Implementation of Diabetes Tracking Applications into the Chronic Care Model in the Program of All-Inclusive Care for the Elderly (PACE): A Quality Improvement Effort

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Table of Contents

Abstract

Background: Those with type 2 diabetes are at a higher risk of debilitating consequences such as impaired vision, nephropathy, and decreased quality in life, resulting in premature death. The cost of diabetes care is also at least 3.2 times greater than the average per capita health care expenditure, rising to 9.4 times in the presence of complications.

Review of Literature: Articles chosen from PubMed and CINAHL databases using key terms Type 2 diabetes mellitus, mobile applications, chronic care, the program of all-inclusive care for the elderly, diabetes management, quality improvement, and quality of life. Of the 214 articles, 10 met the criteria for review.

Purpose: This paper aims to improve Type 2 Diabetes Mellitus (T2DM) for PACE participants by lowering their hemoglobin A1c to reduce their risk of morbidity and mortality while improving their quality of life using the Chronic Care Model.

Methods: 30 Alcatel Joy Tablets supplied to PACE participants with a diagnosis of T2DM loaded with an application to provide education on the management of T2DM, 12 consented to participate in the practice change. Participants attended an educational session on device functionality and expectation of use. Data extraction of baseline A1Cs collected. Follow-up with participants will occur monthly, either by phone or when present in the office. Pre/post-survey responses will conclude at the end of the project in Dec 2022.

Implementation Plan/Procedure: In September 2022, participants were provided the Alcatel Joy Tablets and began learning about T2DM and managing the disease by taking steps to lower their hemoglobin A1c. In December 2022, hemoglobin A1c data and pre/post-test survey results analysis consisted of calculations using a two-paired T-test to determine the success of project implementation and outcomes.

Implications/results/ Conclusion: Reducing HbA1c's through technology grounded in the Chronic Care Model at PACE location will be successfully implemented. Although multifactorial, data analysis of pre/post HbA1c levels obtained during the Sept-Dec months showed statistically significant results in favor of improved outcomes. The HbA1c average using the mean of pre-initiation was 7.9%. HbA1c's post-project was 6.9%, a reduction of 1.0%, with an HbA1c goal of 7%. A two-sample T-test calculation with an alpha of 0.05 resulted in a p-value of 0.0495.

Improving quality of life (QoL) through management of T2DM's survey results was overall neutral, with little improvements in participants' knowledge and understanding of tablet devices, mobile applications, and perceived quality of life. Improvements are likely the result of the collective impact of the intervention, such as new medications, dietary changes, and exercise habits during the intervention period, which is consistent with Wagner's Chronic Care Model.

Chronic illness is an issue that has been pervasive in the United States healthcare system for several decades. While chronic illness affects those of all ages, it disproportionately affects the elderly population, with 85% diagnosed with a chronic condition (National Institute on Aging, 2017). Type 2 Diabetes Mellitus (T2DM) is one of the most significant chronic illnesses in the United States, culminating in various negative impacts on the health and well-being of older adults, primarily when not managed adequately. The lack of proper tracking and management of T2DM leads to increased hospitalization rates due to exacerbations of chronic diseases and reduced quality of life (QOL) among those affected (Raghupathi & Raghupathi, 2018).

The Program for All-Inclusive Care of the Elderly (PACE) practices within the Chronic Care Model to maintain its participants' current level of health. Since PACE participants live at home and manage their diabetes independently, there is potential for inadequate chronic disease management, which may lead to increased hospitalizations and adverse health outcomes.

With 44% (80/181) of PACE participants diagnosed with type T2DM, we aim to improve or maintain QOL within this population by utilizing diabetes management technology on Alcatel Joy Tab 2 devices. Alcatel Joy Tab 2 is an 8-inch tablet android device that allows 9 hours of video/ screen time or 25 days of stand-by on one battery charge (Metro, 2022). T-Mobile® provides unlimited 4G internet to the devices for participants to engage in the application to learn about T2DM diagnosis and how to manage symptoms. Applying the devices provided to participants with T2DM-specific education and interventions will improve QoL within the PACE population in an urban city in Michigan.

Background/ Significance

T2DM is a severe public health concern that considerably impacts QOL and creates an economic burden. In 2018, approximately 415 million people will develop diabetes, with 90% having T2DM (Chaterjee et al., 2017). By 2060, both types of diabetes will affect more than 60.6 million American adults (Smith et al., 2021). Increased consumption of unhealthy diets and sedentary lifestyles have resulted in elevated Body Mass Index (BMI) and higher fasting plasma glucose, contributing to an increased prevalence of T2DM (Khan et al., 2019). Older age also contributes to the risk of T2DM and is a significant concern for the elderly growing population (Khan et al., 2019).

Those with type 2 diabetes are at a higher risk of debilitating consequences such as impaired vision, nephropathy, and decreased quality in life, resulting in premature death(Smith et al., 2021). The perception of a person's QOL can be affected by disease burden of T2DM due to overall diagnosis of diabetes causing distress, daily medication adherence, and insulin use (Zurita-Cruz et al., 2018). The cost of diabetes care is also at least 3.2 times greater than the average per capita health care expenditure, rising to 9.4 times in the presence of complications (Khan et al., 2020). The total estimated cost of diagnosis for all diabetes in 2017 was $327 billion, including $237 billion in direct medical costs and $90 billion in lost productivity (CDC, 2022).

Nonpharmacological approaches to managing blood glucose levels are essential to diabetes care. Per Gonzalez et al., (2021) diabetes education and support improved self-management knowledge and skill. According to Smith et al., (2021) self-management and understanding diabetes education is associated with better health outcomes and reduced health costs. Pairing diabetes education with mobile application technology can also assist in providing diabetes education that is convenient and cost-effective for PACE participants.

Problem Statement/ Clinical Question

PACE's priority is to maintain its participants' independence within the home. Implementing technology to improve education and provide tracking blood sugar may increase adherence. With a recent grant, 30 Alcatel Joy Tab 2 devices were given to PACE to use for its participants diagnosed with T2DM. Devices were pre-loaded with the Glucose Buddy Diabetes Tracker mobile app for those with a history of T2DM. Participants who met the criteria had no cost of data usage through their T-mobile® partner. We aim to evaluate if implementing diabetes management applications within the PACE population will improve patients' perceived level of health and well-being, while lowering hemoglobin A1c (HbA1c) levels, from September to December of 2022.

PICO statements intend to gather evidence with research to answer a clinical question to promote proof of reliable resources for changes in practice (Melnyk & Fineout-Overholt, 2019). Clinical questions guided the quality improvement project using P for participants, I for the planned intervention, C to compare current practice, O for outcomes expected and T for the time frame of intervention. The following statement guided the examination of articles: For (P) Pace participants with T2DM do (I) mobile applications with diabetes self-management education (C) compared to standard T2DM education provided within the office setting (O) reduce A1C levels (T) within three months; from Sept- Dec 2022.

Description of Clinical Cite

PACE is a community-based model caring for elderly adults 55 years and older, accounting for more than 50,000 participants across 31 states in the US (Gonzalez, 2021). They are dual-enrolled in Medicare and Medicaid. They are also considered a high-risk population due to multiple comorbidities, lower socioeconomic status, and risk for hospitalizations using a

capped financing model (Arku et al., 2022). According to Boersma et al., (2020)76.9% of adults 65 and older who are dual enrolled have two or more chronic conditions. PACE provides a multidisciplinary team approach to managing participants' chronic health conditions allowing them to live in the community and within their homes (Arku et al., 2022).

This PACE location has 181 participants; 51 have a T2DM diagnosis. While it is difficult to identify a causative nature of hospitalizations or deaths due to the multiple chronic conditions, the diagnosis of T2DM is related to poorer health outcomes. The current T2DM education during medical visits is provided verbally from provider to participant. There are currently two physicians, three nurse practitioners, four nurses, five dietary/aides, transportation staff, social workers, dieticians, two pharmacy technicians, physical and occupational therapists, and 20 patient rooms to provide medical care.

The day center is located in the east wing and can allow 70 people to participate in activities planned twice weekly. Activities include bingo, and art/crafts, with lunch provided through meals on wheels. Two showers are handicap accessible for participants unable or who do not have access to bathe regularly. A therapy gym with various pieces of equipment is necessary for occupational and physical rehabilitation.

Medical information is limited to PACE providers and does not interface with other local electronic medical records (EMR), and allows communication with the interdisciplinary team within PACE. Unfortunately, it does not provide portal access to participants access to their medical charts or update them on current diagnoses or visit summaries from each visit encounter. Patient-specific data extraction occurred through interdisciplinary notes created for each patient, including providers, nursing staff, physical therapists, support staff, case management, and transportation.

Key Stakeholders

A stakeholder analysis assessed the organizational system and stakeholder interests in practice change (Appendix A). The analysis identifies needs or unforeseen barriers hindering the proposed change and their involvement. Many stakeholders play a significant role in the proposed intervention of using mobile applications to provide education and management of T2DM to PACE participants. These stakeholders include the medical director, provider including MD and APRNs, nursing support staff, transportation team, participants, information technology (IT), insurance companies, T-Mobile®, grant partners and participants.

Key stakeholders that will strongly influence the intervention and support will be the medical director, providers, participants, insurance companies, and grant partners. These individuals will play a crucial role in initiating the first steps of this change and communicating with other stakeholders about the intervention and its importance. The intervention comes with cost, time, and education using applications. Resistance with medical directors, providers, participants, insurance, and grant partners during the intervention can affect future funding or reimbursement opportunities.

A SWOT analysis provides valuable insight when delimiting the project's scope and strategies to control positive and negative factors affecting success (Harris et al., 2020). It identifies (see Appendix B) strengths, weaknesses, opportunities, and threats during the implementation of the proposed project. It is essential to assess and provide discussion during the initial 1:1 visit when providing the education and expectations of the project to limit barriers.

Quality Improvement Model

The model utilized for application in this project was Wagner’s Chronic Care Model. The Chronic Care Model outlines six critical elements aimed to improve outcomes in those with

chronic conditions. This model also effectively shows the relationship between the community, the healthcare system, patients, and providers of care (see Appendix C).

This model was designed to focus on self education and tracking to promote better health and to strengthen communication within healthcare organizations in individuals with T2DM (Baptisma et al, 2016). Patients with chronic conditions who are informed and activated have more productive interactions with health care teams and are associated with better health outcomes (Wagner, 1998). An additional benefit in utilizing the Chronic Care Model is its emphasis on information tracking systems which is theorized to allow for better feedback to healthcare providers on patients performance and ability to manage their respective chronic illnesses'.

The projected outcomes on the implementation of the Chronic Care Model follows two basic principles with a symbiotic relationship. As chronic healthcare conditions are better managed through improved care systems, not only will patients continue with longer, healthier lives with improved quality of life (Wagner, 1998). But this improved health leads to a decrease in healthcare burden and overall costs to continually treat chronic conditions indefinetly. However, the implementation of this model on a large scale is difficult to quantify as it requires a large scale and comprehensive system change.

Review of Literature

Literature Inquiry Method

The literature review focused on the Cumulative Index to Nursing, Allied Health Literature (CINAHL) and PubMed of the U.S. National Library of Medicine National Institutes of Health databases. Keywords, limitations, and the number of each search criterion results are within Appendix D. Key terms such as "Diabetes type 2" and increased healthcare costs," "

diabetes type 2," and "decreased quality of life," diabetes type 2" and "applications or apps," "self-education or learning," "type 2 diabetes and "healthcare costs and "mobile apps, "type 2 diabetes and "quality of life" and "mobile apps" were considered. Exclusion criteria comprised articles older than five years old, articles missing technology or self-educational learning methods. The PRISMA diagram details the thorough search of evidence collected with the number of results obtained (Appendix E). After evaluation of the stated criteria for exclusion, ten articles remained.

Review of Literature and Synthesis Table

The literature review (Appendix F) identified commonalities between the research and the common themes presented in the studies. After examining each selected article, commonly identified themes are labeled within a synthesis table (Appendix G). The themes selected are using self-education to manage T2DM, self-education to improve quality of life, use of applications for self-management T2DM, and use of applications to improve quality of life. The themes are essential to discuss among healthcare professionals and assist with investigating the presented clinical question.

Self-education to Manage T2DM

Self-management is essential to managing one's blood glucose levels and is associated with improved outcomes, reduced health care costs, and decreased HbA1c measurements (Smith et al., 2021; Nkhoma et al., 2021). Diabetic management applications include similar features, including opportunities for patient education to understand better and track the progress and severity of their T2DM (Nkhoma et al., 2021; Yap et al., 2021). Understanding a complex diagnosis such as T2DM can cause patients to feel overwhelmed or distressed; through education

and management through technology, diabetic distress may be reduced with a coinciding improvement in self-efficacy (Yap et al., 2021; Nkhoma et al., 2021).

Self-education to Improve Quality of Life

Lifestyle changes and treatment are essential in preventing or significantly delaying complications of T2DM while improving QOL (Hilmarsdootir, 2021; Yap et al., 2021). Providing diabetes education programs can assist in ways to reduce HbA1c and lower lifestyle risks, such as weight loss, to manage diabetic symptoms and complications.

According to clinical practice guidelines, people with diabetes should participate in self-management education focusing on self-care and empowerment (Hilmarsdootir, 2021). T2DM is also a chronic condition that can affect mood and self-esteem, generating frustration and symptoms of depression (Zurita-Cruz, 2018). Self-led education and diabetes management through mobile applications have shown reductions in HbA1c levels but also improved health-related QOL (Nkhoma et al., 2021; Sunil Kumar et al., 2020).

Use of Applications for T2DM Self-education

Digital education can offer a way to reduce T2DM with minimal burden on our healthcare organizations by creating early aid among those living with T2DM (Lavikainen et a., 2022; Yap et al., 2021; Nkhoma et al., 2021). Applications can assist with self-management, including a healthy diet, weight loss, increased physical activity, and regular blood glucose monitoring (Hilmarsdottir et al., 2021; Tsunemi et al., 2021). They can increase the effectiveness of diabetes care without increasing the frequency of outpatient visits, which would be positive for the patient's health and save healthcare resources (Hilmarsdottir et al., 2021; Nkhoma et al., 2021). The use of digital health in T2DM management also has the potential to lower healthcare

costs over extended periods of 10-20 year interventions compared to standard management techniques (Gilmer et al., 2019).

Self-care and management of chronic conditions can be challenging to understand. According to the World Health Organization (WHO), education provides the bases and foundation for the treatment of diabetes, and key objectives include raising awareness of individuals' attitudes and behaviors to promote self-care (Ghoreishi et al., 2019). By using daily tracking and monitoring, individuals become active participants in their care and develop a better understanding and knowledge base related to their T2DM (Lavikainen et al., 2022).

Methods

Clinical Site Methodology of Project

Thirty participants received an Actel Joy 2 Tablet with the application “Glucose Buddy Diabetes Tracker” pre-downloaded onto the device. Before application use, the participants completed a pre-survey detailing their current skill level with tablet devices and their current knowledge of T2DM. A group presentation along with one-on-one instruction on device and application functionality occurred during September 2022. A project description guideline and expectations of daily use take home handout was provided to each participant. Participants completed a pre/post-survey that included questions on prior technology use, knowledge of diabetes A1C levels and current QOL rating are provided (Appendix H).

Daily participation of minimally 5 minutes or 1 article per day will focus on knowledge of HbA1c levels, effects of T2DM and self- management. Medical staff were also provided instruction on project expectations to reinforce the importance of use during all interactions at PACE. The team process may uncover barriers to use or problems with the application prior to the end of the project.

Participants have been chosen by the PACE medical director, including patients with T2DM and active with PACE who are willing to enroll in the site program. The usual care of diabetes education provided at PACE currently includes consultation with dietitians and verbal education during office visits.

Ethical Considerations/ Protection of Human rights

Federal Policy for protecting human subjects requires universities and other institutions to seek approval from the International Review Board (IRB) to protect the human rights of the participants who enroll in the clinical site project (Harris et al., 2020). Before implementing the proposed project, the IRB at Michigan State University reviewed the outlined proposal application of form HRP-512 and provided consent to proceed with implementation in September 2022. Data collection included assessing the electronic medical record containing comorbid conditions, social and economic factors, access compliance, barriers, and interventions necessary to improve health and quality of life. The information collected did not contain identifiable data to protect the individual's identity and privacy.

Cause/effect Analysis

A fishbone diagram is a comprehensive view of essential components of the clinical problem. Contributing factors assessed include socioeconomic status, comorbidities, barriers to implementation such as lack of device experience, perceived health status, and genetic components located within Appendix I. The assessment will guide team members when difficulties arise during the course of the practice improvement project (Moran, Burson, & Conrad, 2020).

Intervention and Data Collection

T2DM is a patient-specific chronic condition with varying levels of disease progression. Our intervention focuses on quality improvement of diabetic care using diabetes tracking applications on the Alcatel Joy Tab 2. Over three months, beginning in September 2022, participants were asked to track health information via Glucose Buddy Diabetes Tracker mobile application, pre-downloaded onto their device with five minutes or one article daily minimal use required for participation. Of the 30 identified participants, 12 consented to participate.

Data collection occurred over 12 weeks. The PACE support staff will continually monitor the interventions to ensure proper use and application adherence. All data collected will be compiled and stored anonymously via a password-protected shared drive between both DNP students and the medical director located within Appendix J.

Measurement Instruments and Tools

Data collection will occur via PACE TruChart Electronic Health Record (EHR) system. EHR screening included deidentified general and demographic information such as age, race, gender, and comorbid conditions. Completion of a pre/post-survey questionnaire occurred with all participants in writing with the help of PACE staff.

The survey questions utilized a five-point Likert scale and examined patient satisfaction, knowledge, and HrQOL. Other means of data collection will occur through Glucose Buddy Diabetes Tracker that allows participants to measure, track data such as weight, blood pressure, blood sugar, HbA1c, and carbohydrate intake.

Three primary measurements defined the quality improvement effort. Health data will be measured to see changes in participants' objective health data recorded before and after implementation to assess changes in weight, and HbA1c measurements. Pre- and

post-questionnaires using 5-point Likert scales measured participant satisfaction, perceived health, QOL, and current knowledge of T2DM A1C goals.

Analysis of the pre/post surveys included a paired T-test comparing before implementation and after responses. Success of the project will be determined by participants' response. Clinical significance will be measured using the responses, EHR values of HbA1c, and glucose levels to compare results. The self-created survey determines each participant's perceived quality of life and the understanding of T2DM as a chronic condition which is the main goal of the practice improvement project.

Implementation Plan

Scheduled tasks were formatted using a Gantt chart located in Appendix K. A Gantt chart focuses the project to remain on schedule by ensuring task completion within a reasonable timeframe. The details include project activity, the person responsible for the task, the start and end dates, and expected completion date. Duties included IT verification/ download of the application onto tablets, participant pretest, education with training staff/ participants on the use of technology, obtaining baseline HbA1c's, touching base every two weeks with participants to identify any barriers, meeting with the PACE medical director monthly, obtaining after implementation HbA1c's and completion of the pre/post-test. The project team completed a stakeholder analysis and SWOT matrix to help ensure the project's success and to decrease barriers and limitations early in the project process.

Project Budget

The Alcatel Joy tablets were purchased using grant funding awarded to PACE. The amount purchased tablets for PACE to use at their discretion. T-mobile® provided the paid

internet use for each tablet at no cost to the participant or PACE. No other cost is associated with the project other than time for education, implementation, and analysis.

Analysis

HbA1c target levels can vary by each person's age and the complexity of medical conditions. According to the American Diabetic Association (ADA), an HbA1c above 6.5% indicates a diagnosis of T2DM (2023a). An HbA1c goal for many nonpregnant adults of less than 7% (53 mmol/mol) without significant hypoglycemia is appropriate; Grade A (ADA, 2023b). It is essential to determine the process used to test the samples to ensure reliability. According to the ADA, point-of-care measurements are unreliable compared to venous samples (ADA, 2023b). The data collected for this analysis used venous samples processed by an outside laboratory.

Data collection included HbA1c venous levels pre/post-intervention and pre/post-intervention survey responses. The HbA1c average using the mean of pre-initiation was 7.9%. HbA1c's post-project was 6.9%, a reduction of 1.0%, and the HbA1c goal of 7% and below is the desired outcome (see Appendix L). A statistical two-sample T-test calculation assessed the significance of HbA1c samples. The alpha level used was 0.05. The p-value for pre and post-HbA1c was 0.0495 (see Appendix M). This value is statistically significant, validating reliable results.

The survey consisted of seven questions, and one was open-ended. The responses included 1 (very poor), 2 (poor), 3 (neutral), 4 (good), and 5 (excellent). Question 1 stated: What is your current experience with tablets and app use with technology? The question response ranges from 1 (very poor) to 5 (excellent). Participants who scored 3 (fair) to 1 (very poor) were closely monitored monthly for reinforcement of education and technology use to increase

compliance. Data analysis of Pre/post-intervention scores included using the mean and two sample T-tests. The mean pre-implantation score is 3.08; the post is 3.0, which indicates a neutral response with current technology use (see Appendix N). The alpha significance level is 0.05, with a p-value of 0.43 (see Appendix O). Although the score is not statistically significant, the scores slightly decreased. Potential causes include functionality differences between current devices and application use.

Evaluating satisfaction is essential for future improvement projects with the community partner. Questions 2 and 3 described satisfaction with the application glucose buddy and the Actel Joy tablet. The post-question mean score is 2.8 meaning poor to neutral for the application, while the tablet score is 3.5 (Appendix P), implying neutral to good feedback.

Question 4 asks the participant to evaluate their perception of health status and its effects on their quality of life. How would you describe your current quality of life? The pre-survey median response is 3.67; the post-survey is 3.91 (Appendix Q). The two-sample T-test for alpha is 0.05; the p-value is 0.23 (Appendix R). The response is not statistically significant, with a mean improvement of 0.24. However, the overall increase in quality of life can substantially impact emotional health and is necessary to assess (Hilmarsdottrr et al., 2021).

Question 5 explores how happy participants were with their current health; designed to gain further insights into participants' QoL based on emotional health. The pre-survey and post-survey responses were 3.083 and 3.833 (Appendix S), respectively, with a mean improvement of 0.8 with a p-value of 0.022, suggesting a statistically significant increase in participants' happiness with their current health (Appendix T).

The chronic care model emphasizes patient self-management of disease to proactively improve patient-provider interactions and overall health outcomes. Question 6 evaluates

participants' perceived self-management and control of their T2DM. Respectively pre-survey and post-survey mean results were 3.0 and 3.75, a 0.75 mean increase (Appendix U). A two-sample T-test revealed a p-value of 0.047, a statistically significant finding in the rise in T2DM self-management (see Appendix V). Of the twelve responses, only one participant reported a post-survey decline.

The final survey question focused on understanding the extent of personal knowledge gained by determining participants' understanding of their HgA1c goals. If participants answered 'yes,' they were expected to write their HgA1c goal as a percentage. 75% (9/12) of participants needed to learn what their HgA1c goal was. Post-survey results yielded the same level of understanding, with the same 75% (9/12) participants' responding 'no.'

Limitations and Community Partner Takeaways

Limitations in this quality improvement effort were extensive. These multifaceted limitations included participant-specific limits and constraints within the organization and third-party funding bodies. Fallout was high during the early implementation of this project, with 60% (18/30) electing to not participate in implementation as explained previously; thus limiting the sample size of participants observed to 12.

The tablets utilized in this quality improvement effort were accessible due to a grant from a T-mobile® partnership. This donation of tablets also included the addition of unlimited free 4G internet access for the tablets once set up by the community partner. This access was delayed during the implementation, meaning participants could not access the "Glucose Buddy Diabetes Tracker" in their homes or public as initially intended. A decrease in the utilization of diabetic self-management and tracking likely occurred.

Battery life on the selected tablets was an issue and barrier to participants. While education on tablet use was extensive, including a demonstration of charging, some participants believed their device no longer functioned once the battery died even after multiple one-on-one learning sessions.

Overall acceptance and perceived self-efficacy regarding using tablets and mobile applications remained low due to prior beliefs and failures with different technology exposures in the past among participants despite motivational efforts. Acceptance and willingness of various factors considering a significant number of participants in this effort are dually eligible for Medicare and Medicaid. Other motivationally limiting factors not explored may have included language and literacy barriers, the highest level of education completed, and previous professional experience.

Sustainability Plan

The sustainability of this project is set to follow the outline of the chronic care model and a continuous process of improvements among both participants and providers (Wagner, 1998). Participants were able to continue use of their tablets and applications for T2DM management after the implementation was completed. The goal for this project's sustainability would be to see an overall plateau of HgA1C and a gradual increase in patient self-efficacy and knowledge of their T2DM. Prior to implementation, all staff at this site were given educational material on the intervention and goals of the project. The hope of educating staff was to provide a point of contact for patients to continue the interventions to improve long term health outcomes. Per Medical directors request, participants are permitted to keep tablets for continued use.

Discussion/Implications for Nursing

The positive impact on both HgA1c and patient perceptions on quality of life are promising which warrants further investigation in future practice to improve population health by improving self-efficacy among patients. The implications for this project has an array of potential long term benefits. Overtime, we believe that acceptance and understanding of these technologies will only grow as the younger population ages. If this intervention was applied to a younger adult population with more access and understanding of technologies, we may have seen different results.

Further inquiries may be beneficial among populations with chronic health conditions who have an initially higher aptitude for technology use and application. By utilizing and understanding these technologies as healthcare providers we can be of benefit for patients utilizing interventions such as the ones observed in this project. One gap that would impede potential future inquiries on this topic would be the cost of implementation on a larger scale as future costs would likely be placed on the patients opening the door to socioeconomic concerns of implementation. This issue was negated in this project due to grant funded tablets and free applications. As more people now have access to smart devices, this could counteract future costs if further investigated and may prove to be a low-cost implementation for chronic care management.

Conclusion

Prevalence of T2DM has continued to increase without signs of remission (Smith et al., 2021). The overwhelming impact of T2DM compounds its harm as a chronic illness with an array of potential negative comorbidities if not addressed or adequately controlled at both the primary and secondary levels of healthcare (Zurita-Cruz et al., 2018). Older adults are

disproportionately affected by chronic illnesses like T2DM (National Institute on Aging, 2017). Incorporating technology into chronic disease with self management in the future may enhance provider to patient communication, improve QOL, and compliance with use of the chronic care model.

This project aimed to utilize Alcatel Joy Tab with the "Glucose Buddy Diabetes Tracker" pre-downloaded to promote participant self-management and tracking of their T2DM by utilizing technology to motivate and promote participants' self-efficacy to drive improvements in T2DM management and quality of life, respectively. HgA1c data and pre and post-surveys were analyzed to determine the effectiveness of interventions on diabetes self-management and overall quality of life among participants (see Appendix H and Appendix L). Twelve participants participated in the quality improvement effort. Survey results were overall neutral, with little improvements in participants' knowledge and understanding of tablet devices, mobile applications, and perceived quality of life. An increase in participants' emotions toward their health with observed A1C improvements can increase perceived ability and confidence to manage T2DM.

HgA1c was used as a measurement to understand potential improvements in participants' self-lead management in their diabetic care as outlined in the chronic care model. A decrease in HbA1c's observed after intervention from an overall group mean HbA1c pre-intervention of 7.91 to 6.99 post-intervention. It is essential to note that the reduction in HbA1c is multi-faceted. Improvements are likely the result of the collective impact of the intervention, such as new medications, dietary changes, and exercise habits during the intervention period, which is consistent with the chronic care model (Wagner, 1998).

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Appendix A

Stakeholder Analysis Matrix

Stakeholder	Contact person Phone, email	Impact (How much does interventi on affect them low, med, or high)	Relationship to the intervention: How is the stakeholder affected by it	How much influenc e do they have over the interven tion, low med or high	What is important to the stake holder	How can the stakeholder contribute to the intervention	How can the stakeholder reject the intervention	Strategy for engaging the stakeholder
PACE Medical Director	517-319-0700	High	Medical director/ provider	High	Participants improved quality of life and decreased hospitalizations	Can report back success or failures, provide alternative approaches to caring for Pace participants	By not approving the proposed interventio n	Meeting her monthly with updates with the intervention Answer questions
PACE NP's	517-319-0700	High	NP/ provider	High	Improved education delivery system to participants, decreasing hospitalization rates, improving quality of life	Can oversee patients use of device and recommend options or changes to improve sucess	Not offering interventio n to participant or refusing to participate	Meeting monthly with updates with the intervention answer questions
Nursing support staff	517-319-0 700	Med	RN, MA	Med/ High	Will help aid in providing diabetic education and management in home while working with their patients	Support staff see patients in home more frequently and may help with technological issues that may arise.	Potential for adding additional workload if patient tracking is not correct or if education is not utilized.	Monthly communicat ion with support staff to discuss issues, barriers, and compliance. Answering questions.
Transportati on	517 -319-0700	Low	Minimum	Low	Decreased hospitalizations and coordination of care may lessen transportation	Minimal contribution	Unknown	Devices do not require wifi and can be used during transport

					burden			
Participants		High	Self care	High	Self management of their own chronic condition and health	Highest level of contribution. Primary role in tracking, managing, and understanding theirT2DM.	Non compliances or not utilizing education of management tools through tracking applications	Observation of application use and data being tracked. Perceived level of health and wellness with intervention
IT	517-319-0700	Med	Support	Low	Assuring applications and devices work correctly and participants can accessT2DM management applications from anywhere.	Allowing application permission and the ability to add outside applications of tablet devices	May be perceived as added workload if problems arise	Minimize workload burden early. Utilizing easy to use applications on tablet devices for the participants.
Insurance companies		High	Hospitalizations result in high healthcare cost; lower health care costs by decreasing hospitalizations	High	Reduce health care costs associated with increased hospitaliztions	Support the education by approval of education reimbursement	Refusing to reimburse for visits educating patients on use of device and education	ability to generalize results of intervention to use for future use with participants with chronic diseases
T-Mobile®		Low	More use of participants more data used, increased customers with wifi use	Low	Increasing customers with use of devices that require wifi	Provide quality wifi without internet interruptions	Provide low quality internet with many interruptions	Ability to generalize intervention for future use with wifi and devices to help manage chronic dx in the future, invitation to presentation in April 2023

Grant partner		High	Future grant funding, future projects	Low	Grant funds are used appropriately	Providing more grant funding in the future	Not provide future grant funding in the future	Invitation to presentation in April 2023

Table A1.

Appendix B

SWOT Analysis

Strengths	Weaknesses
● Tablets received as a grant from T-mobile® making it no cost to participants ● Tablets do not require wifi in order to operate ● Health tracking data is readily available and graphed to share with patient and provider	● Technology may not be fully understood by the participants in selected population ● Sensory deficits may impact application and tablet use ● Requires participants to read. Literacy of participants is not known at this time.
Opportunities	**Threats**
● Improve patient self efficacy in management of T2DM ● Wide scale implementation of health data tracking in home ● Improved provider understanding of patients chronic illness management	● Selection bias of patients receiving devices that may be more apt to use devices based on functional status ● Fragility of tablet devices if dropped, lost, stolen, or otherwise incapable of use by participants.

Table B1.

Appendix C

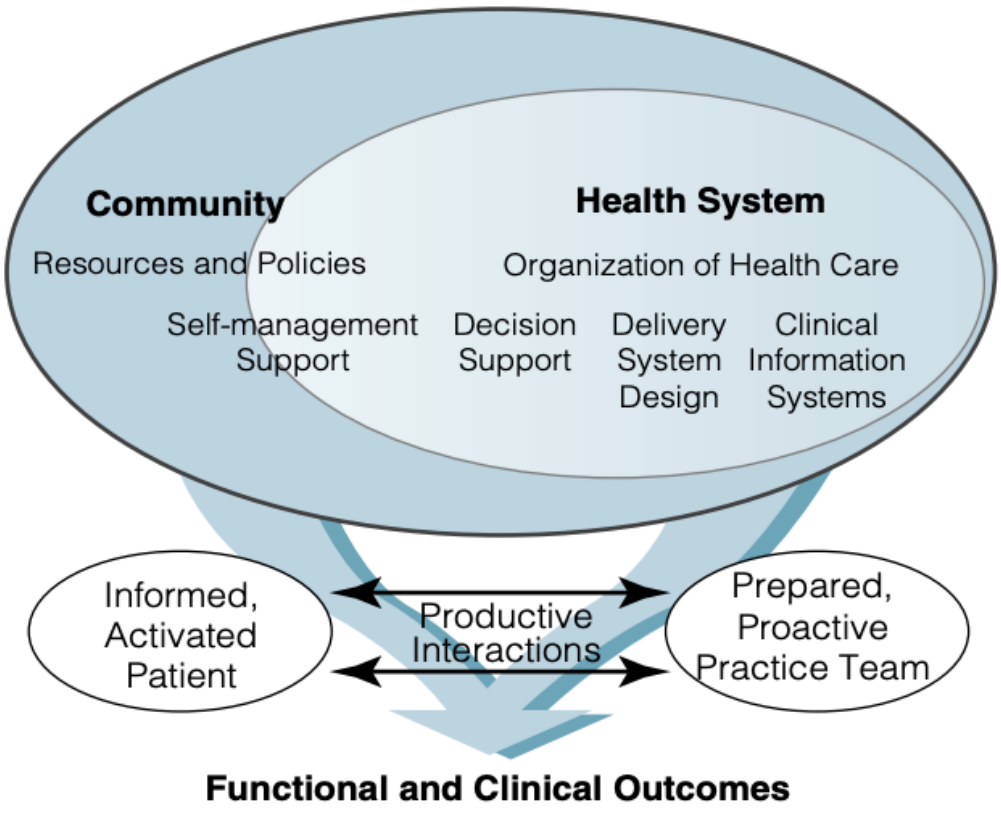

Figure C1. Chronic Care Model flow sheet

Appendix D

Literature Inquiry

DataBase	Keywords	Limitations	Number of Results
PubMed	" Diabetes type 2" and increased healthcare costs"	Within 1 year	62
PubMed	" type 2 diabetes" and " decreased quality of life"	From 2019-2022 (3 years), with systematic reviews and RTC	77
CINAHL	" Diabetes type 2" and "applications or apps" and "self education or learning"	Within the last 5 years	32
PubMed	(type 2 diabetes) AND (healthcare costs) AND (mobile apps)	Within past 5 years	11
PubMed	(type 2 diabetes) AND (Quality of life) AND (mobile apps)	Within past 5 years	33

Table C1.

Appendix E

Prisma Table

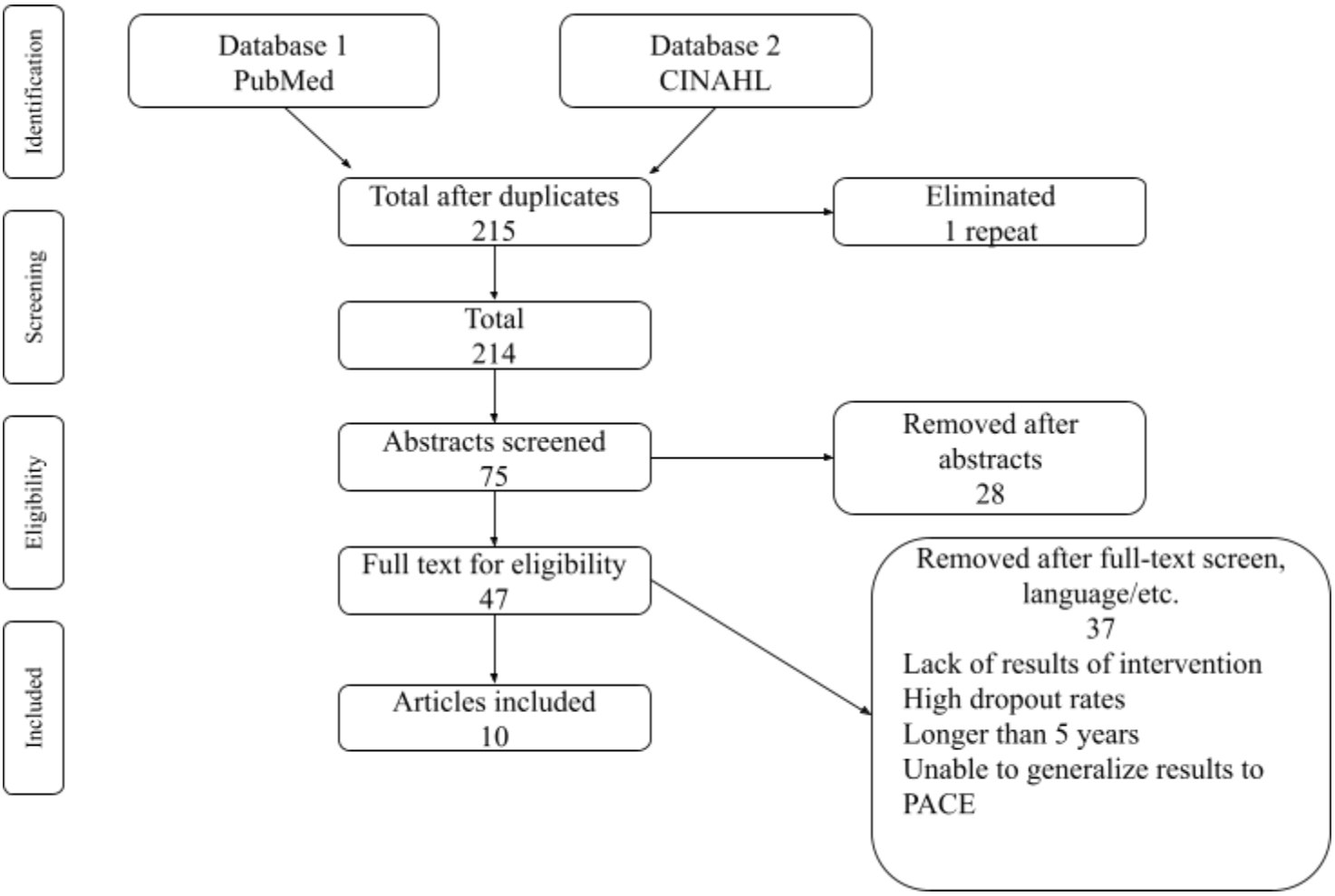

Figure D1.

Appendix F

Literature Review

Citation	**Design/level of evidence/ purpose**	**Sample**	**Intervention**	**Measurable variables/ instruments**	**Findings**	**Strengths/limitations/ implications**
Batch et al, 2021	Longitudinal Level: III	n=201 participants	Download an application of a self guided mobile app for diabetes education using Time2Focus by completing 12 levels of education	Pre/post Hgb A1C, after all 12 levels were completed participants were sent a follow up survey. The primary outcome was change in HbA1C, secondary outcomes included medication adherence, self-care activities, self reporting of physical activities, diabetes self efficacy illness perceptions, diabetes distress scale, and users engagement with and rating the app	Not statistically significant with reduction of HbA1c and how many levels were completed within the app, Diabetes self efficacy showed a large and significant increase during app users for completers, Severity of illness perceptions showed a small but significant decrease for users who completed the levels. The net promoter score was 62.5, indicating that those who completed the levels rated it highly and recommended it to others	**Limitations**: Small amount of participants, short duration of study, lasting 3 months **Strengths**: intervention of design, which is based on behavior change theory and focuses on increasing self efficacy and problem solving skills, limited resources needed for study, collection of data in new ways

Citation	**Design/level of evidence/ purpose**	**Sample**	**Intervention**	**Measurable variables/ instruments**	**Findings**	**Strengths/limitations/ implications**
Gilmer et al., 2019	Randomized Clinical Trial Level: I	n= 301 patients with T2DM	3 arm randomized control with Project Dulce wireless diabetes care management (PD), and Project Dulce with technology enhancement (PD-TE) including mobile application	Cost of intervention and quality of life -adjusted life years. Measurements were to improve A1c, blood pressure and lipids. Clinical staff had access to diabetic tracking information. Analyzed cost of interventions against cost of diabetic complications.	PD-TE arms had a significantly higher cost of initiation and management. All 3 arms showed improvement in cost-effectiveness for diabetes management. PD and PD-TE arms have better long term cost effectiveness. All arms have improved estimated life years	**Limitations**: Younger population not as generalizable to PACE population. Technology enhancements included a glucometer device. Limited cost effectiveness at 5-10 years with PD-TE arms. **Strengths**: Study design. Use of medication and blood sugar reminder systems. Strong cost analysis.
Hilmarsdottr r et al, 2021	Randomized Control Trial Level: II	N=30	Participants were randomly assigned to an intervention or control group after age and gender stratification. In addition to the standard of care, intervention group participants used a	Every 6 months variables tested were body weight, HbA1c levels and lipids as well as questionnaires about distress related toT2DM, health related quality of life, depression and anxiety Statistics included comparisons between both groups	One difference was a significant difference in A1C, a decrease in disease specific distress and anxiety in symptoms was noted in the intervention group, no differences were noted in the control group	**Limitation**: Small amount of participants, short study, no follow up after the intervention, not enough staff in clinic to support the study due to illness **Strength**: the randomization and stratification of the participants according to age and gender and results reported according to the intervention to treat.

Citation	Design/level of evidence/ purpose	Sample	Intervention	Measurable variables/ instruments	Findings	Strengths/limitations/ implications
			smartphone application to access a lifestyle program (SidekickHealth) through which they received personalized recommendations and education on healthy lifestyles.			
Lavikainen et al, 2022	Randomized Control Trial: Level: I	N=1022	Objective: investigate healthy habits, BitHabit and in T2DM RF. An RTC evaluating the improvement application by itself or partnered with an in person group with education in comparison with current	Groups DIGI and DIGI + accessed BitHabit for 12 months. Intervention goal to encourage people to develop healthier choices to improve T2DM using self determination theory. BitHabit offered thirteen areas of improvement from diet, exercise, and healthier sleeping habits. Other areas included ways how mood affects	Adhering to the intervention daily successfully improved diets, and lost weight over the course of a year. Intermittent use of 2-3 times per week only showed mild improvements comparing those who did not participate or quit. Every day users showed the greatest benefit from the intervention. Older adults were	**Limitations**: More women than men in the study also calculated how much the person participated in monthly instead of weekly to show adherence. It was noted in the study, the sensitivity of detecting any types of changes within the risk factor is not known. **Strengths:** Large sample size, had a 1 year F/U Initial application participation was nearly 100% for using the application. These results reduced bias in selection of participants.

Citation	Design/level of evidence/ purpose	Sample	Intervention	Measurable variables/ instruments	Findings	Strengths/limitations/ implications
			practice. Participants were randomly allocated into a digital intervention group DIGI, a group combining the digital intervention and face to face DIGI+GROUP or control group	lifestyle, how to deal with stressful situations limiting smoking and alcohol intake. The DIGI+ group Attended six coaching sessions. BMI and waist measurements. At next office visit lab values such as blood sugar and first measurements repeated 12 months later.	associated with increased engagement.	
Nkhoma et al., 2021	Meta-Analysis Level: I	N= 39 Studies included with 6861 participants	None	(DSMES) improving A1C, diabetes education, and (HrQoL) of Type 1 & 2 DM in 10 years	DSMES improved A1C, diabetic knowledge with T2DM. No significant changes in HrQoL.	**Limitations**: HrQoL was not found to have a statistically significant improvement at 6 or 12 month follow-ups. **Strengths**: Study design. Large sample size and number of studies included

Citation	**Design/level of evidence/ purpose**	**Sample**	**Intervention**	**Measurable variables/ instruments**	**Findings**	**Strengths/limitations/ implications**
Smith et al, 2021	longitudinal level III Prognostic study investigating the outcome of disease, over time. The primary outcome variable of interest was HbA1c and estimated health care costs savings associated with HbA1c reductions	n=5,907 participants	Interactive workshop taught in Spanish and English, collecting data at 5 time points; baseline 3,6,9,12	A1C, and expected health savings cost. A series of independent sample test and linear mixed model regression analysis was used to identify changes over time	The largest HbA1c drop 3 m F/U; P <0.001 adj change -0.926, at 6 months: P <0.001 adj change -0.870, 12 months, P 0.001 adj change: -.731 Cost savings: using the Gilmer approach: was an estimated cost savings if f/u every 12 months for 3 years, est savings would be 1501 per person.	**Limitations**: the high attrition rate was a significant finding, which prohibited obtaining HbA1c measures over time for all participants with baseline data and may have introduced bias. Attribution rates at 12 month follow up were higher among younger participants, uninsured, or medicaid insured and those who drank alcohol and smoked. Cost savings were extrapolated based on 2 prior studies of cost savings from reduction of A1C. cost savings were est after 3 years, location South Texas **Strengths**: Large population sample, 5 follow up points, and measuring more than 1 variable: HbA1c and health care costs. Study is 1 year old.
Sunil Kumar et al., 2020	Randomized field trial Level: II	N= 300 patients age 18-65 with = type 2 diabetes over a year	Intervention group received the android smartphone app Diaguru	Pre and post test results were reviewed for the quality of life using the same WHO QOL BREF Questionnaire at the end of six months	Improved quality of life with mobile app intervention	**Limitations**: Fixed sample size. Non-scientific calculation of sample size **Strengths**: Randomized study. Use of pre and post test quality of life questionnaires

Citation	**Design/level of evidence/ purpose**	**Sample**	**Intervention**	**Measurable variables/ instruments**	**Findings**	**Strengths/limitations/ implications**
Tsunemi et al., 2021	Pilot Study Level: III	18 patients T2DM	Single arm pilot study using the Calomeal mobile app over the course of 3 months	HbA1c was the primary measurement. Secondary measures were bodyweight, lipids, and quality of life scores. The DTSQ and PAID administered to evaluate patient QOL at the beginning and end of the study	Improvement of short term HbA1c and BMI that were statistically significant. DTSQ and PAID improved but were not statistically significant at P=0.1063 and P=0.1361 respectively.	**Limitations**: Study design and small sample size in Japan, may have different dietary intake compared to eating habits in the United States. **Strengths**: Use of mobile applications with clear outcomes. Older population utilized self dietary management and tracking of T2DM.
Yap et al., 2021	Meta-Analysis Level: I	18 randomized controlled trials included	None	Technology-based psychosocial interventions (TBPIs) and diabetes distress, patient self efficacy, HrQoL, Hgb A1C	TBPIs reduced diabetic distress, and Hgb A1C. Improved patient self efficacy No significant change in HrQoL	**Limitations**: Multiple studies reviewed had small sample sizes. Studies reviewed related to HrQoL and depression were related to one study specifically. **Strengths**: High level of evidence with study design. Large sample size and number of studies included

Citation	**Design/level of evidence/ purpose**	**Sample**	**Intervention**	**Measurable variables/ instruments**	**Findings**	**Strengths/limitations/ implications**
Zurita-Cruz et al, 2018	Cross sectional study level IV	n=1,394 participants	Patients were classified into 3 groups according to their HRQol scores, those with scores 0-50, 51-75, 76-100 Depressive symptoms were defined as having a score of less or = to 14	The following variables related to quality of life were studied: age, sex, occupation, marital status, years of T2DM2 evolution, comorbidities, and presence of depression (Beck Depression Inventory). Perceived QOLwas measured with a health-related quality of life scale (HRQol) scale and a 36-short item Short-Form Survey (SF-36), the Shapiro-Wilk test was applied to determine the distribution of the quantitative variables also the chi test was used along with Shapiro-Wilk used for comparisons among the groups.	Identified factors: in physical function: increased age and depression were statistically significant factors. The emotional role, mental health and body pain include: depressive symptoms, duration of months of T2DM2, and number of comorbid conditions were also significant	**Limitations**: more women in the study, and the results should not be generalized to both genders as environmental factors may have been influenced by biological sex, Second they did not address the influences of genetic stratification. Third they did not address the possible participation of educational level and or socioeconomic status in the triad quality of life-emotional distress of T2DM2. **Strength**: Large number of participants, study occurred 3 years ago

Table E1.

Appendix G

Literature Synthesis Table

Study	Self-education, manage T2DM	Self- education to improve quality of life	Use of apps for self education for management of T2DM	Application use and cost analysis
Lavikainen et al, 2022,			X	
Hilmarsdottir et al, 2021			X	
Batch et al, 2021			X	
Smith et al, 2021	X			
Zurita-Cruz et al, 2018		X		
Gilmer et al., 2019				X
Nkhoma et al., 2021		X		
Sunil Kumar et al., 2020		X	X	
Tsunemi et al., 2021		X		X
Yap et al., 2021	X		X	

Table F1.

Appendix H

Pre/post Survey

Participant Statement of approval:

This is a quality improvement project being done to help us evaluate diabetic care and education using mobile apps at PACE. We are asking you to complete a survey before and following the use of diabetic tracking applications for a 3 month period. The project team is going to evaluate health data collected through the mobile applications. The data collected will be anonymous.

Participation in this survey is voluntary and you may refuse to answer any question. You may withdraw or stop participating at any time without consequence. By completing the survey, you are indicating your voluntary agreement to participate.

Please answer the following prompts:

What is your current level of experience with tablets and app use with technology?

1	2	3	4	5
Very Poor	**Poor**	**Fair**	**Good**	**Excellent**

Please rate your satisfaction with tracking information on the Glucose Buddy Diabetes Tracker application.

1	2	3	4	5
Very Poor	**Poor**	**Fair**	**Good**	**Excellent**

How would you describe your ability to use the Actel Joy tablet?

1	2	3	4	5
Very Poor	**Poor**	**Fair**	**Good**	**Excellent**

How would you describe your current quality of life?

1	2	3	4	5
Very Poor	**Poor**	**Fair**	**Good**	**Excellent**

How happy are you with your current health?

1	2	3	4	5
Very Unhappy	**Unhappy**	**Neutral**	**Happy**	**Very Happy**

I feel I have better management of my type 2 diabetes.

1	2	3	4	5
Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**

I know what my HbA1c goal is?

Yes NO goal_____

Figure G1.

Appendix I

Fish Bone Diagram

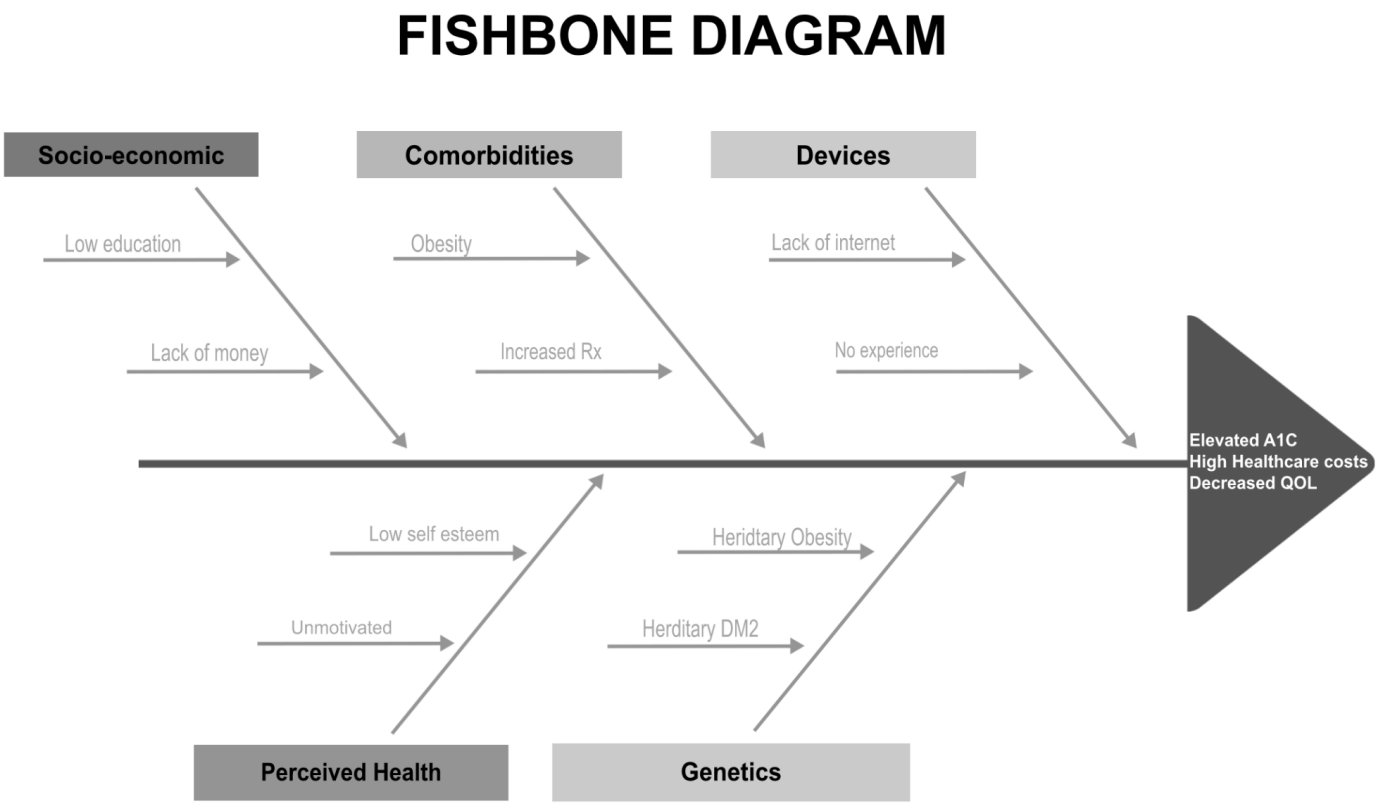

Figure H1.

Appendix J

Data Collection Tool

ipant	Care team	Weight	BMI	RN Visits	Race	Age	Day Center	Dialysis	Gender	Last A1C	Insulin	Meds	Education provided	Survey Pre	Survey Post
1	2														
2	3														
3	1														
4	3														
5	3														
6	3														
7	3														
8	2														
9	1														
10	3														
11	2														
12	2														
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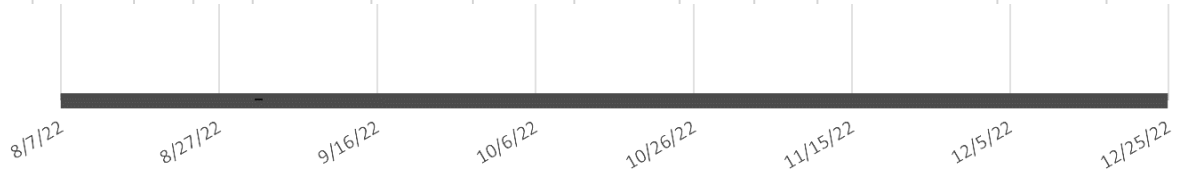

Figure I.1

Appendix K

GANTT Chart

Task 1: IT adding apps on tablets	DNP Students
Task 2: provide pre test to participants	DNP Students
Task 3: educate each participant on use and functionality of the application/ use	DNP Students
Task 4 : Obtain HbA1c levels in charts for September to mark for baseline	DNP Students
Task 5: review expectations with participants and staff in relation to QI project and goals	DNP Students
Task 6: follow up with participants monthly to identify barriers or implementation procedures that require fixing	NPs, Nursing Staff, DNP Students
Task 7: Update Medical director monthly on implementation process to quickly resolve and conflicts	DNP Students
Task 8 Gather HbA1c results in December if applicable	DNP Students
Task 9: Review with each participant the process, complete post assessment in December	DNP Students

Table J1.

Appendix L

HbA1c levels Pre/Post Intervention

N	Pre-HbA1c	Post-HbA1c	Age
1	10.5	6.7	74
2	10.4	8.6	78
3	10.3	6.6	74
4	8.2	8.6	75
5	7.7	7.6	55
6	7.6	6.7	66
7	7.3	6.6	66
8	7.2	6	55
9	6.9	6.7	66
10	6.7	6.6	76
11	5.5	7	77
12	5.6	6.2	78
mean	94.9/12=	83.9/12=	840/12=
AVG/Mean	7.91	6.99	70

Table K1. Average and Mean HbA1c pre and post project implementation.

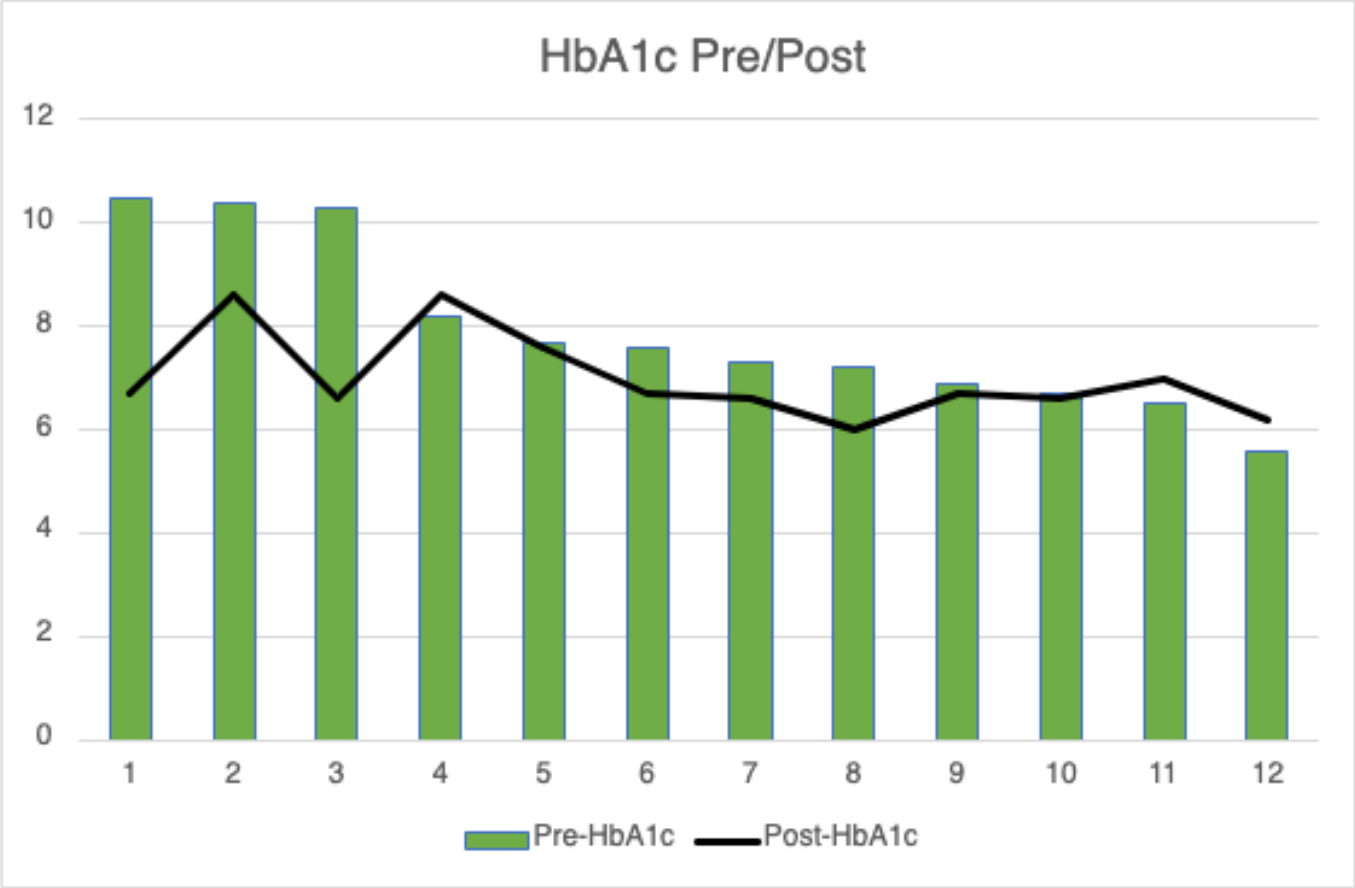

Figure K1. Graphical representation of HbA1c results pre and post intervention.

Appendix M

HbA1c Pre/Post Intervention Paired T-test

	Pre-HbA1c	Post-HbA1c
Mean	7.90833	6.99167
Variance	2.68447	0.71538
Observations	12	12
Pooled variance	1.69992	
Hypothesized Mean diff	0	
df	22	
T Stat	1.72216	
P(T<=t) one tail	0.04954	
T-critical one tail	1.71714	
P(T<=t) two tail	0.09907	
T-critical one tail	2.07387	

Table L1. Paired T-test results of HbA1c's pre and post intervention.

Appendix N

Question 1 Survey Results

N	Pre-survey	Post-survey
1	3	4
2	4	2
3	3	2
4	1	1
5	1	3
6	3	5
7	3	3
8	2	2
9	5	3
10	3	5
11	5	2
12	4	4
	37/12=	36/12=
AVG/ Mean	3.08	3.0

Table M1. Question 1: What is your current level of experience with tablets and app use with technology?

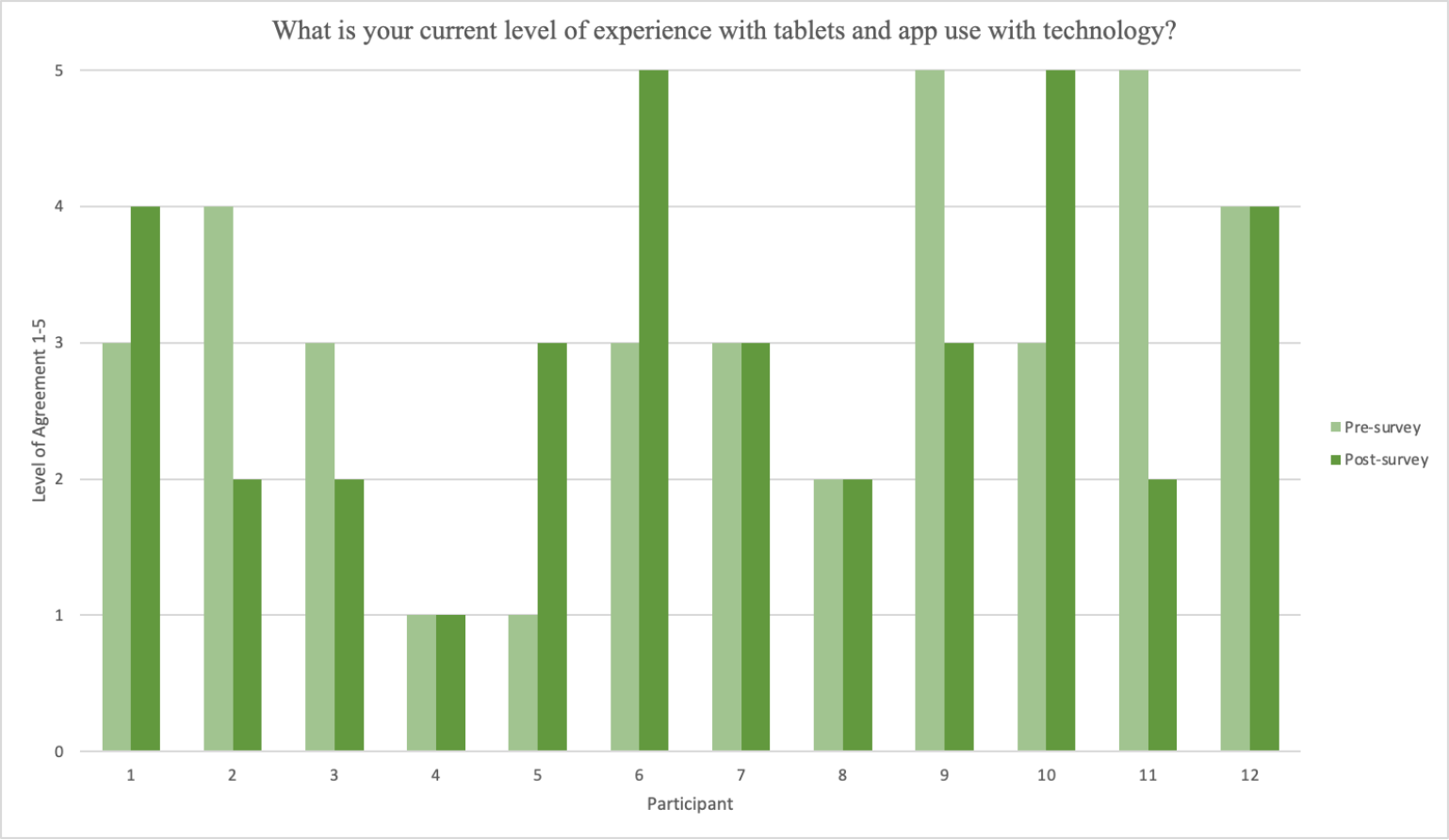

Figure M1. Graphical representation of question 1 pre and post survey responses.

Appendix O

Question 1 Paired T-test

	Pre-survey	Post-survey
Mean	3.08333	3
Variance	1.7197	1.63636
Observations	12	12
Pooled variance	1.67803	
Hypothesized Mean diff	0	
df	22	
T Stat	0.15758	
P(T<=t) one tail	0.43811	
T-critical one tail	1.71714	
P(T<=t) two tail	0.87623	
T-critical one tail	2.07387	

Table N1. Paired T-test results of question 1: What is your current level of experience with tablets and app use with technology?

Appendix P

Question 2 and 3 Survey Results

Glucose Buddy		Actel Joy Tablet	
N	Post-survey	N	Post-survey
1	3	1	5
2	2	2	3
3	3	3	3
4	1	4	1
5	3	5	3
6	5	6	5
7	4	7	3
8	1	8	2
9	4	9	5
10	1	10	3
11	3	11	2
12	4	12	4
	34/12=		39/12
AVG/Mean	2.8		3.5

Table O1. Question 2 and 3 Responses with AVG/Mean: Please rate your satisfaction with tracking information with Glucose Buddy and Actel Joy Tablet (Respectively). Note: these questions were not included as part of the pre-survey as participants had no prior knowledge of the tablet devices or mobile application.

Appendix Q

Question 4 Survey Results

N	Pre-survey	Post-survey
1	3	4
2	4	5
3	3	3
4	3	5
5	3	3
6	5	5
7	4	4
8	3	3
9	3	3
10	4	4
11	5	5
12	4	3
	44/12=	47/12=
AVG/Mean	3.67	3.91

Table P1. Question 4 responses with AVG/Mean: How would you describe your current quality of life?

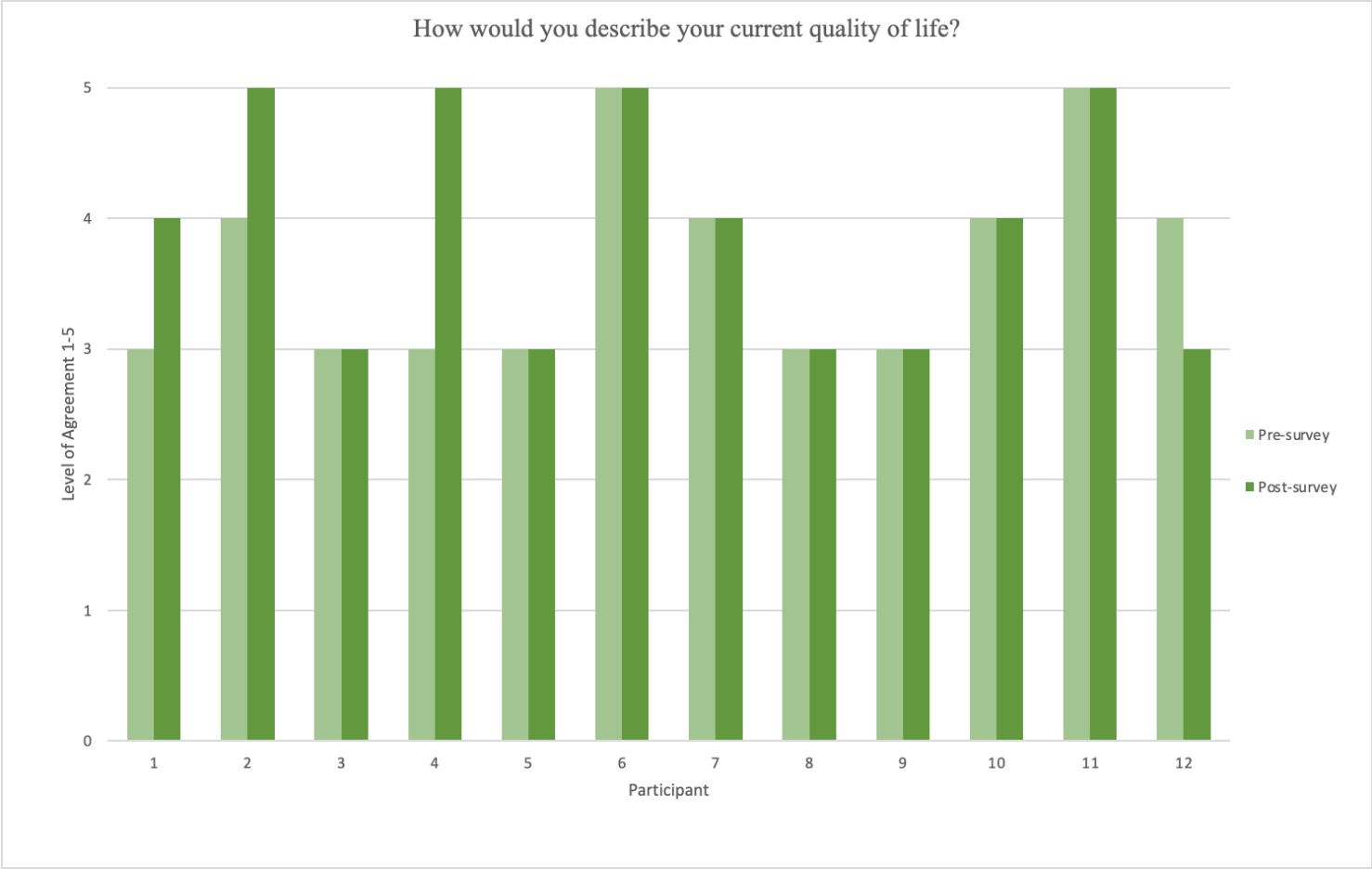

Figure P1. Graphical representation of question 4 responses.

Appendix R

Question 4 Paired T-test

	Pre-survey	Post-survey
Mean	3.66667	3.91667
Variance	0.60606	0.81061
Observations	12	12
Pooled variance	0.70833	
Hypothesized Mean diff	0	
df	22	
T Stat	-0.72761	
P(T<=t) one tail	0.23726	
T-critical one tail	1.71714	
P(T<=t) two tail	0.47453	
T-critical one tail	2.07387	

Table Q1. Paired T-test results of question 4: How would you describe your current quality of life?

Appendix S

Question 5 Survey Results

N	Pre-survey	Post-survey
1	3	4
2	4	4
3	2	3
4	2	5
5	3	3
6	5	5
7	3	4
8	3	3
9	2	3
10	4	4
11	3	5
12	3	3
AVG/ Mean	37/12=3.08	46/12= 3.83

Table R1. Question 5 responses with AVG/Mean: How happy are you with your current health?

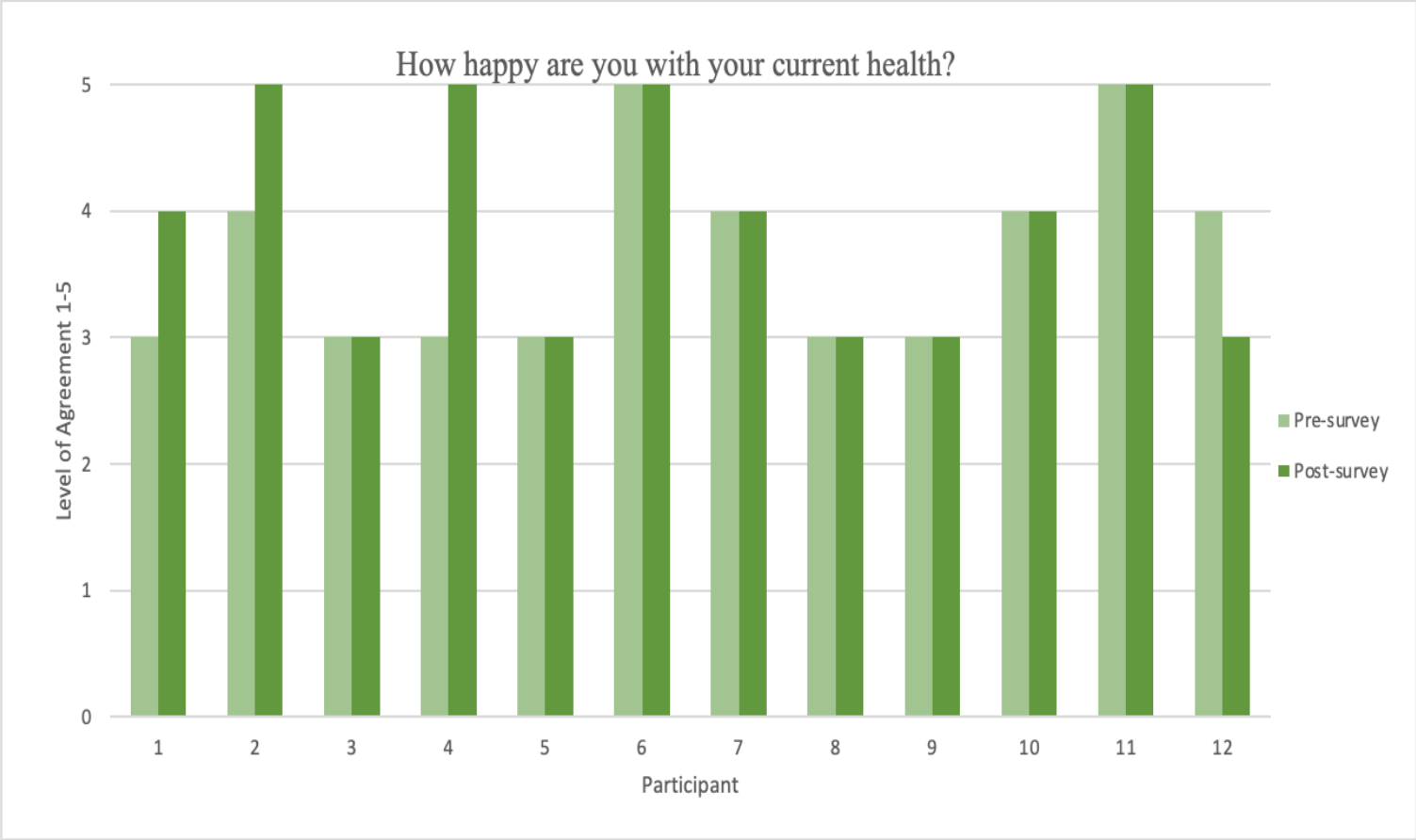

Figure R1. Graphical representation of question 5 responses

Appendix T

Question 5 Paired T-test

	Pre-survey	Post-survey
Mean	3.08333	3.83333
Variance	0.81061	0.69697
Observations	12	12
Pooled variance	0.75379	
Hypothesized Mean diff	0	
df	22	
T Stat	-2.11598	
P(T<=t) one tail	0.02295	
T-critical one tail	1.71714	
P(T<=t) two tail	0.0459	
T-critical one tail	2.07387	

Table S1. Paired T-test results of question 5: How happy are you with your current health?

Appendix U

Question 6 Survey Result

N	Pre-survey	Post-survey
1	3	4
2	1	4
3	2	3
4	3	4
5	1	2
6	5	5
7	3	4
8	3	3
9	4	4
10	4	4
11	3	5
12	4	3
	36/12=	45/12=
AVG/ Mean	3	3.75

Table T1. Question 6 responses with AVG/Mean: I feel I have better management of my type 2 diabetes.

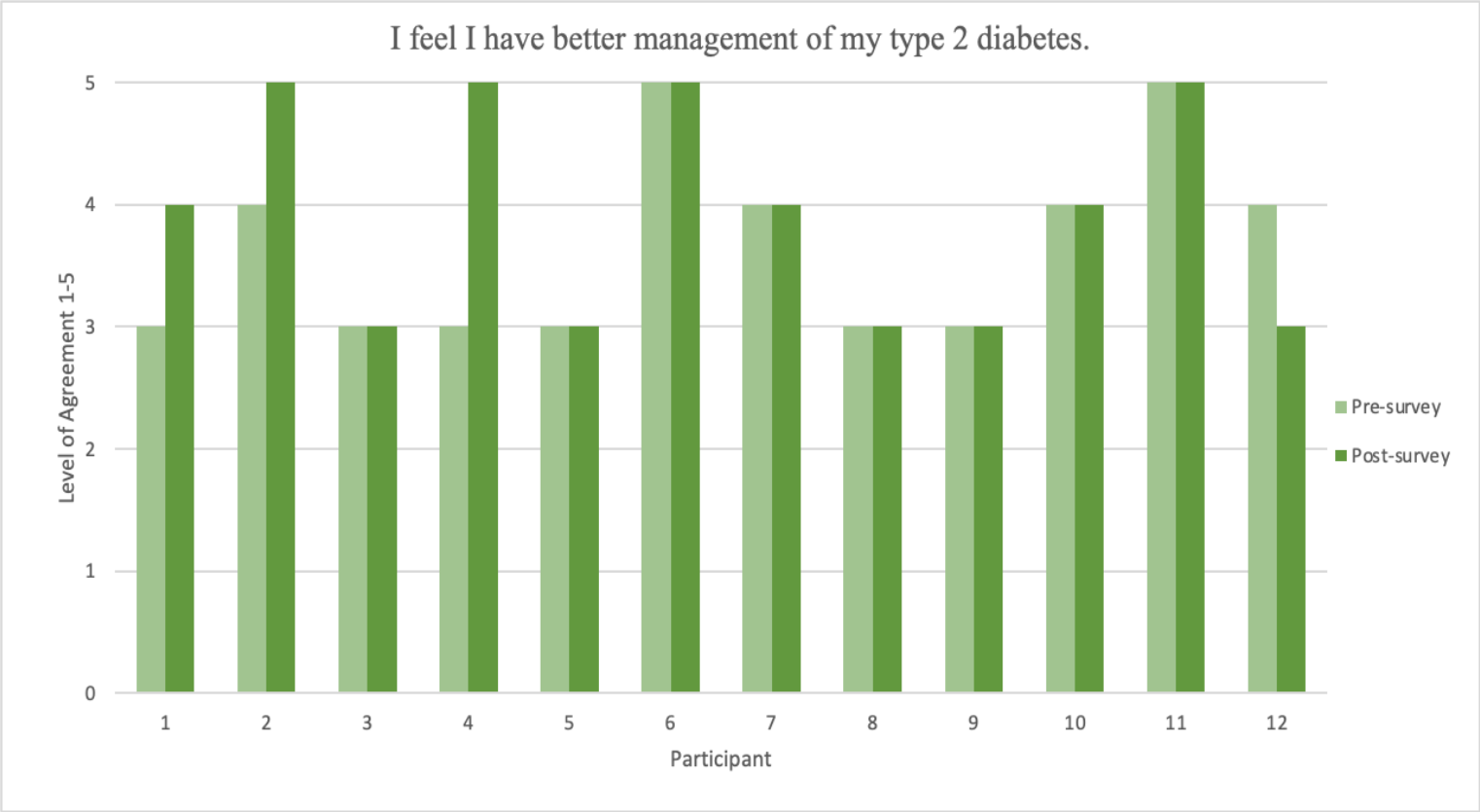

Figure T1. Graphical representation of question 6 responses.

Appendix V

Question 6 Paired T-test

	Pre-survey	Post-survey
Mean	3	3.75
Variance	1.45455	0.75
Observations	12	12
Pooled variance	1.10227	
Hypothesized Mean diff	0	
df	22	
T Stat	-1.74982	
P(T<=t) one tail	0.047	
T-critical one tail	1.71714	
P(T<=t) two tail	0.09409	
T-critical one tail	2.07387	

Table U1. Paired T-test results of question 6: I feel I have better management of my type 2 diabetes.