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Charles Head
head801@msn.com

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Use of Text Messaging for Type two Diabetes Management in Patients over Sixty-Five

Charles Head

Roseman University

512-Nursing Research and Evidence-Based Practice

Jill Schwartz

November 17, 2022

Use of Text Messaging for Type two Diabetes Management in Patients over Sixty-Five

Type two diabetes is a chronic illness that is prevalent throughout the world (Kannikar et al., 2022). This disease occurs when your blood glucose is too high (Kirkman et al., 2017). Blood glucose is the main fuel that your body uses (Centers for Disease Control and Prevention, 2019). This glucose comes from the food that you consume (Centers for Disease Control and Prevention, 2019). Glucose is transported to the cells because of the hormone insulin which is made in the pancreas (Centers for Disease Control and Prevention, 2019). In type two diabetes the body does not make sufficient insulin or the body does not use it well (Centers for Disease Control and Prevention, 2019). This leads to too much glucose being in the bloodstream and not enough of it reaching the cells (Centers for Disease Control and Prevention, 2019).

Type two diabetes can occur at any age however it is more likely to occur in adults aged 45 or older (Kirkman et al., 2017). Some of the risk factors for the development of diabetes are age, obesity, and physical inactivity (Goyal & Jialal, 2022). Diabetes is considered a macro and microvascular disease (Goyal & Jialal, 2022). This means this condition affects the large and small blood vessels of the body (Goyal & Jialal, 2022). This causes several complications that such as raising the risk of heart attack and stroke, as well as kidney damage and limb neuropathy (Goyal & Jialal, 2022). Each of these complications can affect a person's life and health (Goyal & Jialal, 2022). One of the groups that are at greater risk is the elderly defined as people sixty-five years of age or older (Kim et al., 2018). The reason this population is more at risk is that they are more likely to have comorbidities (Kirkman et al., 2017). These comorbidities along with type two diabetes increase the elderly patient's risk of morbidity and mortality (Kirkman et al., 2017).

Problem Statement

Why is there a need for tight glucose control for diabetics sixty-five years old or older? Tight control of glucose which can be trended as a 90-day snapshot of blood sugar control is measured using HgA1C levels (Centers for Disease Control and Prevention, 2019). HgA1c levels under six percent in diabetics have been shown to reduce diabetic complications that be detrimental to health (Krapek et al., 2004). Adults aged sixty-five years old or older are also at greater risk for the development of acute and chronic diseases that are a result of poor blood sugar management (Leung et al., 2018). Adherence to prescribed medication regimens lowers blood glucose which is reflected in lower HgA1c levels (Krapek et al., 2004). Frequent communication with adults aged sixty-five years old or older is an important factor in medication adherence (Bussell et al., 2017). Therefore, text messaging has been found to improve glycemic control in the literature (Choudhry et al., 2018). The aim of this quality improvement project is to examine the evidence to show incorporating text messaging in this population helps to decrease hemoglobin A1c levels in type two diabetics over the age of sixty-five (Fang & Deng, 2018).

PICO Question

The PICO question for this quality improvement capstone project focuses on adults sixty-five years and older to improve hemoglobin A1c levels. In adult type two diabetics sixty-five years or older, would bi-weekly text messages for medication management lower HgA1C?

Background and Significance

Diabetes is a tangible challenge to the elderly. Currently, adults sixty-five years or older account for approximately twenty-five percent of the population with type two diabetes in the United States of America (USA) (Leung et al., 2018). Adults aged sixty-five years old or older are

also at greater risk for acute and chronic diseases that can affect their level of functioning these diseases may include microvascular problems that lead to extremity amputation, myocardial infarctions, as well as renal disease (Leung et al., 2018). Type two diabetes is not only a physical burden to adults aged sixty-five or older but a financial burden as well (Leung et al., 2018). “A recent analysis of the economic cost of diabetes showed that 61% of all health care costs attributed to type two diabetes are incurred by people with diabetes who are 65 years of age” (Leung et al., 2018, p. 245).

Another challenge that diabetics over age sixty-five face is the presence of comorbid conditions (Lichtman et al., 2019). For the elderly, these comorbid conditions are more likely to exist than for type two diabetics under the age of sixty-five (Leung et al., 2018). Adult type two diabetics aged sixty- five years old or older have challenges including dementia, depression, pain, and physical disabilities (Leung et al., 2018). These conditions can make remembering to take medications and follow a blood sugar control regimen difficult. There also may be issues with being able to physically follow the suggested blood glucose control regimen (Centers for Disease Control and Prevention, 2019). Healthcare providers need to be more innovative in coming up with solutions to help adults aged sixty-five or older manage their blood glucose. Technology has greatly advanced over the past thirty years. This advance in technology has assisted Americans with advances in education.

A Pew research study estimates that ninety-six percent of Americans own a cellular phone of some sort with about eighty-one percent of Americans owning smartphones (Pew Foundation, 2019). In adults sixty-five or older, ninety-one percent own cellular phones, and fifty-three percent own smartphones (Pew Foundation, 2019). With a vast majority of diabetic

patients over sixty-five owning cellular phones, it makes sense to leverage cellular phones in clinical practice.

Text messaging has become a preferred method of communication in America (Daniell, 2019). Text messaging is now a more reliable method to communicate than ever before (Daniell, 2019). Statistically, ninety-five percent of all text messages are typically read within three minutes of being sent (Daniell, 2019). Texting is also an inexpensive intervention as it costs little to send a text. However, one can ensure that the message has reached the recipients by looking for a received message at the bottom of the sent text (How Do I Know If My Message Was Delivered or Read? n.d.).

With preprinted paper education there is a risk that educational materials or instructions may be discarded or misplaced, but with texts, educational materials or instructions can be sent directly to clients' phones. The provider can also send new materials to the patients on the fly and do not have to wait for the next office visit to educate them (Daniell, 2019). Text messages can be used to convey a variety of messages; they can be used to send educational information and materials to the patients who have agreed to participate in the program. Links can also be sent to the participants that contain tools that may better help them track and trend their blood glucose levels (Mastrototaro, 2016). More importantly, text messaging can be used to ask patients if they are complying with regimens that have been established for their diabetic control. Messages may include: have you taken your blood sugar today? Or are you using the sliding scale for your insulin as directed (Mastrototaro, 2016)? When a patient replies to the text message that there is a problem, or that they are not in compliance; then it presents an opportunity to reach out and help that patient. An appointment can also be made if further intervention is warranted. These things can help the provider catch problems early while they are

small. This can help an elderly population stay in compliance with treatment more often, and help them to gain better control of their HgA1C. By being able to increase the patient's compliance and assisting with better glycemic control will lessen the impact of diabetes in adults over sixty-five (Mastrototaro, 2016).

These three studies have shown that text messaging leads to better glycemic control (Kannikar et al., 2022). This improvement is measured by us HgA1c which provides a 90 snapshot of glucose levels (Centers for Disease Control and Prevention, 2019). The Kannikar et al. (2022) study showed a 1.3% reduction in blood glucose and the Levy et al 2018 showed that a quarter of the intervention group had a 2% HgA1c reduction.

Because of advances in technology, older type two diabetics can have tighter glycemic control with the use of texting between provider and patient. Patients over sixty-five statistically have a more difficult time keeping tight control of their HgA1C (Kirkman et al., 2017). There is a growing rate of type two diabetics and by bringing their blood glucose levels under control to a normal level the risk of neurological and vascular problems can be reduced (Kirkman et al., 2017). Kassavou et al. (2020) used underserved locations in the United States to show that the technology is widely available, and that sending texts that inquire about a patient's blood glucose readings and making adjustments are effective methods to lower a patient's HgA1c.

Kannikar et al, (2022) showed that using educational texts that educated about diabetic injection, diet, and exercise is effective as well to lower HgA1c. That the content does not have to be asking about blood sugar to work.

Choudhry et al. (2018) took a different approach. This study used a combination of motivational interviewing and education to help persuade the participant to medication adherence and a lower HgA1c.

Barriers to Intervention

Whenever communicating with a patient in any fashion other than face-to-face privacy becomes a real concern and ensuring privacy is of the utmost importance (Cohen & Mello, 2018). Providing information over text messaging carries the inherent risk of that information being sent to the wrong recipient. As recent data breaches have shown sharing private information can have real unintended consequences such as that information being stolen (Cohen & Mello, 2018). With data breaches that have touched healthcare, it shows that nefarious actors do have an interest in capturing and using healthcare information for personal gains (Cohen & Mello, 2018). For health care providers the inappropriate possible sharing of privileged participant information could be embarrassing, and it could be career-ending as well. The Health Insurance Portability and Accountability Act (HIPAA) of 1996 and The Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 deal with healthcare providers sharing a patient's privileged health information (Cohen & Mello, 2018). These acts carry large economic and possible criminal penalties for the improper disclosure of patient-protected health information (Cohen & Mello, 2018). To make sure that this two-way texting intervention does not run afoul of HIPAA or HITECH laws it makes sense to ensure that all initial messages are devoid of any possibly identifying patient information (Cohen & Mello, 2018). When one of the participants in the intervention texts back that there is a problem or that they are non-compliant with the treatment protocols then the provider needs to stop and make sure that the participant is identified before giving out any personal information that would be considered privileged by the HIPAA or HIGHTEC acts. A second barrier that may be faced would be making sure that the participant can participate in the intervention. This would include making sure that patients over sixty-five years old or older had a device that could send and

receive text messages (Mastrototaro, 2016). The provider would also need to make sure that the participant knows how to operate the device and make sure that they were able to read the texts that were received and respond to the texts appropriately (Mastrototaro, 2016).

Theory

Several theoretical models will be used to answer the research question in adult type two diabetic patients who are sixty-five years old or older, would bi-weekly text messages for medication management lower HgA1C levels? The first theory that will be used is King's theory of goal attainment which describes the interpersonal dynamic relationship in which a patient changes to attain certain life goals. This theory explains that factors that may affect the attainment of goals are roles, stress, space, and time (King, 1992). The second theory is the deliberative nursing theory that says patients have their own meanings and interpretations which says patients have their own meanings and interpretations of situations and therefore nurses must validate their inferences and analyses with patients (Petiprin, 2021).

Kings Theory of Goal Attainment

The theory of goal attainment was originally developed in the 1960s by Imogene King the theory is centered on the dynamic of the interpersonal relationship between the patient and the nurse (King, 1992). The result of this relationship is that the patient grows and develops through this relationship and achieves life goals (King, 1996). The theory explains that factors that influence the achievement of these life goals include stress, space, and time. King's theorem goes on to explain three systems that work together which are social, personal, and interpersonal and each of these systems has their own set of concepts (King, 1992). The concepts that are put forth in the social system are decision-making, organization, power, status, and authority. The concepts

that are focused on in interpersonal dimension include role, interaction, stress, communication, and transaction. While personal focuses on are self, growth, space, time, and body image (King, 1996). In this theory the practitioner's assessment begins during the first interaction in which each party brings an essential part to the first interaction the practitioner brings their knowledge of medicine and skill; while the patient brings their unique knowledge of self and their concerns for the problems they are facing to the interaction (King, 1992). In the assessment the provider collects a wide array of data including health information, the patient's perception of self and their current health status as well as their growth and development at this point the provider gains a perception of the patient and their health, the next step is communication in which the provider and patient talk to validate that the perception that provider has is accurate (King, 1996). The diagnosis is developed by the synthesis of the data collected in the assessment and the provider's concerns and problems for which the patient is seeking health (King, 1996).

The Deliberative Nursing Process Theory

In 1958 Ida Jean Orlando developed the deliberative nursing process theory that still resonates and is used by many providers today (Toney-Butler & Thayer, 2021). This theory stresses the relationship between the provider and the patient. Orlando's theory uses a systematic approach to care utilizing critical thinking, client-centered treatment, evidence-based treatment, and goal-oriented care and stresses nursing intuition in the care process (Toney-Butler & Thayer, 2021). In deliberate nursing process theory, five steps are used those steps are assessment, diagnosis, planning, implementation, and evaluation (Toney-Butler & Thayer, 2021). In the assessment phase data is collected using objective data such as vital signs, height, and weight; plus, subjective information such as the patient's symptoms and concerns are gathered. This information it leads to diagnosis which employs the practitioner's critical thinking and clinical

judgment skills. Planning is where the patient is consulted and goal-setting treatments and outcomes are established in collaboration with the patient. Implementation where interventions are carried out based on the plan of care that has been established. Lastly evaluation this is where the patient and the provider look at what has happened and decide whether the interventions were useful for the patient at this point the plan of care may be changed based on the new data gleaned from the evaluation phase (Toney-Butler & Thayer, 2021).

How these Theories Have Influenced the Advanced Practice of Nursing

King's theory of goal attainment has influenced advanced practice nursing by making the patient a more integral part of the healing process; by considering how the patient feels about a diagnosis or an intervention this theory has more fully incorporated the patient into their own care. The Advanced Practice Registered Nurse (APRN) not only increases the patient's well being through communication they also enhance the quality of nursing care provided through interactive communication with their patients (Park, 2021). Patients feel more satisfied with their care and are more trusting of their provider if they feel respected during their care, and if the communications and clarification between provider and patient lead them to gain an understanding of their health status and treatment. They become partners and more engaged in their own care (Park, 2021). Effective and therapeutic communication in particular raises the quality of patient care by establishing a therapeutic relationship between the APRN and the patient (Park, 2021). Orlando's theory has a great influence on advanced practice nursing because the theory relies on principles of critical thinking and clinical judgment (Toney-Butler & Thayer, 2021). These skills are foundational in advanced practice nursing. Orlando's theory also relies heavily on the process which is a skill set that is needed in advanced practice.

Theoretical Framework Analysis

Borrowing from King's and Orlando's theory will lay the blueprint for this MSN project diabetes management in adults over sixty-five. This project theorizes that in adult type two diabetic patients for are sixty-five years old or older, bi-weekly text messages for medication management would lower HgA1C levels. The contributions that can be taken from Orlando's theory would be planning, implantation, and evaluation (Toney-Butler & Thayer, 2021). King's theory will also be helpful because combining the practitioner's knowledge and skill with the patient's willingness to learn may determine whether the MSN project is successful or not (King, 1992). The use of patient education that is entrenched in both of these theories may be central to the success or failure of the MSN project. Since the provider may need to educate the patient not only on diabetes management but also on the mechanics of text messaging as well.

This project may also serve as a conduit to continue to prove King's and Orlando's theories by showing that interpersonal relationships between practitioner and patient may improve the quality of care and patients' health. It may also serve to show that the deliberative process of healthcare is still valid. This project may contribute to the medical community by providing an innovative way to track blood sugar and make adjustments far more quickly than waiting until the patient's next scheduled visit. By leveraging text technology, the outcome may be a more responsive method to track and change insulin use resulting in better blood sugar control (Schwebel & Larimer, 2018). This project if successful may act as a tool to lessen the effects of diabetes on those participants that participate fully in the intervention.

With the problem outlined this MSN project offers a solution to the problem and barriers that may be faced in the execution of the project. Nursing theories have been advanced that will assist the success of this MSN capstone project through innovation in design and education that speak to the patient core needs as referenced in King's theory and the deliberative nursing

process theory. The thoughts forwarded in this project did not occur in a vacuum and the literature that was found after research on this project will now be presented.

Literature Search

To determine the impact of sending bi-weekly medication management text messages on HgA1C in adult type two diabetic patients who are sixty-five years old or older a literature search was conducted. The databases Cumulative Index to Nursing & Allied Health Database (CINAHL), Cochrane library, and PubMed were searched. These sources catalog journal articles about nursing, allied health, biomedicine, and healthcare. The search term that was used in these databases was (diabetes mellitus type 2 or diabetes mellitus or diabetes type 2) AND (text messaging or texting or SMS messaging) which yielded 228 results. To further the search, results were limited to (Full Text; Published Date: 20180101-20221231, aged 65+ years). By narrowing the terms, it reduced the results to 18 articles. Only peer-reviewed, current studies from within the past five years were included in this final search. Seven studies were excluded for the following reasons: one study discussed using texts to reduce sitting time for diabetics with a job; one study discussed texting diabetic patients with severe acute respiratory syndrome coronavirus 2 2019 (COVID-19); one study examined ways to send more effective messages to diabetic patients. One study is planned has not yet occurred; one study addressed texting coronary heart disease patients and not diabetes type 2 patients; one study addressed ways to improve and personalize therapeutic communication between patient and provider; and, the last study excluded addressed using telehealth to make risk stratifications on diabetic patients for hospital admission. Therefore, eleven studies were included to show the evidence to support the use of text messaging in older adults with type two diabetes: One quasi-experimental study (Santero et al., 2018). 10 randomized clinical trials (Choudry et al., 2018, Fang & Deng, 2018, Huo et al.,

2019, Kanniker et al., 2022, Kassavou et al., 2020, Langford et al., 2018, Levy et al., 2018, Mayberry et al., 2019, Middleton et al., 2020, Muigg et al., 2020).

Definitions

This project will use the following definitions

- 1) Type two diabetes mellitus- Diabetes mellitus is a chronic metabolic disorder that has the characteristics of persistent hyperglycemia. It may be due to impaired insulin secretion, resistance to peripheral actions of insulin, or both factors (Goyal & Jialal, 2022).
- 2) Bi-weekly- occurring twice a week (Merriam-webster, 2022).
- 3) Text message short messaging service (SMS)-The creation and exchange of alphanumeric utilized through mobile communication channels (Hall et al., 2015).
- 4) Medication Management- a periodic review that is provided to reevaluate the dosage, risks, and benefits of the current medication regimen to help the patient meet their goal for disease management (Kim et al., 2018).
- 5) HgA1C-A 90-day time-integrated marker of glycemic control (Pai et al., 2019).

Literature Review

There is a need for intervention for type 2 diabetes. Diabetes is not only a problem in the United States but every nation in the world struggles with type two diabetes affecting their population. Cell phones and texting technology have been present for more than 20 years. This technology has shown wide adoption worldwide. Some countries even have more citizens with cell phones than with running water and sewage (Santero et al., 2018). Not only is the technology widespread but it is also currently accessible to a vast majority of the population of most countries. This wide usage leads to a greater chance that the elderly population worldwide

has a cell phone and some familiarity with the phone's use. The following review of the studies shows there is evidence to support the use of text messaging to reduce HgA1c levels.

Text Messaging methodology

Text messaging is seen as an up-and-coming platform for delivering healthcare education because of the already existing infrastructure that exists worldwide (Santero et al., 2018). Medical providers can take advantage of the existing technology. This makes treatment for chronic diseases such as type two diabetes more accessible because patients are no longer constrained to having to make face-to-face visits to monitor the progress of their care (Kassavou et al., 2020). The intervention used in all the studies was text messaging. Ten of the studies were randomized control trials (Choudry et al., 2018, Fang & Deng, 2018, Huo et al., 2019, Kanniker et al., 2022, Kassavou et al., 2020, Langford et al., 2018, Levy et al., 2018, Mayberry et al., 2019, Middleton et al., 2020, Muigg et al., 2020). There was one quasi-experimental study (Santero et al., 2018). Three of the studies Kassavou et al. (2020), Levy et al. (2018), and Langford et al. (2019) focused on daily texts that focused on the patient's daily fasting blood glucose with emergency response ready for fasting blood glucose under 80 mmol/dl or over 400 mmol/dl. When the participant responded with their fasting blood glucose the study staff adjusted the participant's regimen to help maximize blood glucose control by optimizing the insulin dose. By concentrating on -fasting blood glucose and changing the amount of medication given Kassavou et al (2020), Levy et al (2018), and Langford et al (2019) all showed statistically significant decreases in HgA1c during their study period. Alternatively, Choudry et al. (2018) relied on using text based on the concept of motivational interviewing to see if these types of texts would effect change. Motivational interviewing is a patient-centered intervention that is targeted at the resolution of ambivalence to enable patient behavior change (Cooper, 2017)-

Finally, Kannikar et al. (2022), Santero et al. (2018), and Fang & Deng (2018) sent a selection of educational based messages that included multimedia video components of education that showed techniques such as the proper way to draw insulin up and inject insulin; as well as focusing on diet and physical exercise with weekly messages that focused on these topics. Regardless of the method of text messaging whether based on fasting glucose, motivational interviewing, or educational texts all of the studies found that there was a statistically significant change in lower HgA1c. All the studies show that text messaging is a useful intervention for lowering HgA1c. With reductions in HgA1c up to 2% in Levy et al. (2018) this is an inexpensive intervention that has yielded tighter glycemic control and which may help limit some of the negative effects of type two diabetes. Text messaging is a scalable intervention that providers can utilize for effective glycemic control in adults over sixty-five. The data shows that this is an effective intervention.

This lowering of HgA1c is significant in helping elderly participants have fewer complications from type two diabetes. The studies presented above give clear evidence that texting is an effective intervention to use to lower HgA1c. Even though the studies used different types of texts (information only, education, and motivational interviewing) it is clear that all the studies show improvement in the participant population being studied. These studies clearly show that they can be translated and used to achieve real-world success as an intervention to lower HgA1c and lessen the effects of type two diabetes by providing better glycemic control.

Medication Adherence

One of the issues faced by patients who have diabetes, especially patients aged sixty-five years of age or older, is medication adherence (Levy et al, 2018). Proper medication adherence leads to better HgA1c levels and may lead to fewer vascular problems (Levy et al, 2018) It has

been shown that when insulin management is used, and therapeutic goals are reached and maintained that there is a prevention of complications and mortality associated with type two diabetes (Levy et al, 2018)

All eleven of the studies reviewed dealt with medication adherence either directly or indirectly. In five of the studies Choudhry et al. (2018), Huo et al. (2019), Kassavou et al. (2020), Langford et al. (2019), and Levy et al. (2019) discussed medication adherence directly in their studies. Kassavou et al. (2020), Langford et al. (2019), and Levy et al. (2019) used type two diabetic participants that had been previously nonadherent to their medication regimen. This nonadherence ranged from intentional nonadherence patients who purposefully did not take their full dose or skipped days of medication and unintentional nonadherence which were participants who forgot to take their medication or were unclear about their prescriptions. These three studies also had control and intervention groups. The control group received initial education at their provider's visit and nothing else. The intervention group not only received education at the initial visit but also received daily texts inquiring about fasting blood glucose and adjusting from what was reported. These three studies used a self-reported questionnaire on their adherence as well as tracking the patient's prescription claims during the study time period to help analyze and independently gauge adherence. By sending questions about blood glucose and adjusting the patient's medication regimen the studies reported that the optimal insulin dose (OID) was reached sooner in the intervention groups than in the control groups. The studies showed that the control groups had more days with an OID than the control groups. OID is defined as a pre-meal fasting blood sugar range of between 80-130 mg/dL and a post-meal blood sugar lower than 180 mg/dL (Thompson et al., 2018). It also showed that the intervention groups realized a lower HgA1c than the control groups did. The intervention groups showed a significant statistical

change in lowered HgA1c, and the control group did not show a significant statistical change in HgA1c.

Kassavou et al. (2020) noted in their study that participants with high glucose levels were recruited from primary care practices; the participants in the intervention group who used the texting intervention increased their adherence to medication at 3 months by an average of 2 days. Another point to consider is that medication adherence typically declines in the first month following the usual treatment consultation.

Alternately Choudhry et al. (2018) used participants that were just receiving their diagnosis of type two diabetes and used the intervention of motivational interviewing to try and affect change. By using motivational messages tailored to the participants they felt that they could show a change in medication adherence. When compared to the control group the interventional group who received these messages did statistically greater medication adherence as well as lower study HgA1c in their studies. Huo et al. (2019) on the other hand used a mixture of messages both motivational messaging and educational messaging on the subjects of proper injection and diet as their intervention. The study revealed that this intervention led to greater statistical medication adherence than the control group and lower HgA1c numbers.

Fang & Deng (2018), Kanniker et al. (2022), Mayberry et al. (2019), Middleton et al. (2020), Muigg et al. (2020), and, Santero et al. (2018) did not directly list medication adherence in their studies or track medication adherence. These studies focused on the texts but did not mention the topic of medication directly in their studies. Medication adherence can be inferred because these interventions can only successfully occur with medication adherence.

From the review of the evidence, it is inferred a correlation can be drawn that greater medication adherence resulted in a lower HgA1c. Communicating by text helped the study

participants by reinforcing education and giving providers the ability to make adjustments to the medication regimen more often. From the results of the studies, these changes led to better medication adherence than in the control groups and a lower HgA1c. It was also noted by Kassavou et al. (2020) that the daily texts were viewed by the control group. The participants felt that the daily texts served as a great reminder to take their medication which in turn also raised medication adherence.

A1C Reduction and Significance

One of the concerns that need to be addressed is the usefulness of the proposed intervention. Kannikar et al. (2022) set up and studied two groups for their study. Both groups received an initial session of diabetic education and continuous measurement of progress through office visits. The intervention had multimedia-based texts that sent education and demonstration on subjects such as the proper technique for injecting insulin to the intervention group. This intervention group had a statistically significant lowered HgA1c than the control group did. The intervention group showed a 1.3% lower HgA1c than the control group with a did and this study showed a ninety-five percent confidence interval in the results. The study goes on to note that the intervention group started this study with an HgA1c of 8.7% and lowered it on average to 7.8%. In addition, the control group actually showed an increase in their HgA1c during the same time period

The Fang & Deng (2018) study out of China showed a noticeable decrease in HgA1c in the texting intervention group as compared to the control group who were only provided education at their initial office visit at the beginning of the study.

The Kassavou et al. (2020) random clinical study also showed a positive difference between the control group and the intervention group. The intervention group showed a decrease

of 0.21 standard deviation compared with the control group. The authors explained the intervention group added an additional 2 full days of medication adherence at the 3-month mark of the study. It was also noted that in diabetics adherence generally declines during the first month after initial education and the control group showed a decline in the first 3 months of the study.

In the Levy et al. (2018) study, a significant statistical difference in the HgA1c of the intervention group was noted as well. The mean HgA1c between the control and intervention groups was 11.4% at the time of enrollment. The intervention group lowered their HgA1c to ten percent at the six month follow-up with no significant statistical change in the control group. In addition, more than half of the intervention group decreased their HgA1c by at least one percent and more than a quarter of the intervention group showed a decrease in HgA1c of more than two percent. While the control group shows no major statistical change in their HgA1c. (Levy et al., 2018). The Langford et al. (2019) study included low-income participants in New York. They had control and intervention groups as well and their intervention group showed a decrease in HgA1c as well. The mean HgA1c between the two groups was 11.5% and the study showed a one percent decrease in HgA1c at three months. The control group showed no major change in their HgA1c. More than that the intervention group was able to achieve seventy-eight percent medication adherence to their insulin regimen.

Santero et al. (2018) showed an average starting HgA1c of 8.6%. The intervention group showed a decrease in their HgA1c to eight percent. There was no significant change in the control group.

Choudhry et al. (2018) Found that there was a 2.5% mean change in the intervention group as compared to the control group with the telephone-based intervention. They showed that

the intervention group also had a 4.7% compliance increase in the intervention group with no major rise in the control group being shown.

Limitations and Strengths

There were several limitations and strengths evident in this review Mayberry et al. (2019) pointed out that the use of this technology may create a disparity in care and exclude those who struggle with technology. Adults over the age of sixty-five may have a harder time with this technology than their younger counterparts. Even though cell phone technology has a wide presence throughout the world care must be taken to ensure that the use of this technology does not exclude people that may not be able fiscally to afford a cellular telephone. Kannikar et al. (2022) echoed the concern that some elderly people may find it difficult to navigate cell phone technology and effectively use it.

Another limitation identified by Kassavou et al. (2020) is they did not identify the medication changes made during the study. This means that there was no way to know what changes were made to medications like insulin. This leaves the study showing a change but not being able to explain exactly how that change occurred.

Choudhry et al. (2018) discussed the homogeneous patient population and that a more diverse study population was needed. In addition, they focused on several different conditions with diabetes being one of them. They theorized that they may have achieved better results if they concentrated on a single condition. Another limitation that Choudhry et al. (2018) identified is that they only tested their intervention on insured individuals. They feel that if they included the uninsured it may have presented a more representative sample.

One of the strengths presented by Fang & Deng (2018) is that at baseline both the intervention group and the control group had risk index values of $p > .05$. The intervention group

showed that there were significant decreases in HgA1c, fasting plasma glucose levels all showing $p < .05$ with a ninety percent confidence index.

An additional strength reported by Levy et al. (2018) showed that the participants involved in the intervention group were satisfied with the intervention. Eighty-four percent of the intervention group felt that the text messages intervention helped with medication adherence. Eighty-seven percent of the intervention group found the educational materials useful and ninety-seven percent preferred not having to come into a clinic to make medication adjustments. This shows that the intervention helped to increase medication adherence and lower HgA1c in the study population.

Another strength that was demonstrated by Kassavou et al. (2020) was that they were able to recruit study participants from a vast range of areas. The majority of the participants recruited were from depressed socio-economic areas. This means that there is a great deal of confidence that texting interventions can be scaled to provide this intervention to a broader range of practices and reach patients of different socioeconomic backgrounds.

Gaps in Literature

Another gap that is shown is the age of the patients in these studies they are fifty years old or older. More studies are needed with a younger participant population. This intervention is showing validity; including a younger patient population in further studies will help to validate this intervention.

Conclusion

The question has been asked in adult type 2 diabetics sixty-five years or older, would bi-weekly text messages for medication management lower HgA1C? This paper has established a problem that type two diabetes is a serious chronic disease that affects many lives, especially the

lives of this sixty-five years of age or older. A theoretical framework was established by incorporating both King's theory of goal attainment and Orlando's deliberative nursing process theory. The selected theories help to establish a framework for text messaging education to occur. The evidence provided supports the use of text messaging to educate patients to adhere to medication management which ultimately decreases HgA1c levels. The evidence shows that adults over the age of Sixty-five have the dexterity and aptitude to use text messaging to learn about their health condition and adapt to improve their glycemic control. Text messaging is a viable option and necessary intervention to aid the adult population to manage their type two diabetes. The usefulness of the technology at the intervention's backbone is shown throughout the studies. Using a cellular device and texting is already widely used throughout the world. Text messaging as an intervention to educate older adults about their type two diabetes and help them manage it is promising and deserves further study to help solidify its implementation in the primary care setting.

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