.6630	…to evaluate the effectiveness of an automated text messaging intervention designed to improve medication adherence among African Americans with uncontrolled BP	RCT	n=123 participants n=58 from PC n= 65 from ED	Medication adherence was measured with the MMAS-8 scale	A greater improvement in medication adherence among BPMED participants compared to those who received usual care (mean change 0.9, SD 2.0 vs mean change 0.5, SD 1.5; *P*=.26).	Level II good

Construction of Evidence-based Practice

Synthesis of Critically Appraised Literature

The synthesis of the literature identified several interventions geared toward improving medication adherence using text messages. A total of 10 high and good qualities were critically appraised using the Melnyk and Fineout-Overholt's Rapid Critical Appraisal tools and Hierarchy of Evidence. Common themes were extracted from the literature evaluating the best interventions enhancing medication adherence, such as messages frequency, messages content, message direction, and self-report outcome.

Message frequency. The effect of text message reminders interventions on improving medication adherence has demonstrated to be effective (Andre et al., 2019; Thakkar et al.,2016; Wald & Butt, 2015; Kassavou et al., 2020; Khonsari et al.,2015; Varleta et al., 2017; Buis et al., 2017; Park et al.,2014; Bobrow et al., 2016; Leon et. al, 2015). However, there were differences in the frequency of sending medication reminders: once every day, at every dosing time, and weekly, and every 12 to 14 days.

Although all studies have demonstrated to positively affect medication adherence using different strategies, daily text messages at every medication dosing time were the most common pattern used in the literature and were shown to significantly improve medication adherence (Kassavou et al., 2020; Andre et al., 2019; Buis et al., 2017; Thakkar et al., 2016; Khonsari et al., 2015; Park et al.,2014).

Message content. The content of the text messages varied in the literature. Two studies only sent text message reminders (Andre et al., 2019; Khonsari et al.,2015), and others incorporated educational content in addition to reminding participants of medication intake (Thakkar et al.,2016; Wald & Butt, 2015; Kassavou et al., 2020; Varleta et al., 2017; Buis et al., 2017; Park et al.,2014; Bobrow et al., 2016; Leon et. al, 2015). The delivery of daily text messages at every dosing time was the most consistent method of reminding participants to take their medication with the addition of educational content. The frequency of educational messages varied between every day at every dosing time, every three day, and weekly. The only study that looked at the use of text message and educational information on medication adherence reported a higher percentage of correct doses and medications taken on time among participants who received reminders and educational text messages as opposed to those who did not receive text messages or only received text message reminders (Park et al., 2014).

Message direction. The delivery of text messages varied between the studies. Two studies evaluated the effectiveness of a 2-way messaging system (Andre et al., 2019; Bobrow et al., 2016) and the others 1-way messaging system (Thakkar et al.,2016; Wald & Butt, 2015;

Kassavou et al., 2020; Khonsari et al.,2015; Varleta et al., 2017; Buis et al., 2017; Park et al.,2014; Leon et. al, 2015). In interventions that utilized 1-way text messaging, participants were not able to reply in comparison to 2-way text messaging which allowed participants to interact with the researchers. For instance, in some studies participants were able to generate a series of educational messages by texting back some keywords (Andre et al., 2019; Bobrow et al., 2016). Although it was found that 2-way messages were more effective than 1-way messages, there was no statistical difference between using a unidirectional or bidirectional messaging program (Bobrow et al., 2016).

Measuring adherence. The use of the Morisky Medication Adherence Scale-8 (MMAS-8) was the most consistent method of measuring outcomes for medication adherence interventions in the literature (Andre et al., 2019; Thakkar et al.,2016; Wald & Butt, 2015; Kassavou et al., 2020; Khonsari et al.,2015; Buis et al., 2017; Park et al.,2014). The MMAS-8 is a low cost, simple, and validated self-report scale widely used in the literature to assess patient adherence to chronic medications. variables. The MMAS-8 scale contains eight-items specifically developed to facilitate the identification of barriers to antihypertensive medication adherence, which is crucial in clinical practice (Morisky et al., 1986a; Morisky et al.,2008b).

Best Practice Model Recommendation

After running an exhaustive search and reviewing the appraised literature, the use of daily text messaging at every medication dosing time, with educational information, was identified as the best practice to improve medication adherence with hypertensive patients. The use of text messages is a cost-effective, time-efficient, patient-centered intervention, which can benefit a large number of participants. The literature has shown that participants were satisfied with the experience and the ease of the intervention, yet highly effective. The use of secured software protected participants' confidentiality and anonymity. Utilizing text messaging as a

reminder system in addition to education has shown to increase health literacy and compliance which has resulted in improved compliance to therapies and subsequently patients' health outcomes.

CHAPTER 3

IMPLEMENTATION OF PRACTICE CHANGE

This chapter represents the seventh step in the Iowa Model Revised, which focuses on designing a practice change. The purpose of the EBP project was to explore and implement the best practice to increase medication adherence among patients diagnosed with hypertension. The synthesis of the literature supported the positive impact of daily text messaging for patients with a hypertension diagnosis who take at least one antihypertensive agent to improve medication adherence to therapy. To ensure a successful implementation of this project, a collaboration took place between the DNP student, two providers, and two medical assistants (MAs).

The PICOT question that guided this EBP project reads, “In primary care setting, in adults, male or female, aged more than 18 years with a diagnosis of hypertension and who are taking antihypertensive medications (P), does receipt of daily text messages (I) compared to education provided during each office visit (C) influence medication adherence (O) over a six-week time period (T)?”

Participants and Setting

The setting for this EBP project was a primary care clinic in Indianapolis, Indiana. Being part of a large physician group practice, clinic X was staffed with seven physicians, one physician assistant, and at least eight MAs. The clinic operated from Monday through Friday from 8:00 am to 4:00 pm. Stakeholders in this project included the DNP student, two MAs, project advisor, one physician and her hypertensive patients. All patients with uncontrolled BP were invited to participate. Other factors deciding whether including for participation in the EBP project were individuals (1) who had been given their first antihypertensive medication prescription during the previous 3 months, (2) aged 18 and older; (3) who owned a mobile phone with access to SMS text messaging and telephone calls (4) who understood English, and

(5) who could read. Exclusion criteria included: patients (1) with cognitive impairment, (2) who were illiterate or unable to read text messages (3) unable to complete questionnaires, and (4) unable to operate a mobile phone or receive text messages.

Pre-Intervention Group Characteristics

The EBP project invited as many participants as possible who met the inclusion criteria who were seen in the office on recruitment days. In the days of recruitment, participants' blood pressures were measured manually by the MA and was used as baseline data for this project. The Morisky Medication Adherence Scale (MMAS-8) was also used to measure participants' medication adherence prior to the initiation of the project. The MMAS-8 is a verified and validated tool used to measure non-adherence and has proved to be effective in addressing issues related to adherence, such as forgetfulness or discontinuation of medications (Andre et al., 2019; Thakkar et al.,2016; Wald & Butt, 2015; Kassavou et al., 2020; Khonsari et al.,2015; Buis et al., 2017; Park et al.,2014). The literature has supported the MMAS-8 as a reliable and valid tool for medication adherence assessment with hypertensive patients. Validity of the MMAS-8 has been demonstrated in an independent study conducted with a total of 1367 hypertensive patients. The MMAS-8 medication adherence scale was reliable (alpha=.83) and was also statistically associated with blood pressure control (P<.05) (Morisky et al., 2008). Additionally, sensitivity and specificity of the MMAS-8 was 93% and 53%, respectively, with a cut–off point of six or lower as measure of non–adherence (Morisky et al., 2008).

After the initial encounter with the provider, patients were expected to wait in the room until their check-out paperwork was ready, which took approximately 10 minutes. During that time, participants were informed about the telephone call from the DNP student to complete the MMAS- 8 questionnaire. The questionnaire took less than 3 minutes to complete. The form had each participant's code, and the DNP student placed all information in a locked cabinet in the clinic. Demographic data such as gender, age, number of antihypertensive medications, and number of years with high BP were collected from client charts by the DNP student.

Intervention

The Iowa Model Revised was used to prepare for the EBP intervention. A project plan was developed using the steps determined by the model for successful project design and implementation. Prior to initiating the EBP intervention, eligible patients were identified by the DNP student and staff, and they were invited to participate in the project at the end of their office visits. The potential participants were introduced to the EBP project. Benefits and potential discomfort of the project were discussed with the patients before freely consenting to join the EBP project (see Appendix A). Patients who agreed to join the project were educated on their right to withdraw from the project as each text message included instructions on how to do so.

As it is supported by the evidence, the length and number of characters in the text messages were kept short to ensure that the message was simple, practical and easy to understand. Consequently, The DNP used the following template ‘‘[Mr./Ms.] [Patient’s Name], please take [Medication Quantity] tablet of [Medication Name] at [Time]’’. Besides, participants had also received educational content about hypertension control and management, and medication adherence retrieved from the American Heart Association and used in a high level and quality evidence by Varleta et al. (2017) every three days (see Appendix C).

Comparison

Pre-implementation data and post-implementation data were compared. The pre-implementation data consisted of the MMAS-8 score and blood pressure measurements collected prior to the EBP project initiation, and the post- implementation data include the MMAS-8 score and blood pressure measurements collected at the end of the project implementation. MMAS-8 scores were analyzed for increases or decreases in adherence rates. An analysis of data was performed using the paired t-test to determine if the implementation of daily text messages had an effect on adherence rates. Data collected was protected to maintain standards of Health Insurance Portability and Accountability Act (HIPAA).

Outcomes

The targeted primary outcome of the EBP project to increase medication adherence with patients diagnosed with hypertension, and who were taking at least one antihypertensive agent. Medication adherence was measured using the MMAS-8 scale. Data provided from the MMAS-8 included high adherence (score of 8), medium adherence (score of 6 to <8) and low adherence (scores of <6). Items 1 through 7 offer “yes” or “no” response choices while item 8 has a 5-point Likert response choice. A score of “1” was given to each ‘‘no” response, whereas each ‘‘yes” is scored as ‘‘0” except for item 5, in which each response ‘‘never/rarely” was scored as ‘‘1” and ‘‘once in a while, sometimes, usually, and all the time” was scored as ‘‘0” (Morisky et al., 1986a; Morisky et al.,2008b). The MMA-8 was also administered to the participants at the end of the project period via telephone call.

The secondary outcome of the EBP project was the change in blood pressure measurement. Blood pressure was measured manually prior to the project implementation. This is considered pre-data. Participants who completed the project were asked to report their latest blood pressure reading, which was considered post-data.

Time

The implementation of the EBP project consisted of six weeks. The EBP project implementation was divided into three phases: pre-implementation phase, pilot phase, and evaluation phase. The pre-implementation phase consisted of introducing the project to the stakeholders and discussing the project expectation with them (provider approval, see Appendix B), and completing the “Social Behavioral Educational Researchers” course, a web-based training and certification through the Collaborative Institutional Training Initiative (CITI, see Appendix C). In addition, approval from the clinic’s legal and compliance committee was obtained prior to implementation. The next step was selecting the potential participants at clinic X.

Upon arriving at the clinic, potential participants followed the clinic routine: vitals are taken by the MAs, patients are invited to a room, medications record is completed by the MA. After the encounter with the providers, all participants with a hypertension diagnosis were approached by the DNP student or MA, who introduced them to the EBP project. The benefits and potential discomforts related to joining the project was discussed with the patients. Patients who agreed to be part of the project freely signed consent and were then referred to as participants. Participants demographics information and medication administration time were obtained by the DNP student in the chart and confirmed during recruitment. Participants were asked to provide their direct phone number, where text messages and educational information were sent. Participants' blood pressures were recorded by the MA and antihypertensive medication administration time was confirmed, per the clinic's routine and policy.

The implementation phase consists of sending daily text messages at participants' dosing times and educational content about hypertension every three days. The duration of intervention in the reviewed literature most frequently lasted 30 days to 12 months (Andre et al., 2019; Thakkar et al.,2016; Wald & Butt, 2015; Kassavou et al., 2020; Khonsari et al.,2015; Buis et al., 2017; Park et al.,2014). The six-weeks' timeline of the EBP project was determined by the literature and the clinic's allowable time. The implementation of this project started on the 4th of October 2020 after receiving IRB and clinical site approval.

Participants received a telephone call to complete the MMAS-8 scale prior the start of the EBP project and upon completion of this EBP project. The DNP student compared the pre- and post- MMAS-8 score to evaluate adherence to antihypertensive medications. In case the participants did not record their BP, the secondary outcome was not measured.

Protection of Human Subjects

Prior to initiating the EBP project, the DNP student obtained permission from the practice manager and providers to implement the change at the clinic. The DNP student obtained an IRB approval from Valparaiso University and completed the CITI training to ensure the protection of

human rights. All patients who showed interest in the project were asked to sign a consent that was obtained before the project implementation (See Appendix A). To protect patients' confidentiality, participant data was secured throughout the EBP project implementation and outcomes collection in the office setting. Participants were assigned a code number to protect their identity and data was compared against the baseline data at the end of the intervention. Participants' initials and date of birth were matched with a code number (see Appendix F) and all information collected during this project was kept in a locked cabinet in the office to maintain the standards of HIPAA. Only the DNP student and MAs had access to the cabinet.

Participants' phone numbers were manually entered in a secured software to receive text messages. The DNP student was the only person to access the software account where participants' phone numbers were stored. Additionally, the DNP student was the only person to compose and schedule text messages to participants. Participants received daily text messages and three times per week educational content about hypertension from the American Heart Association was sent by text messages via a secured software, *Textedly* (policy and confidentiality, https://www.textedly.com/privacy-policy/). Each text message included information about how to opt-out of the project at any time. Upon the project completion, data were analyzed using SPSS version 25.

CHAPTER 4

FINDINGS

The purpose of the EBP project was to explore and implement the best practice to increase medication adherence among patients diagnosed with hypertension using text message reminders over a 6-week period. Medication adherence was measured using the MMAS-8 scale. Participants' adherence rates were determined after analyzing the pre- and post-intervention scores on the MMAS-8 scale. Outcomes for the project included appropriate medication adherence rate, defined as a score of 6 or higher on the MMAS-8 scale, and a decrease in blood pressure. The PICOT question for this project was: "In primary care setting, in adults, male or female, aged more than 18 years with a diagnosis of hypertension and who are taking antihypertensive medications (P), does receipt of daily text messages (I) compared to education provided during each office visit (C) influence medication adherence (O) over a six-week time period (T)?

In this chapter, details regarding participants' demographic information, and statistical analyses on the data collected will be presented.

Participants

Size

In total, 21 adults, male and female, diagnosed with high blood pressure signed consent forms agreeing to participate in the project. Of these participants, 17 (80.95%) participants completed the EBP project.

Characteristics. The DNP student and project facilitator reviewed patient charts and determined eligibility based on the diagnosis. Participants of the EBP project were all patients at the clinic and were recruited during their routine visits. Inclusion criteria for the project included, (1) patients who had been given their first antihypertensive medication prescription during the previous three months, (2) aged 18 and older; (3) who owned a mobile phone with access to

SMS text messaging and telephone calls (4) who understood English, and (5) who could read. Exclusion criteria included: patients (1) with cognitive impairment, (2) who were illiterate or unable to read text messages (3) unable to complete questionnaires, and (4) unable to operate a mobile phone or receive text messages. Descriptive statistics describing the demographic data for participants are represented in Table 4.1.

The reported racial demographic characteristics of the participants consisted of 13 (76.47%) African-Americans, 3 (17.65%) Caucasians, 1 (5.88%) Hispanics. Frequencies and percentages are presented in Table 4.1. The ages of the participants ranged between 31 year of age to 73 years. The mean age of the participants was 54.41 (*SD* = 12.81). Female was the most frequently observed category of gender (*n* = 12, 71%).

Table 4.1

Participants Demographics

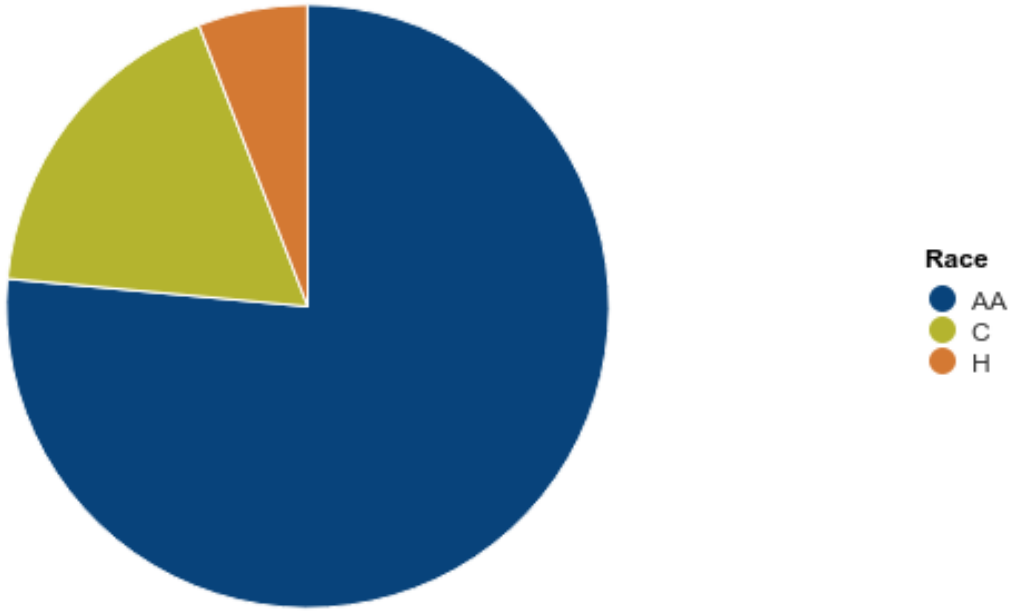
Variable	*n*	%
Gender		
Male	5	29.41
Female	12	70.59
Missing	0	0.00
Race		
African-American	13	76.47
Caucasian	3	17.65
Hispanic	1	5.88
Missing	0	0.00

Variable	*M*	*SD*	*n*	SE_M	Min	Max
Age	54.41	12.81	17	3.11	31.00	73.00

Note. Due to rounding errors, percentages may not equal 100%.

Figure 4.1

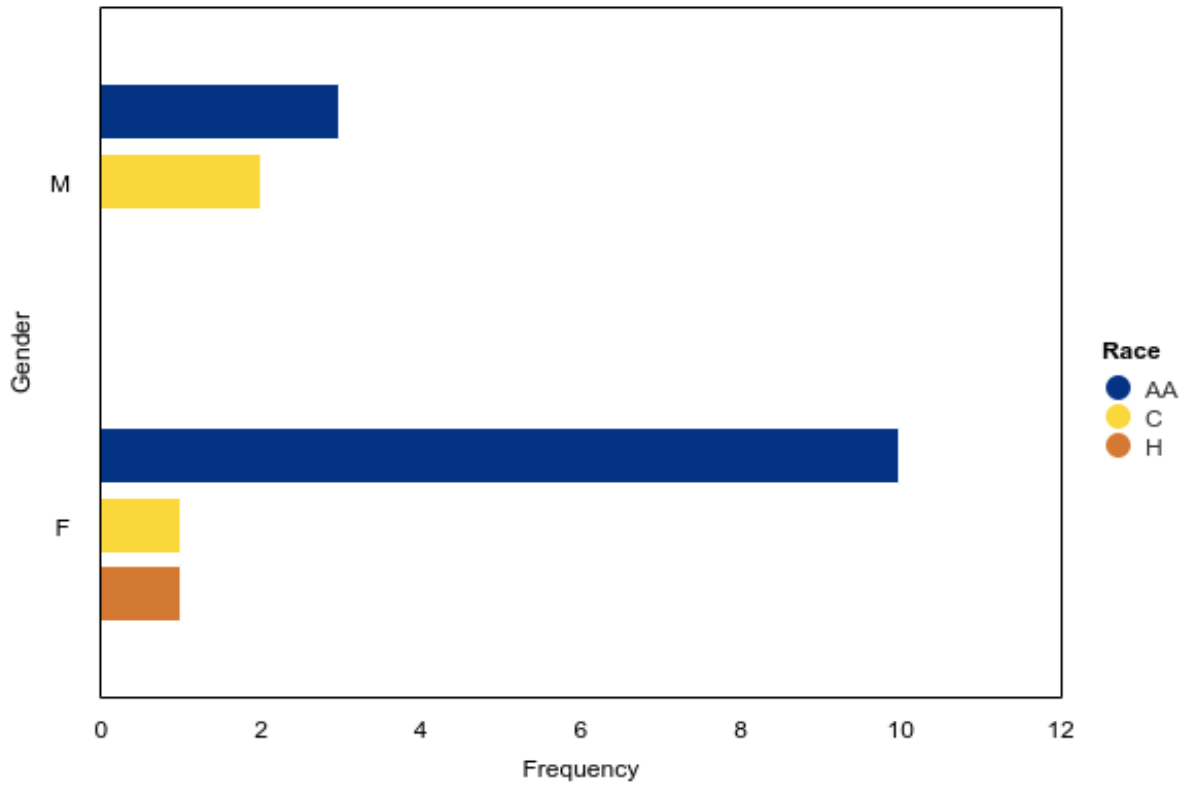
Pie Chart of Race



Note. AA = African-American. C = Caucasian. H = Hispanic.

Figure 4.2

Barplot of Gender by Race



Note. AA = African-American. C = Caucasian. H = Hispanic.

Changes in Outcomes. The primary outcome of this project was an appropriate medication adherence rate, defined as a score of 6 or higher on the MMAS-8 scale. Prior to the initiation of the project, the DNP student contacted all participants by telephone calls to complete the MMAS-8 scale. A code was attributed to each participant and data were recorded and stored in the clinic in a locked box to protect participants' confidentiality. Only the DNP student and MAs had access to the cabinet. After completion of the project, participants who completed the project were contacted by the DNP student by telephone calls to complete the MMAS-8 scale.

The secondary outcome was a decrease in systolic and/or diastolic blood pressure. Although blood pressure was measured during recruitment days and recorded as baseline, none of the participants were able to provide the DNP student with a blood pressure measure after the intervention.

Statistical Testing and Significance. The primary outcome was evaluated using the MMAS-8 scale; an increase in score indicates improvement in medication adherence. Data provided from the MMAS-8 included high adherence (score of 8), medium adherence (score of 6 to <8) and low adherence (score of <6). Items 1 through 7 offer “yes” or “no” response choices while item 8 has a 5-point Likert response choice. A score of “1” was given to each ‘‘no” response, whereas each ‘‘yes” is scored as ‘‘0” except for item 5, in which each response ‘‘never/rarely” was scored as ‘‘1” and ‘‘once in a while, sometimes, usually, and all the time” was scored as ‘‘0” (Morisky et al., 1986a; Morisky et al.,2008b). Frequencies and percentages were calculated for each item (see Table 4.2, Table 4.3).

SPSS version 25.0 software was used to conduct a two-tailed paired sample paired t-test to examine whether the mean difference of adherence rate before and after the intervention were statistically significant. It was established that statistical significance for all analyses would be $p < 0.05$. The result of the two-tailed paired samples t-test was statistically significant, (0.05, $t(10) = -3.08$, $p = .012$) demonstrating that the true difference the difference in the mean of pre-intervention and the mean of post-intervention was significantly different (see Table 4.4, and Figure 4.4).

Table 4.2

Frequency Table for Nominal Variables prior to The Intervention

Variable	*n*	*%*
Question 1 “Do you sometimes forget to take your medications?”		
Yes	10	58.82
No	7	41.18
Missing	0	0.00
Question 2 “People sometimes miss taking their medications for reasons other than forgetting. Thinking over the past two weeks, were there any days when you did not take your medications?		
Yes	9	52.94
No	8	47.06
Missing	0	0.00
Question 3 “Have you ever cut back or stopped taking your medications without telling your doctor, because you felt worse when you took it?”		
No	11	64.71
Yes	6	35.29
Missing	0	0.00
Question 4 “When you travel or leave home, do you sometimes forget to bring along your medications?”		
No	16	94.12
Yes	1	5.88
Missing	0	0.00
Question 5 “Did you take your medications yesterday?”		
Yes	12	70.59
No	5	29.41
Missing	0	0.00
Question 6 “When you feel like your health condition is under control, do you sometimes stop taking you medications?”		
No	14	82.35
Yes	3	17.65
Missing	0	0.00
Question 7 “Taking medications every day is a real inconvenience for some people. Do you ever feel hassled about sticking to your treatment plan?”		
No	11	64.71
Yes	6	35.29
Missing	0	0.00

Question 8 “How often do you have difficulty remembering to take all your medications?”		
Sometimes	5	29.41
Never/Rarely	4	23.53
Once in a while	7	41.18
Usually	1	5.88
Missing	0	0.00

Note. Due to rounding errors, percentages may not equal 100%.

Table 4.3

Frequency Table for Nominal Variables Post-intervention

Variable	*n*	*%*
Question 1" Do you sometimes forget to take your medications?"		
Yes	2	11.76
No	9	52.94
Missing	6	35.29
Question 2" People sometimes miss taking their medications for reasons other than forgetting. Thinking over the past two weeks, were there any days when you did not take your medications?"		
Yes	2	11.76
No	9	52.94
Missing	6	35.29
Question 3" Have you ever cut back or stopped taking your medications without telling your doctor, because you felt worse when you took it?"		
No	5	29.41
Yes	6	35.29
Missing	6	35.29
Question 4" When you travel or leave home, do you sometimes forget to bring along your medications?"		
No	11	64.71
Missing	6	35.29
Question 5 "Did you take your medications yesterday?"		
Yes	11	64.71
Missing	6	35.29
Question 6" When you feel like your health condition is under control, do you sometimes stop taking you medications?"		
No	11	64.71
Missing	6	35.29
Question 7" Taking medications every day is a real inconvenience for some people. Do you ever feel hassled about sticking to your treatment plan?"		
No	9	52.94
Yes	2	11.76
Missing	6	35.29
Question 8 "How often do you have difficulty remembering to take all your medications?"		
Never/Rarely	3	17.65
Sometimes	5	29.41

Once in a while	3	17.65
Missing	6	35.29

Note. Due to rounding errors, percentages may not equal 100%.

Table 4.4

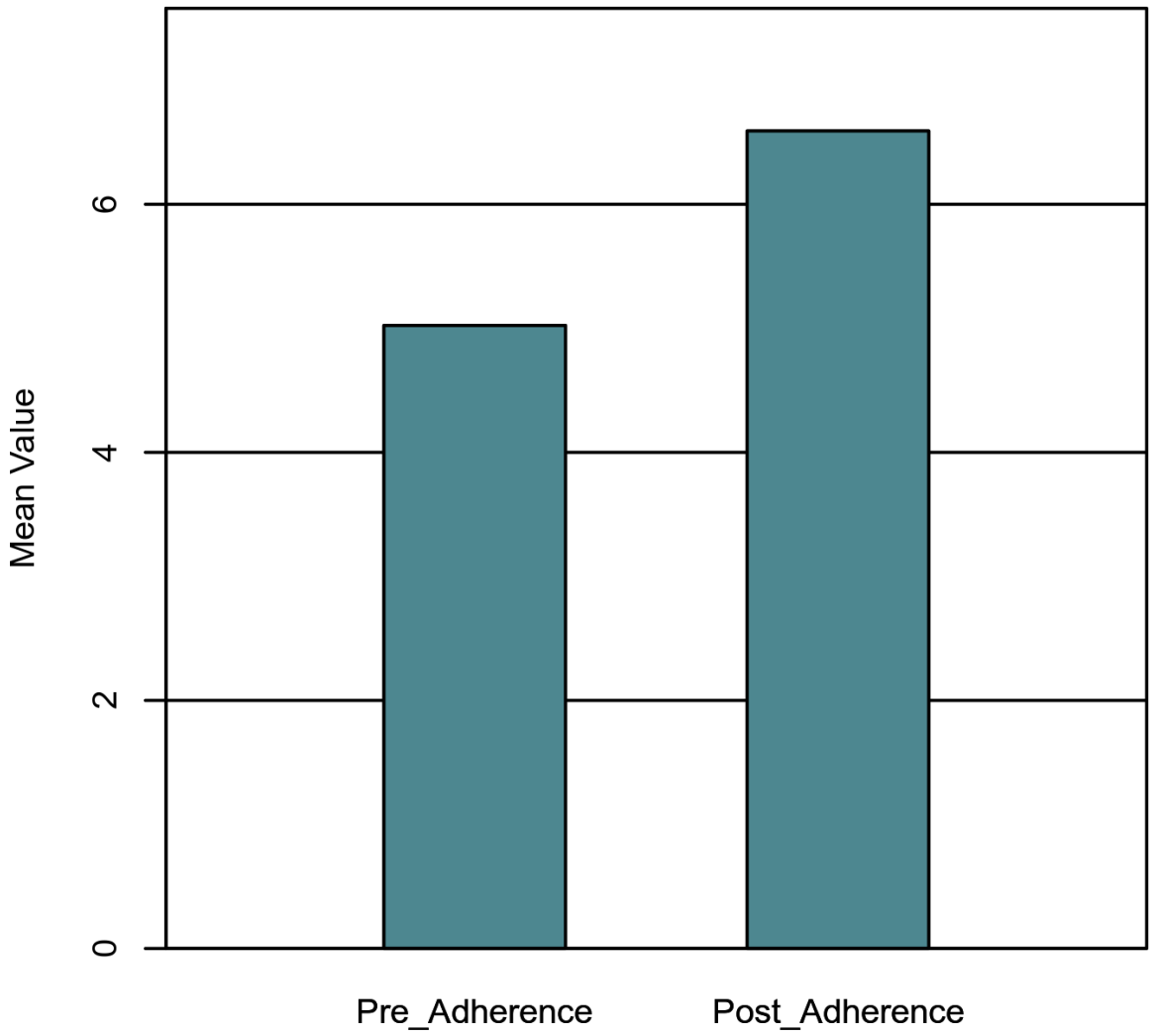
Two-Tailed Paired Samples t-Test for the Difference Between Pre_intervention and Post_intervention Scores on the MMAS-8

Pre_intervention		Post_Intervention				
M	*SD*	*M*	*SD*	*t*	*p*	*d*
5.02	1.96	6.59	1.03	-3.08	.012	0.93

Note. N = 11. Degrees of Freedom for the *t*-statistic = 10. *d* represents Cohen's *d.*

Figure 4.3

The means of Pre-intervention and Post-intervention adherence rate



Note. Pre_Adherence = Pre-intervention adherence rate. Post_Adherence = Post-intervention adherence rate.

CHAPTER 5

FINDINGS

The purpose of the EBP project was to identify and implement the best practice to increase medication adherence among patients diagnosed with hypertension. Through an extensive literature search, the DNP student identified current evidence-based practice, which supports the use of daily text messaging in improving medication adherence for patients diagnosed with hypertension. This EBP project served the purpose of answering the following PICOT question, “In a primary care setting, in adults, male or female, aged more than 18 years with a diagnosis of hypertension and who are taking antihypertensive medications (P), does receipt of daily text messages (I) compared to education provided during each office visit (C) influence medication adherence (O) over a six-week time period (T)? The findings, strengths, and limitations of this EBP project will be discussed in this chapter.

Explanation of Findings

The clinic where this EPB project was implemented had no protocol in place to assess for medication adherence. The DNP student identified this issue during her clinical rotation. With the help of the project site facilitator and medical assistants, this EBP project was designed and implemented. All patients with a hypertension diagnosis who take at least one antihypertensive agent were invited to participate in the project. Patients who consented to participate were contacted by telephone to complete a questionnaire to assess their medication adherence level before and after the implementation of the project using the MMAS-8 scale. The final sample consisted of 21 adults who received daily text messages near the time they were taking their medications. Additionally, three times per week, educational texts about hypertension were also sent out by text messages to all participants.

. The ages of the participants ranged between 31 years of age to 73 years. The mean age of the participants was 54.41 (SD = 12.81). Female was the most frequently observed

category of gender (n = 12, 71%). Two participants opted out of the project in week 3. While participants were not required to inform us before opting out of the project, one of them reported, by replying to the automated text messages, that he ran out of his medications. Another participant opted out of the project in week 4, the participant replied to the automated text messages stating she was hospitalized. In week 4, another participant left the EBP project for unknown reasons.

Secondary outcome. Compliance with the antihypertensive medication has been shown to have a positive impact on blood pressure (Andre et al., 2019; Bobrow et al., 2016; Varleta, et al. 2016). Therefore, the secondary outcome of this EBP project was a decrease in systolic and/or diastolic blood pressure. Participants' blood pressures were measured on the recruitment day, and the readings were used as baseline data. However, it was determined during the telephone calls post-intervention that participants failed to measure their blood pressures daily as advised by their provider. Consequently, the DNP student was not able to adequately record accurate blood pressure to use as post-intervention data.

Strengths and Limitations of the DNP Project Strengths

Several strengths and weaknesses were revealed after the evaluation of this EBP project over the course of the six weeks designated for its implementation. This evaluation will be especially helpful for future DNP students or healthcare providers interested in implementing similar projects to change practice.

Strengths

One of the greatest strengths of this EBP project was the collaboration between the DNP student and the staff at the clinic. The stakeholders directly involved in the project embraced it and invested their time to help make it a successful project. The MAs helped with the recruitment process, and blood pressure measurements. The current issue of uncontrolled hypertension in the clinic and the need to improve medication adherence automatically created

a sense of urgency to change practice and improve patients' health. The stakeholders recognized the importance and benefits of this EBP project on patients' health. Additionally, the DNP student received strong support from her project advisor and librarian. Another strength considered during the implementation of the EBP project was the low cost of the software used to send automated text messages to participants. Also, several participants expressed great satisfaction towards this project. Finally, this EBP project maintained patient privacy and confidentiality.

Limitations

The main limitation to this EBP project was the inability to ensure that the text messages were read. Although the software allowed the DNP student to see when the text messages were delivered to the participants, it did not provide an option to track if they were read. Another barrier was the implementation of the project during the pandemic, which hindered secondary outcome post-intervention data collection. Participants reported rough estimation of their blood pressures as they failed to monitor it daily as advised by their provider. Additionally, collecting data about the outcomes of this project was challenging because only 11 participants out of 17 who completed the project answered the post-intervention phone calls made by the DNP student.

Implications for the Future

Practice

The findings of this EBP project support the use of text message reminders in combination with educational text messages about hypertension to improve medication adherence, which has been shown to promote patients' health in primary care settings. The daily text message can easily be incorporated into the hypertensive patients' chart to deliver automated text messages with the goal to increase awareness about uncontrolled hypertension

and the benefits of complying to the treatment regimens while reminding patients to take their medications.

EBP Model

This EBP project has demonstrated that the Iowa revised model can successfully be used to incorporate an evidence-practice intervention into a primary care clinic by appropriately following the steps outlined in the model. The steps in the model were easy to follow. The DNP student would recommend it for future similar projects in the primary care setting.

Research

The literature supports the positive effect of daily text messages combined with educational content on blood pressure control and management in primary care clinics. Thus, this intervention was deemed best practice and findings were statistically significant. This intervention was cost-effective and easily incorporated to practice at this site. However, changes had to be made due to the implementation of this project during the pandemic. Participants were instructed to continue to monitor and record their blood pressures at home until their next visit to the clinic. Unfortunately, participants were not compliant. Consequently, future research should also focus on the effect of daily text messages in decreasing blood pressure. Congruent with the literature, primary care clinics are the ideal setting to incorporate this project. Additionally, future projects should aim at maximizing the implementation and data collection in the primary care settings to accurately measure pre-and post-intervention data.

Education

Evidence supports that education increases the likelihood of medication compliance. Thus, it is crucial to educate patients about the benefits of adhering to treatment and frequently monitor their blood pressure to increase knowledge about hypertension and prevent the harmful effects of elevated or uncontrolled bloop pressure.

Conclusion

The purpose of this EBP project was to explore and implement the best practice to increase medication adherence among patients diagnosed with hypertension. This EBP project answered the following PICOT question: “In a primary care setting, in adults, male or female, aged more than 18 years with a diagnosis of hypertension and who are taking antihypertensive medications (P), does receipt of daily text messages (I) compared to education provided during each office visit (C) influence medication adherence (O) over a six-week time period (T)?

The primary outcome for the project was an improvement in medication adherence rate measured with the MMAS-8 scale. A two-tailed paired sample paired t-test was used to examine whether the mean difference of adherence rate before and after the intervention was statistically significant (0.05, $t(10) = -3.08$, $p = .012$). Decrease in blood pressure was the secondary outcome of this project; however, it was not measured due to lack of accuracy regarding the post-intervention data. Providers must assess hypertensive patients for medication adherence in primary care clinics to reduce or prevent the worsening of the disease.

This EBP has demonstrated that the use of daily text messages combined with educational text messages improve medication adherence in patients diagnosed with hypertension. This EBP project also demonstrated the abilities of a doctorally prepared nurse to identify a clinical problem, design, develop, implement, and sustain change in a primary care practice by working collaboratively with a multidisciplinary team to improve patients’ health.

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BIOGRAPHICAL MATERIAL

Gaelle M. Bulabula

Gaelle graduated from Valparaiso University with a Bachelor of Science in Nursing in 2017 and a Master of Science in Nursing Education in 2018. She is currently pursuing her a Doctor of Nursing Practice degree, which she will complete in May of 2021. During this time, she became an adjunct faculty member at Valparaiso University, teaching clinical rotations on a Pediatric medical-surgical unit at Comer Children's Hospital in 2018. Since 2017, she has received her training in a variety of units as a registered nurse such as medical/surgical, orthopedic, and labor and delivery/high risk at local hospitals in Chicago Heights, IL and in Indianapolis, IN. Gaelle also serves as an educator, precepting both students and peers. She is an active member of the Coalition of Advanced Practice Nurses of Indiana and Sigma Theta Tau International Honor Society of Nursing, Zeta Epsilon Chapter. In addition, Gaelle was a recipient of the Herbert H. Gerke Award in 2017, 2018, and 2021, as well as the CVS Health Foundation Advanced Practice Nurse Scholarship 2019. Gaelle presented her EBP project to the 28th National Evidence-Based Practice conference on April 14th, 2021. Upon graduation, she hopes to focus on women health and later volunteer her expertise in the Democratic Republic of the Congo, where she is from.

ACRONYM LIST

ACS: Acute Coronary Syndrome

BMI: Body Mass Index

BP: Blood Pressure

CHD: Coronary Heart Disease

CINAHL: Cumulative Index to Nursing and Allied Health Literature

EBP: Evidence-based Project

EMR: Electronic Medical Records

CEBM: Centre for Evidence-Based Medicine

CINAHL: Cumulative Index to Nursing and Allied Health Literature

CITI: Collaborative Institutional Training Initiative

CVD: Cardiovascular Disease

CDC: Centers for Disease Control and Prevention

DBP: Diastolic Blood Pressure

DNP: Doctor of Nursing Practice

HIPAA: Health Insurance Portability and Accountability Act

HTN: Hypertension

IRB: Institutional Review Board

JBI: Joanna Briggs Institute

MA: Medical Assistant

MEMS: Medication Event Monitoring System

MMAS: Morisky Medication Adherence Scale

RCA: Rapid Critical Appraisal tool

RCT: Randomized Controlled Trials

SBP: Systolic Blood Pressure

US: United States

WHO: World Health Organization

APPENDIX A

Informed Consent

Project manager: Gaelle Bulabula, MSN, RN
Doctoral of Nursing Student
Valparaiso University
College of Nursing and Health Professions
Gaelle.bulabula@valpo.edu
Project Advisor: Dr. Julie Brandy, PhD, RN, FNP-BC

1. **Purpose of the project**

This consent form is for all individuals over the age of 18 who take at least 1 prescribed medication. By signing this form, you understand that you are being asked to take part in this educational project. The title of the evidence-based project is "Improving medication adherence using text messages in adults with a hypertension diagnosis".
The purpose of this evidenced-based practice project is to increase medication adherence by sending daily text message reminders at every antihypertensive medication due time.

2. **Procedures to be followed:**

Your participation will consist of receiving daily text message reminders when it is time to take your antihypertensive medication (the same message at the same time each day) and every three days (twice a week) you will receive educational text messages about hypertension that includes facts about the disease in addition to the medication reminders. You will receive a telephone call from the project manager to complete a questionnaire before and after the project implementation. This project is designed to help you remember to take your medication and increase your knowledge about hypertension.

3. **Benefits and discomfort**

There are no anticipated risks to you for participating in the project, but you may experience temporary stress or anxiety while reading some facts that you may not know about hypertension. Potential benefits include improved adherence to antihypertensive medications and knowledge.

4. **Alternatives**

You have the alternative not to participate in the scholarly project. Your choice to participate or not participate will have no impact on the care you receive at the clinic.

5. **Statements of Confidentiality:**

Your participation in this research study will be kept confidential. All results of this project will be reported in aggregate form.

☐ By checking this box, I acknowledge that I have read and understood the above information.

Participant Name: _____ Participant Signature: _____Date:_____

APPENDIX B

Provider Permission

---------- Forwarded message ---------
From: **Sabrina williams** <brimd@att.net>
Date: Sun, Jul 12, 2020 at 10:59 PM
Subject: NP student G.B.
To: julie.koch@valpo.edu <julie.koch@valpo.edu>

Gaelle has informed me of here intent to do a Hypertension study and evaluation using patients from our AHN system. I do not believe she will endanger any of our patients and she will be discrete with their private and confidential information as she interviews them. I also believe that there is an opportunity for our patients to improve when they receive individual attention to discuss their medical problems with Hypertension. I look forward to hear her final report.
Sabrina Williams, MD

Sent from AT&T Yahoo Mail for iPhone

APPENDIX C

Text Messages Content

Remember to take the medication prescribed by your doctor following the recommended dose and schedule. Do not stop any tablet!

Blood pressure drugs act through different mechanisms. If you suspend a tablet, you will lose the action and can raise blood pressure

If you have a medication prescribed at night, remember to take it! The drug's effect lasts some hours and if you forget this dose, blood pressure can rise

Remember that salt raises blood pressure. Decrease your intake of high-sodium products such as sausages, canned goods, and instant soups

Remember that your doctor knows your particular case and knows what you need to lower blood pressure. Take what you have been prescribed

Promptly take the medications your doctor prescribed, strictly following the schedule and doses indicated

If you feel that your blood pressure medicine causes you inconvenience, tell your doctor immediately for a change. Do not decide to change it by yourself

Do not stop treatment even if your blood pressure has returned to normal, or if you feel better, except on the advice of your doctor

Stress affects hypertension. Take space and moments of tranquility, and do not forget to take your medications at the time and dose indicated

If you forget to take the morning medicine, do so as soon as possible. To avoid forgetfulness, leave it near your toothbrush or your breakfast cup

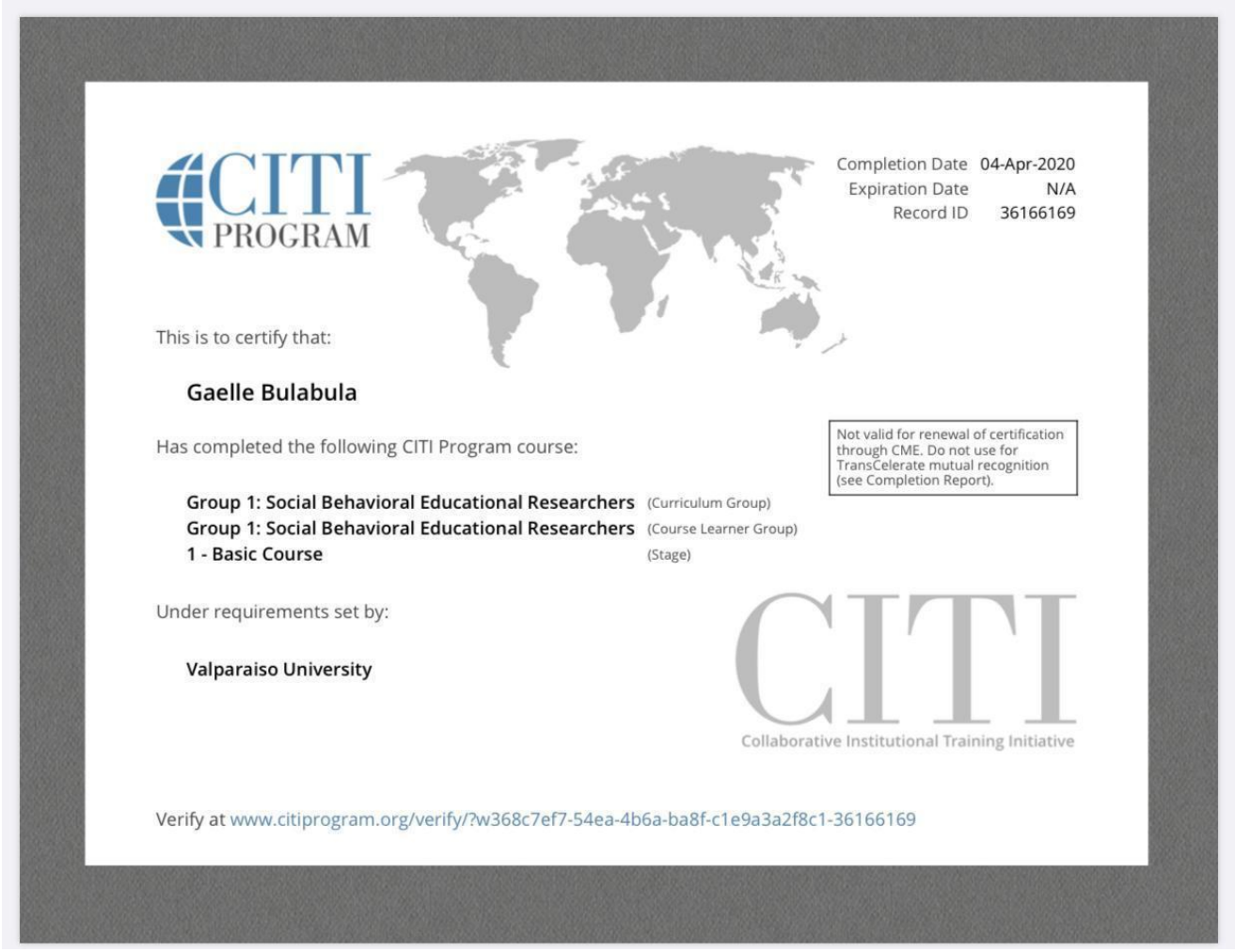
Have you tried eating bread without salt? If you do not like it, at least try to get the salt-shaker off the table. That is already an improvement.

If this week you have taken all your medications at the correct time and dose, congratulations!

By controlling blood pressure, you add years to your life. Remember to take your medications to control it. We want to take care of you!

APPENDIX D

CITI Program Certificate



CITI PROGRAM

Completion Date 04-Apr-2020
Expiration Date N/A
Record ID 36166169

This is to certify that:

Gaelle Bulabula

Has completed the following CITI Program course:

Not valid for renewal of certification through CME. Do not use for TransCelerate mutual recognition (see Completion Report).

Group 1: Social Behavioral Educational Researchers (Curriculum Group)
Group 1: Social Behavioral Educational Researchers (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

Valparaiso University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w368c7ef7-54ea-4b6a-ba8f-c1e9a3a2f8c1-36166169

APPENDIX E

Master List of Participants Information

Personal code	10-digit Phone number	Initials and date of birth	Medication administration time