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An Interprofessional Prediabetes and Diabetes Self--Management Education Quality Improvement Project Among Vulnerable Populations at a Tuberculosis Hospital

Robert Saul Castro Natal
University of the Incarnate Word, castrona@student.uiwtx.edu

AN INTERPROFESSIONAL PREDIABETES AND DIABETES SELF-MANAGEMENT EDUCATION QUALITY IMPROVEMENT PROJECT AMONG VULNERABLE POPULATIONS AT A TUBERCULOSIS HOSPITAL

ROBERT SAUL CASTRO NATAL BSN, RN

DNP PROJECT ADVISOR

Maureen Rauschhuber PhD, MSN, RN, RNC-OB
Illa Faye Miller School of Nursing and Health Professions

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Abstract

Background: Patients greatly benefit from diabetes self-management education (DSME) as it boosts knowledge and self-efficacy, decreases body weight, fasting blood sugar, and hemoglobin A_1C levels, and improves overall health outcomes in a cost-effective manner. Unfortunately, many individuals with prediabetes and diabetes who qualify for DSMEs do not attend these classes nor receive sufficient prediabetes and diabetes support elsewhere to attain guideline recommended metrics. However, individuals from vulnerable populations and without DSME education experience disproportionate diabetes-related complications worsening health outcomes. *Aims*: Increase general prediabetes and diabetes knowledge, facilitate behavior change, improve glycemic, metabolic, and lipid values, and increase healthy dietary planning and physical activity among patients with prediabetes and diabetes. *Purpose*: Provide an interdisciplinary team DSME education program to patients at a tuberculosis hospital with diabetes and prediabetes in order to empower patients in self-management knowledge and skills in order to prevent or delay complications. *Objectives*: Review American Diabetes Association (ADA) medical care guidelines with providers, monitor changes to ordered dietary and medication regimens based on laboratory values as per guideline recommendations, reduce individual glycemic, metabolic, and lipid laboratory markers, improve patients' verbalization of guideline-supported dietary and exercise recommendations, increase patient recognition of signs and symptoms of dysglycemia along with its management, and increase aerobic and resistance exercise participation. *Interventions*: Provide a closed-caption television (CCTV) prediabetes and diabetes educational programming, conduct weekly DSME classes, initiate a walking and yoga exercise program, encourage online educational module learning, and reinforce class and CCTV interventions with prediabetes and diabetes infographic handouts. *Evaluation*: Monitor the

electronic health record for orders, laboratory results, and staff documentation of education and participation along with the use of patient surveys to assess changes in knowledge, motivation, and self-efficacy. *Practice implications*: Many studies have researched the effectiveness of DSMEs in many settings, but none have studied the application of this intervention in a long-term care setting among individuals from vulnerable populations who are experiencing an acute bout of illness. The findings from this quality improvement project will help establish the efficacy of implementing prediabetes and diabetes education programs in hospitals as this presents an opportune time to educate patients.

Keywords: diabetes mellitus type II, prediabetes, quality improvement, self-management, educational activities, educational assessment, health education, self-care, multidisciplinary health team, disadvantaged populations.

An Interprofessional Prediabetes and Diabetes Self-Management Education Quality Improvement Project Among Vulnerable Populations at a Tuberculosis Hospital

The initial idea behind this QI project came after a conversation with the Chief Nursing Executive (CNE) at the tuberculosis (Tb) hospital. She and the facility's registered dietician wanted to initiate a project to ameliorate a problem the hospital has been having with their diabetic patient population. According to the CNE and the registered dietician, the majority of the patients with diabetes have multiple hypoglycemic and hyperglycemic events throughout their 6 to 36 month hospital stay. This is a problem that has been long standing within the facility, and one that has been difficult to surmount since it is multifactorial in nature involving the staff and administrative factors.

Upon further inspection, there were unique reasons directly attributable to patients that further explain the fluctuations in blood sugar levels. The typical patient who is transferred to the Tb hospital is in a critical state of health. Their weakened immune system, fluctuating course of acute tuberculosis illness, and multiple uncontrolled medical and psychiatric comorbidities create difficulties and complications in the medical management of these patients. Further complicating this clinical picture is the fact that patients often arrive in various states of malnutrition. Their nutritional deficiencies coupled with an inability to tolerate consistent oral intake as a side effect of the intense Tb medication regiment makes establishing a steady nutritional schedule arduous. This presents a challenging situation for this patient population as dietary management is the cornerstone of diabetes treatment (Boocock et al., 2021). Moreover, the patients at the Tb hospital have numerous social determinants of health such as-educational deficiencies, limited health literacy, and language and cultural barriers that makes them highly susceptible to worse diabetes outcomes.

Because of the above issues, it is of outmost importance for patients at the Tb hospital to have the knowledge and skills necessary to successfully manage their own diabetes on a daily basis. Indeed, guideline recommendations and clinical expectations for any patient with diabetes is to bolster their diabetes self-management skills and knowledge with the use of diabetes self-management education (DSME) (Beck et al., 2017). The overall goal of a DSME education is to facilitate health behavior change through patient empowerment in order to improve diabetes health outcomes. The invaluable diabetes education is particularly important as many patients in the facility currently lack motivation and concern for their diabetes management. Thus, the patient population is highly unlikely to come into frequent contact with other healthcare systems, much less ones capable of providing a DSME education as there is a lack of providers skilled in DSMEs, and a significant portion of patients do not receive appropriate outpatient diabetes education (Chomko et al., 2016; Nassar et al., 2019). Therefore, this may be the only chance for the vulnerable prediabetic and diabetic population to receive vital diabetic self-care information, and hospital admission presents an opportune time for diabetes education (Nassar et al., 2019).

Statement of the Problem

Patients at the Tb hospital do not have the knowledge or experience necessary to manage their diabetes as evidenced by the multiple episodes of dysglycemia throughout their hospitalization effectively increasing their chances of adverse health outcomes.

Background and Significance

Described as one of the largest epidemics in the world, diabetes consistently ranks as one of the top global public health challenges (Zimmet et al., 2016). The statistics are not encouraging as more than 450 million individuals are living with diabetes worldwide, a number that has more than doubled in the past two decades alone and is expected to continue to rise

(Ogurtsova et al., 2017; Xia et al., 2020; Zimmet et al., 2016). Globally, its prevalence is estimated to surpass its current level of 9% within the next decade (Ogurtsova et al., 2017; Xia et al., 2020). In the United States, there are over 34 million individuals living with diabetes with an additional 7.3 million who are currently undiagnosed (National Institute of Diabetes and Digestive and Kidney Diseases [NIDDKD], 2020). In total, this makes up more than 20% of the U.S. population that is afflicted by this disease (NIDDKD, 2020). There are also an additional 88 million individuals in the United States with prediabetes, and many of them will go on to develop diabetes within the next few years as many are unaware of their clinical status (NIDDKD, 2020). In Texas, the percentage of the population diagnosed with diabetes, 10.6%, is higher than the national average with Bexar County having an even higher percentage given that 14.3% of adults are diagnosed with this disease (Texas Department of State Health Services, 2014).

Diabetes exerts a considerable toll on healthcare systems and individuals. The United States spent $237 billion dollars in direct medical costs with an additional $90 billion in reduced productivity (American Diabetes Association [ADA], 2018a). These expenditures are also shouldered by patients who pay more than double for diabetic care compared to other medical costs (ADA, 2018a). Patients are also saddled by a myriad of medical complications, comorbidities, and morbidity if their disease is not adequately controlled (NIDDKD, 2020; Rawshani et al., 2018). Diabetes also exerts a mental strain on individuals as the increased burden and stress in self-care makes them more likely to develop diabetes-related distress, depression, and anxiety (Wilson, 2021; Zabell et al., 2021). However, these complications are disproportionately shared among patients with diabetes who are minorities, from low socioeconomic status, have co-existing mental disability or illness, have limited education, and

are uninsured (ADA, 2019; Boakye et al., 2018; Kahkoska et al., 2021; Zabell et al., 2021). These individuals collectively receive limited services, support, and education in diabetes care worsening their health outcomes more than any other population group (Zabell et al., 2021).

Well respected organizations like the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC) suggest patient-centered education should be an essential component of chronic disease management (Xia et al., 2020). For individuals with diabetes and no DSME education, the stakes are high considering that they are four times more likely to experience complications from their disease (Mulala, 2019). Therefore, DSMEs offer an effective solution to patients through its comprehensive educational, psychological, and behavioral interventions that provide foundational skills necessary to manage daily diabetic self-care (Davies et al., 2018; Xia et al., 2020). Additionally, DSMEs have been shown to boost patients' knowledge in diabetes, increase self-efficacy, decrease body weight, fasting blood sugars, and hemoglobin A_1C, mitigate future complications, and improve overall health outcomes in a cost-effective manner (Boakye et al., 2018; Xia et al., 2020). Yet, despite national standards intended to assist those who implement DSMEs (Beck et al., 2017), there continues to be inconsistencies to their applications (Xia et al., 2020). Referrals have also remained historically low, which is why approximately 50% of patients who qualify for these services typically do not attend (Nassar et al., 2019). Patients with diabetes who do partake in DSME activities are typically not from vulnerable populations as vulnerable populations do not receive necessary DSMEs needed to sustain successful diabetic self-management (Fan & Sidani, 2018; Shaw et al., 2011).

There is a well-documented, unrelenting, and unsettling relationship between Tb and diabetes. One of the providers in the Tb hospital perfectly stated the significance of diabetes to

tuberculosis. The physician mentioned that "what HIV is to Africa is what diabetes is to the [Tb] hospital" (A. Vasquez, personal communication, October 29, 2021). Her comments were based on the fact that the number one risk factor for contracting Tb are conditions that weaken the immune system like diabetes and HIV (Liu et al., 2017). In 2020, diabetes was the most common reported risk factor for Tb in the United States as immunocompromised patients are three times more likely to develop Tb (CDC, 2021b; Ronacher et al., 2015). Along the Texas-Mexico border, where most of the tuberculosis cases arise in Texas, diabetes is a contributing factor in almost of a third of adult Tb cases and in over 50% of Tb cases in those 35 to 60 years of age (Restrepo, 2016). The commonalities between both conditions are not surprising given their strong association in persons facing social inequalities (CDC, 2020). The risk is even greater for individuals from vulnerable socioeconomic groups experiencing stress, homelessness, malnutrition, poverty, crowded living conditions, and those with other chronic conditions and behavioral disorders (Marais et al., 2013; Pereira et al., 2016).

The overwhelming worldwide iniquitousness of diabetes coupled with an increasing prevalence of Tb, mainly its drug resistant form, presents a neglected and re-emerging significant public health problem and a challenge to the control of diabetes and eventual eradication of Tb (Agarwal et al., 2016). Both conditions jointly complicate the diagnosis and management of each other as patients present with more severe clinical manifestations of either disease and are less responsive to the initial intensive four drug Tb regiment (Agarwal et al., 2016; Kapur et al., 2016). Individuals with Tb and poor glycemic control also have a twofold increase in developing adverse Tb treatment outcomes (Restrepo, 2016). These adverse outcomes include Tb treatment failure, developing drug resistant Tb, reactivation of active Tb from its latent stage, relapse with reinfection of Tb post treatment completion, delayed sputum conversions, and death (Salindri et

al., 2016; Shewade et al., 2017; Siddiqui et al., 2018). Irrespective of Tb, poor glycemic control alone, as evidenced by fluctuating blood sugar levels in hospitalized patients, impairs the body's counterregulatory mechanism further worsening health outcomes related to increased rates of infection, longer hospitalization, and mortality for this population group (Iqbal & Heller, 2018; Marín-Peñalver et al., 2016).

Assessment

Needs Assessment

The majority of the Tb patients with prediabetes and diabetes are part of multiple vulnerable population groups, which historically have worse access to medical care and subsequent outcomes as stated earlier. This is made apparent considering: 1) over 90% are either White, Hispanic, or African American with a 2:1 ratio, respectively, 2) over 80% are uninsured, 3) 76% are either homeless or have precarious living arrangements, 4) 38% do not have a high school diploma, and 5) 46% are unemployed. Likewise, many of the risk factors and conditions associated with prediabetes and diabetes along with disease related complications are present in this patient population as evidenced by 1) 82% are over 45 years of age, 2) 63% have moderate to severe malnutrition, 3) 25% have hypertension (HTN), 4) 63% have hyperlipidemia (HLD), 5) 44% have a history of depression, and 6) 50% are daily smokers. Extensive substance and alcohol abuse together with several mental health conditions within the sample further complicate outcomes as 85% of patients report experiencing stress, 69% report anxiety, and 54% have expressed feelings of depression since admission, and nearly all of the patients refuse engaging with the hospital's clinical psychologist and substance abuse counselor to address these problems.

There are other general statistics that are quite telling since all but one of the patients with prediabetes and one patient with diabetes are unaware of their diagnosis. Almost 70% of the sample does not understand the pathophysiology of diabetes. Even more worrisome is the fact that 60% of the diabetic and 100% prediabetic population were unaware of their own complications from poor glycemic control. Additionally, over half of the diabetic and 100% of the prediabetic sample are not confident or unsure of their current ability to manage their blood sugar levels. Similar findings were found for patients' motivational level in addressing glycemic control. Not surprising then that 50% of the diabetic sample has uncontrolled diabetes with A_1C's >7% and daily blood sugar time in range values under 30%. The majority of the sample population is also unaware of target blood sugar levels, cannot fully recognize hypoglycemic/hyperglycemic symptoms nor trouble-shoot its management, or identify proper dietary and physical exercise recommendations. Perhaps, the most convincing need for this project is that 85% of the sample reports never having received diabetes education from the hospital staff, and 100% report have never attended a DSME.

There are also a number of facility wide problems engendering the glycemic events at the Tb hospital that further compounds the deficiency in diabetes knowledge among its patient population. Despite diabetes being one of the top comorbidities at the hospital, there is lack of glycemic management policies as well as insufficient protocols to support staff in the care of patients with diabetes. There are also concerns expressed by the CNE and the Director of Nursing regarding the nursing staff's ability to manage glycemic events, a sentiment that was repeated among some of the nurses who feel unsupported by the absence of diabetes education within the hospital. This was further corroborated by the Director of Education who confirmed that it is the hospital's expectation for nurses and other staff members to receive their diabetes

education elsewhere. The hospital also no longer has a diabetes educator who could serve as additional support to patients and staff alike. This is why 50% of nurses report giving diabetes education to their patients either rarely or sometimes, and 70% would like for the dietary department to have more diabetes educational interventions for patients, which is difficult to accomplish as the hospital has a vacancy in this position.

There are other problems with work processes that worsen diabetic management like an inability of the staff and dietary department to monitor and enforce ordered diabetics diets. Nearly half of the nursing staff reports never or rarely observing what patients eat on a daily basis. As a consequence, patients are allowed to eat whatever and however much they want at any given time. The hospital is also ill-equipped to handle patients who are unresponsive to traditional glycemic interventions. This is largely due to the fact that its long-term care structure does not accommodate for multiple levels of acuity and a restricted formulary in the pharmacy. On occasion, the hospital's structural limitations have resulted in nurses calling 911 in order to have the patients' acute glycemic episodes managed at an outside facility. The practice of transferring dysglycemic patients with Tb creates unnecessary and unexpected costs for the hospital, straining the already limited budget it receives from the state legislature.

Organization Readiness for Change

There is support for this project from the hospital's administration since the CNE was considering instituting an educational diabetes project in the facility. There is also ample support from the dietary, behavioral, quality, and case management departments. Other individuals have also voiced their excitement regarding this educational project including the physicians, who freely offered to assist with publishing the results and the director of nursing. Many of these departments and groups of individuals have been calling for more patient engagement for which

patient education is well suited. Patient education is also a topic the hospital is currently focusing on with its nursing staff, so this project perfectly aligns with the administrative expectation of the hospital's staff. However, the one group of employees who have mixed opinion is the nursing staff as some want to be left alone in their nursing duties without administrative or third-party involvement while others welcome more assistance and support in patient care matters.

Project Identification

Purpose

The purpose of the QI project is to empower patients with knowledge and skills necessary to facilitate behavioral change so that they may be successful in their daily diabetes self-management.

Objectives

The objectives of the project are to:

1. Identify which diabetes guidelines are initiated and followed among admitted patients with prediabetes/diabetes and review with providers the 2021 American Diabetes Association's Standards of Medical Care in Diabetes (ADA) guidelines.
2. Monitor changes in provider ordered treatments regarding dietary and medication regimens from admission to post implementation among patients with newly diagnosed prediabetes/diabetes and those with established prediabetes/diabetes diagnosis per current ADA guideline recommendations.
3. Monitor changes in dietary orders and medication adjustments as a result to changes in metabolic lab markers.
4. Reduce individual glycemic markers among patients with diabetes and prediabetes to ADA guideline recommended targets.

5. Reduce metabolic and lipid values to ADA guideline recommended targets.
6. 75% of patients will be able to verbalize ADA guideline-supported exercise recommendation.
7. Increase aerobic and resistance exercises by patients participating in a yoga and/or walking activity for 30 minutes at least 5 days per week per ADA guidelines.
8. 90% of patients with diabetes and prediabetes will correctly verbalize signs and symptoms of hyperglycemia per ADA guidelines recommendations.
9. 90% of patients with diabetes and prediabetes will correctly verbalize provider ordered hyperglycemia dietary management.
10. 100% of patients with diabetes will correctly verbalize ADA guideline supported signs and symptoms of hypoglycemia.
11. 85% of patients with diabetes will correctly verbalize ADA guideline supported hypoglycemia dietary management.

Outcomes

By the end of this project, the anticipated outcomes are to:

1. Increase diabetes knowledge in 100% of the patients with prediabetes and diabetes.
2. Increase self-efficacy and self-care behavior as shown by patients reporting healthy eating patterns, increase physical exercise, and symptom monitoring.
3. Improve stress management in 100% of patients with a decrease in smoking and alcohol dependence.

Summary and Strength of the Evidence

DSMEs offer a practical solution to many of the problems related to glycemic control in a cost-effective manner with beneficial effects to clinical, psychological, and behavioral outcomes

(Powers et al., 2021). This is why the ADA recommends for primary care providers to offer patient-centered group or individualized DSMEs to patients with diabetes in order to improve diabetes self-management, health status, lifestyle behaviors, and quality of life (ADA, 2020a). Unfortunately, providers have not been consistently educating patients about DSMEs nor referring patients who qualify for such education (Alsayed Hassan et al., 2020; Nassar et al., 2019). Thus, DSMEs have traditionally been plagued with poor patient attendance as more than half of those referred do not engage in the educational services (Alsayed Hassan et al., 2020; Horigan et al., 2016; Nassar et al., 2019). To counteract these unfortunate trends, providers must become more involved with DSMEs as efforts to promote diabetes education and self-management are essential in order to reduce the personal and economic burden of diabetes (Horigan et al., 2016).

There are various clinical outcomes that are vastly improved when DSMEs are utilized to educate patients on diabetes self-management. One of these benefits is a reduction in A_1C, especially when a DSME is conducted by multiple providers in a multimodal and culturally appropriate manner (Ferguson et al., 2015). Systematic reviews conducted by Chrvala et al. (2016), Kumah et al. (2018), Carpenter et al. (2018), and the consensus reports by Power et al. (2021) repeatedly pointed to this finding with most studies indicating an average A_1C reduction of .45% to .57% and an absolute reduction in A_1C levels of .57% to .88%. Similar results were found when giving culturally appropriate educational sessions to vulnerable populations (Hildebrand et al. 2020). Putting the A_1C results into perspective, this is the equivalent to adding another diabetic agent to a patient's drug regiment (Chrvala et al., 2016). Other systematic reviews, like those from He et al. (2016), examined the relationship between DSMEs and mortality, and found reductions in all-cause mortality and delays in onset or worsening of

diabetes-related complications for participants. He et al. continued by stating that significant reductions in mortality were specifically seen in patients receiving repeated, in-person DSME instruction in a structured curriculum with greater than 10 contact hours. Alsayed Hassan et al. (2020) also found that classes with no less than 1 hour in teaching were better in retaining participation.

There are other potential clinical benefits to metabolic profile that can be seen with DSME instruction. Improvement in weight and body mass index (BMI) showed mixed results as Kumah et al. (2018) reports a few randomized controlled trials (RCTs) conducted by Adachi et al. (2013), Merakou et al. (2015), and Moncrieft et al. (2016) that showed significant reductions in BMIs with an average decrease of 0.7 kg/m^2 or weight loss of 1.22 kg. Similar conflicting results were found with lipid profiles as Merakou et al. showed reduction in triglycerides, 21.1 mg/dL, and low-density lipoproteins (LDLs), 10 mg/dL, levels, but another RCT by Carrasquillo et al. (2017) did not find any significant difference in these parameters. The RCT by McGowan (2015) did not clarify this relationship as high-density lipoprotein (HDL) levels slightly improved over controls, but no changes were observed with LDL levels. An RCT by Tang et al. (2015) interestingly found reductions in LDL levels, 15 mg/dL, and corroborated BMI findings from Merakou et al. as BMIs were reduced by 0.8 kg/m^2. However, such reductions were accomplished with peer-support groups among vulnerable populations that served as adjunct to DSME instructions. In addition, it should be noted that many of these studies were long-term in implementation usually 6-15 months, which will be quite different from the shorter interventions planned in this DSME project, which could potentially influence the results.

In addition to clinical outcomes, DSMEs improve emotional outcomes. The emotional involvement in diabetes care is known to cause diabetes distress (DD), a condition where people

experience feelings of stress, guilt, or denial that arises due to the burden of self-management (Evans Kreider, 2017). Diabetes related distress can eventually lead to clinical depression with all both conditions highly prevalent in patients with diabetes (Evans Kreider, 2017). In fact, major depressive disorder (MDD) is two to three times more likely in people with diabetes, however vulnerable populations with diabetes and depression have worse dysglycemia, health outcomes, and higher mortality rates (Evans Kreider, 2017; Murphy et al., 2018). More worrisome is that MDD can alter the effectiveness of DSME instruction (Schinckus et al., 2018). Therefore, providers should integrate psychological support among patients with diabetes (Schinckus et al., 2018).

DSMEs have been shown to provide such support as it improves psychological outcomes with the majority of studies showing positive results. The systematic review by Gutierrez et al. (2018) listed six out of eight studies with significant reduction in depressive symptoms like the RCT by Moncrieft et al. (2016) who showed a greater decrease in Beck Depression Inventory Score II by three points in minority patients attending an educational diabetes program. Likewise, an RCT by Wagner et al. (2016) showed a decrease in the percentage of Latino patients (54% vs 40%) classified as depressed according to the Personal Health Questionnaire (PHW-9) ($\alpha = 0.79$) after attending an educational diabetes plus stress management program. Within this same study, researchers were able to show a decrease in anxiety symptoms with small to medium effect size among participants in the educational plus stress management group using the PROMISE emotional distress/anxiety scale ($\alpha = 0.91$). The QI project previously mentioned by Fallas et al. (2020) also showed an improvement in depressions scores assessed through the PHQ-9 among Latinos attending a DSME. There are some dissenting studies with the most recent by Welch et al. (2015) that showed no significant difference in PHQ-9

depression scores after a diabetes education program involving the use of usual diabetes care with an internet-based program.

There are several core content areas and key behavioral aspects proposed by the American Association of Diabetes Educators (AADE) that serve as a framework for DSMEs and must be assessed among all patients with diabetes and prediabetes in order to improve outcomes (AADE, 2014). These include medication usage, healthy eating, physical activity, blood glucose monitoring, diabetes self-care-related problem solving, prevention and reduction of acute and chronic complication, and healthy coping (AADE, 2014; Beck et al., 2017). The available research does show some disparity regarding the ability for DSME to successfully address all of these areas.

One nonrandomized pilot study by Magee et al. (2014) found that medication usage and adherence even after discharge improved in patients undergoing a diabetes education program. The previously mentioned study by Wagner et al. (2016) found that self-care behaviors using the Summary of Diabetes Self-Care Activities (SDSCA) ($\alpha = 0.75$), which assesses physical activity, diet, blood glucose monitoring, and medication adherence, among others, did not significantly change among its participants undergoing a diabetes education plus stress management interventions. Nonetheless, this same group of participants did report an improvement in their perceived health status after the interventions. The opposite was found in an RCT conducted by Ruggiero et al. (2014) that showed sustained significant improvements over a 12-month period in diet, physical activity, glucose monitoring, and foot care using the same SDSCA among low-income African Americans and Latinos exposed to a diabetes coaching educational intervention. Yet, another randomized study by Toobert et al. (2011) found that minority women enrolled in diabetes education interventions had better problem-solving strategies, meal planning behavior,

and engaged in physical activity when assessed with the Diabetes Problem Solving Interview, Women's Health Initiative Food Frequency Questionnaire, and the Modified International Physical Activity Questionnaire. Although, these positive results were not sustained in the long-term. Finally, a systematic review by Thorpe et al. (2013) showed that healthy coping does improve in diverse populations subjected to DSME along with problem solving approaches and coping skills interventions. However, the authors did point out that more intensive and coping-focused efforts may be required for patients with type 2 diabetes in order to sustain long-term results.

If there is one thing that patients would benefit the most from this DSME QI project is an increase in their self-efficacy. Though, as evidenced by the above studies, implementing and sustaining behavioral change does prove difficult. This is why health education programs must utilize self-efficacy as part of any behavior-change strategy (McGowan, 2015). Further bolstering the need for self-efficacy are research findings showing that individuals with higher self-efficacy are better at managing their disease (Schinckus et al., 2018), which is an essential necessity and expectation with diabetes. There are also cost considerations that are associated with patients who are self-efficacious. Individuals who are better at self-management adhere to medication regiments and are more independent utilizing less acute care services and chronic healthcare resources (Mulala, 2018). This is partly because hospitalization rates and readmissions are attributed to knowledge deficits and lack of self-management skills (Nassar et al., 2019).

A multitude of systematic reviews and meta-analyses continually substantiate the efficacy of behavior interventions that effectively improve health behaviors (Delgado Bomtempo Batalha et al., 2021; Hildebrand et al., 2020; Odgers-Jewell et al., 2017). An RCT by McGowan (2015)

assessed both self-empowerment and self-efficacy through the Diabetes Empowerment Scale (DES) ($\alpha = 0.96$) in individuals attending a DSME with statistically significant DES scores seen at 12 months in addition to improvements in patient reported self-efficacy with regards to symptom and disease management. However, there were no improvements in relation to physical activity, number of visits to physicians or hospitals, or length of hospital stay. An RCT by Gamboa Moreno et al. (2019) showed that peer group support coupled within a DSME helped to increase self-efficacy scores per the Diabetes Self-Efficacy Scale particularly in the category relating to disease control. Unlike the study by McGowan (2015), physical activity did increase per the Physical Activity Recall interview along with a reduction in emergency room visits and the number of medications needed to manage comorbidities, however little was noted regarding dietary changes. Another RCT study looking at the effectiveness of an empowerment program among Hispanics with low educational attainment by Cortez et al. (2017) found a greater percentage increase in DES scores among the intervention group related to self-care and empowerment. It is interesting to note that a systematic review by Delgado Bomtempo Batalha et al. (2021) found that most of the behavior change interventions within their review were conducted by physicians rather than other health professionals with 12 studies showing significant improvements in self-management, self-efficacy, or both when these professionals were involved.

There are other unconventional interventions that have been studied among patients with diabetes that delivered similar educational content as traditional DSMEs. One of the more unique teaching methods was through the use of a video-on-demand cable television (TV) series with web-based lifestyle support tools offered through an interactive patient portal that patients could access anytime while at home (Ackerman et al., 2014). In this study, Ackerman et al. explored

whether such a convenient intervention would decrease body weight among patients with prediabetes. Results showed modest weight loss among its participants (Ackerman et al., 2014), although it should be pointed out that this patient population was the antithesis of the one at the Tb hospital, and many of the participants only partly viewed the videos or participated in the interactive web portals. Another study by Goessl et al. (2019) examined the effectiveness of digital versatile disc (DVD) or in-person, group diabetes prevention education among patients with low and high literacy. Results showed that participants in the DVD group and with higher literacy performed better with teach back questions and demonstrated greater comprehension by answering more questions correctly early on while those with low literacy had difficulty meeting teaching goals (Goessl et al., 2019).

Unfortunately, there are no studies evaluating the impact on clinical outcomes when using a TV to deliver diabetes education to inpatients (Nassar et al., 2019). However, another technology-based intervention studied with diabetes education involves the use of web-based programs (Powers et al., 2021). According to Nassar et al. (2019) and Hermann et al. (2020), engaging patients with technologies is another method of expanding the reach of diabetes education even in hospital settings as digital solutions have shown positive results and have the potential of improving the efficacy of DSMEs. The use of such tools also enables and promotes access for the ongoing management and support of its participants, which may overcome the challenges associated with the poor attendance that often plagues DSMEs (Pal et al., 2018; Powers et al., 2021).

A systematic review by Nkhoma et al. (2021) found that DSMEs assisted by digital tools improved A_1C levels by 0.48%, and increased diabetes knowledge. The majority of web-based interventions utilized patient portals and websites that provided educational and motivational

information (Nkhoma et al., 2021). Rice et al. (2017) recorded and streamed a series of educational and motivational films that patients could watch online. In those who watched the films, there was a significant decrease in A_1C levels, although there were large variations in the number of films watched (Rice et al., 2017). Another successful web-based intervention that supports lifestyle changes and boosts self-management and self-efficacy is online peer support groups. Hansen et al. (2021) and Liang et al. (2021) found significant improvements in all three areas, although individuals with higher education and less than 10 years with diabetes were more likely to enact lifestyle changes. Not all of the studies with web-based applications showed such encouraging data as some had more mixed results. A systematic review and meta-analysis by Hadjiconstantinou et al. (2016) mentioned multiple studies with significant improvements in distress and self-efficacy, however depression showed equivocal results showing both significant and nonsignificant improvements. Unlike Nkhoma et al. (2021), a Cochrane review cited small beneficial effects on blood sugar as A_1C levels changed by 0.2% in participants using computer programs (Pal et al., 2013). Minimal changes to metabolic endpoints were also seen regarding total cholesterol, HDL, and LDL levels along with no changes to body weight (Pal et al., 2013). Psychological outcomes also did not fare better as no improvements were noted to patients' reported depression or coping behavior (Pal et al., 2013).

According to the ADA, physical activity and exercise is part of DSME instruction as it plays a critical component in blood glucose management for individuals with both diabetes and prediabetes (Colberg et al., 2016). Even more so, exercise is fundamental to prevent or delay diabetes-related complications (ADA, 2018b). Unfortunately, the majority of patients with diabetes are not active, exhibiting lower values of energy expenditure, number of steps, and overall physical activity (Fagour et al., 2013). Furthermore, there are certain characteristics that

tend to predispose individuals with diabetes to physical inactivity. Individuals who are less likely to perform physical activity fall into the following categories: 1) female, 2) low educational level, 3) live in poorer areas, 4) overweight or obese, and 5) Hispanic and African American (ADA, 2018b). All of these characteristics are well represented within the sample population at the Tb hospital justifying some sort of exercise program within this DSME QI project.

One aerobic activity that is largely underused among patients with diabetes yet highly effective is walking (Moghetti et al., 2020). An RCT study by Fayehun et al. (2018) found a reduction in A_1C among African American with type two diabetes prescribed a walking intervention even in those not achieving target steps. A systematic review by Moghetti et al. (2020) evaluated 20 RCTs concluding that walking reduced A_1C levels on average by 0.50% with statistically significant results, specifically, when the activity was supervised. Identical results were found by Qiu et al. (2014) in their meta-analysis. Both of these studies also found reductions to BMI, 0.91 kg/m^2, and diastolic blood pressure, 1.97 mmHg (Moghetti et al., 2020; Qiu et al., 2014). The studies differed slightly in other metabolic and cardiovascular outcomes. The Moghetti et al. study stated there was insufficient or inconsistent evidence regarding walking's effect on systolic blood pressure, lipid profile, and changes to insulin resistance, while the Qiu et al. study reported a nonsignificant decrease to systolic blood pressure and no changes to HDL and LDL levels. However, walking is not the only exercise proven beneficial among patients with diabetes.

In addition to aerobic exercise, the ADA further recommends for adults with diabetes to perform resistance exercises to improve glycemic targets and health outcomes (Colberg et al., 2016). Another viable option for patients with diabetes and prediabetes is yoga as it combines flexibility, balance, and resistance activities all in one (Colberg et al., 2016). Among leisure

activities, the systematic review by Pai et al. (2016) found that yoga was the most effective at lowering A_1C levels on average by 0.6%. Another systematic review by Jayawardena et al. (2018) further corroborates yoga's effect on glycemic control as significant reductions in fasting blood glucose, 15.2 mg/dL, post-prandial blood glucose, 28.7 mg/dL, and A_1C levels, 0.39%, were observed. Another systematic review by Innes and Selfe (2016) also showed similar results related to glucose control as the majority of the studies reported statistically and clinically significant results.

Yoga also has other beneficial effects. Metabolic effects were seen in a 3-month randomized trial by Shantakumari et al. (2013) that found participants who performed yoga for 1 hour every day lowered their total cholesterol, 25.3 mg/dL, triglycerides, 21.7 mg/dL, and LDL, 24.2 mg/dL, while improving their HDL levels, 2.5 mg/dL. However, Jayawardena et al. found no significant differences in lipid profiles in any of the studies reviewed. One last benefit to yoga centers around its psychological effects. A 6-week RCT by De Manincor et al. (2016) found significant reduction in depressive symptoms assessed through various scales like the Depression Anxiety Stress Scale and Kessler Psychological Distress Scale, among others. However, minimal differences were noted to anxiety levels between intervention and control groups. A meta-analysis by Hofmann et al. (2016) did find improvements in anxiety levels among participants using various scales like the State Trait Anxiety Inventory and Beck Anxiety Inventory, although greater anxiolytics effects were seen with individuals with elevated anxiety levels. Despite multiple studies, the optimal frequency and duration for individual yoga sessions is not clear, however, at least one 60-minute session per week is necessary to improve depression and anxiety (De Manincor et al., 2016).

Methods

Project Interventions

A 3-month calendar was created with each week individual designated under a particular theme. These themes correlated with the usual topics that are discussed in DSMEs, which included the pathophysiology of prediabetes/diabetes, risk factors for these conditions, medication utilization and symptom management, glucose self-monitoring, exercise and dietary recommendations, stress, anxiety, depression, and how to cope, foot care, and problem-solving skills. Each week a live 60-minute DSME class was held between the project lead and one of the hospital specialists covering the assigned theme for that week. Patients were allowed to ask questions and given time to express concerns in a support group like environment. Once all of the topics were covered, the theme was repeated again in the same succession until the project terminated 3 months later. Attendance was recorded with each class.

A diabetes themed CCTV program was planned as a joint effort between the project lead, various hospital subject specialist (physicians, clinical psychologist, substance abuse counselor, etc.), and a third-party member who would assist with the audio-visual component. This programming was intended to mirror the same DSME topics that were taught in the live sessions with each subject specialist presenting their respective sections. Once recorded, the programming would be streamed 24-hours a day into the televisions in patients' rooms. Staff would encourage and remind patients to tune into the channel to learn about prediabetes/diabetes management at their own leisure. This programming would also be recorded in both English and Spanish. Patients would later be asked the frequency of their viewing during informal interviews planned at the end of the project.

A walk-a-thon competition was coordinated with the recreation team to occur during the entirety of the project. One of the hospital's outside grounds was sectioned off into a track with markers to aid those completing their laps. Patients were also given a map depicting the track to further assist them when exercising. The map also included a helpful equation that would allow patients to easily keep track of their laps, as one lap was equivalent to a quarter mile. Nurses would, in turn, keep a running tally of the patients' walking efforts on a master spreadsheet that was created and located in the nursing station. In addition to the walking intervention, 30-minute weekly yoga classes were held and directed by one of the recreation team members with each team member documenting patient participation in the electronic health record (EHR).

One department within the hospital grounds was converted into a patient resource area. This department was to serve as an educational center where patients could learn more about prediabetes and diabetes while receiving online community support using computers to visit various websites from national organization like those from the ADA and AADE, and local programs like the San Antonio Metropolitan Health District Diabetes Prevention and Control Program. The web addresses to all of these sites were provided in a manual located in the resource area. To keep track of computer use, patients would log in their times on a signing in sheet with their activities verified by looking at the web history on the computers.

Every week, the bedside nurse assigned to a patient with diabetes or prediabetes reviewed and handed each of these patients an infographic card that briefly covered the DSME topic that was scheduled for that week. With this one-on-one intervention, nurses were able to address questions and tailor the information that is specific to the patients' knowledge needs and educational deficiencies as it relates to the DSME topic for that week. In order to keep track of these educational interventions, a diabetes education assessment sheet was created where the

nurse who addressed the infographic topic would record their brief session as completed. On the other side of this sheet, there were questions regarding general diabetes knowledge and self-care abilities that the patient was asked prior to the initiation of the interventions to establish an educational baseline.

Setting and Population

The setting of this project took place in a hospital that has been specializing in Tb care since 1953. Located in south central, Texas, the tuberculosis hospital is designated as an acute care public health facility operating under the Texas Department of State Health Services (DSHS). Despite its acute care designation, as defined by the DSHS, the hospital actually operates as a long-term care facility accepting patients from all over the United States and internationally. However, the majority of the patient population treated at the facility are from the continental United States. Although the hospital would prefer to care for all patients with Tb, admission to the facility is restricted since the hospital is not able to jointly accommodate care and services necessary in other comorbidities. The actual location for most of the interventions were within the first floor of the main hospital building, in patients' rooms, and in the common meeting areas. On occasion, some activities, like those requiring physical exercise, took place on adjacent hospital grounds.

The sample population in this QI project focused on all admitted adults with diabetes and prediabetes. This population was largely composed of Hispanic and African American minorities with multiple social determinants of health, limited financial means and resources, limited health literacy and formal education, and are uninsured, which makes them highly susceptible to poorer diabetes outcomes and increases their morbidity and mortality (Zabell et al., 2021). Because of their vulnerable population status, many have received limited services, support, and education

in diabetes care (Zabell et al., 2021). This is why this population is admitted with a host of uncontrolled conditions like HTN, HLD, anemia, diabetes-related complications (neuropathy, nephropathy, retinopathy), hepatitis, HIV/AIDS, psychiatric illness (depression, bipolar, schizophrenia), malnutrition, and alcohol, tobacco, and illicit polysubstance abuse along with diabetes. Almost the entire sample's age was between 30 to 69 years with twice as many individuals in the 50 to 69 years group than the 30 to 40 years group. Language wise, English was the predominant language spoken with only three patients being bilingual in English and Spanish, and three speaking Spanish-only.

Barriers and Facilitators

There were various barriers involving patients, staff, administration, and other extraneous factors that complicated each intervention. The COVID-19 pandemic was perhaps the greatest factor impinging on all of the interventions. Because multiple patients and staff members became infected with COVID-19, the hospital went into complete lock-down around the time the interventions were to be initiated. As a result, in-person gatherings were strictly prohibited and all common areas, where various project interventions were planned, had been temporarily closed. This meant that the CCTV recordings, computer modules and online-communities, live classes, and exercises program were placed on hold for several weeks until the physicians and infectious control nurse reversed the hospital's policies on in-person gatherings delaying the project implementation by over a month. Other hospital and state regulations made implementing certain interventions difficult as well. For example, even though the latest ADA medical care guidelines were being reviewed with the provider as well as how their documentation changes in regards to these guidelines, state regulatory procedures prohibited implementing any changes to the EHR to facilitate documentation within the project timeframe. Some hospital resources also

made certain interventions suboptimal. For example, the hospital's Wi-Fi system makes it difficult to access the internet at times, and the cable television network fails at times.

Patient and staff motivation were another strong barrier against this project. There was a considerable lack of concern and interest from the patients' standpoint, which was expected as many did not have the knowledge necessary to assess the scope of their condition. Even now, some of the meetings between staff and patients do not have a great turnout for which the hospital often has to incentivize patients with prizes in order to increase attendance and participation. Therefore, motivating patients to take part in the planned interventions was difficult as many were apathetic to any medical intervention. Other patient barriers involved a recalcitrant attitude among some patients in the facility that conflicted with their active participation or follow project instructions.

There was also substantial ambivalence and apprehension from the nursing staff who expressed an equal lack of concern for the dysglycemic problem that engendered this project along with a despondent attitude regarding patients' ability in surmounting their diabetes educational deficiencies and self-management skills. Other staff barriers included turnover in positions that played active, key roles within the project. These vacancies meant that an alternate plan had to be created in order for the interventions to continue. Temporary vacancies were also created in other staffing positions when hospital employees were infected with COVID-19. The hospital needed to supplement, for example, contractor nurses who were not aware of the project details as they were not a part of the permanent staff.

Familiarity with certain activities and procedures helps to facilitate some of the interventions. From the patient's perspective, walking and yoga are activities that they partake in at the hospital, but not sufficiently enough to see beneficial results. Plus, every staff member

requested an activity program to keep patients busy. For staff, they routinely give Tb medication handouts to patients, so adding a diabetes component to this already established educational process was not something entirely foreign to them. The hospital's administration was also in complete support for a diabetes education program as it was pushing for more patient education among its staff members.

Ethical Considerations

In 2001, the Institute of Medicine (IOM) set forth six aims that healthcare systems should adhere when implementing quality improvement projects in order to meet national quality goals (Kadom et al., 2015). Beginning with patient safety, all patients should be protected from harm. None of the planned interventions and activities present physical nor psychological harm to patients nor are they physically taxing on the body. On the contrary, all of the interventions are fully backed by years of evidence-based practice and guidelines that have resulted in positive outcomes for patients, and, as such, have shown to be effective, which is another IOM aim. Patients' right to respect and privacy is another ethical issue that has been implemented across various domains. The Tb hospital's administrative committee has been involved ensuring that all paperwork utilized to collect patient data or disseminate to patients has received pre-approval. Even in-person communication with patients has required prior authorization to ensure patients' rights to privacy are respected. Voluntary consent is another big ethical consideration as no patient has been coerced into participating in any part of this QI project. Prior to initiating any conversation, patients are fully made aware of the intent of such communication and that their involvement is strictly voluntary without any form of hospital retaliation or change in treatment plan if they so choose not to participate.

Providing patient centered interventions is another IOM aim that is playing a heavy part in this QI project. As mentioned earlier, all of the participants have a combination of limited health literacy with additional language and cultural barriers. This is why all of the reading material is being made at an appropriate reading level and is being translated into both English and Spanish. Timeliness is an important aim that has received attention while designing this QI project. While some DSMEs occur every few months, the one that will be conducted at the hospital will occur every week for 3 months, and it will be offered both in person and as a pre-recording that patient can watch in their own private televisions. This greater frequency in classes and through various mediums is intended to maximize participation taking into consideration that patients will not always be able to participate in live classes.

None of the interventions are outside the scope of practice for any of the employees that will participate in this QI project. As such, these educational activities fall well within the hospital's expectation of employees delivering quality care to patients. Moreover, providing DSME is a cost-effective manner to provide diabetes education (Boakye et al., 2018). Therefore, the interventions are fulfilling another IOM aim of efficiency. Patient's values and needs have also been taken into consideration especially when patient surveys were utilized in the assessment phase of the project in order to gain an understanding of patient preferences. Finally, this educational QI project is being made available for free to anyone who would like to participate regardless of their personal characteristics or socioeconomic background ensuring that the IOM aim of equity is being achieved.

Results

Objective 1

All three providers were provided the latest guidelines from the ADA's Standards in Care 2022 in the form of a PowerPoint presentation. The providers had been utilizing guidelines from the ADA when managing patients with prediabetes and diabetes, however their charting was outdated given that one provider referenced 1999 guidelines while another used 2009 guidelines. Despite the update, providers did not immediately change their documentation in regard to the newest guidelines, although there was a noted increase in references to encouraging patients to improve their diet and increase their physical activity through yoga class participation and walking trail activity. It should be noted that the hospital policy concerning provider documentation only requires one note per patient per week. Therefore, noticing changes to provider documentation is a slow process due to the lower frequency of notes.

Objective 2

Table 1

Provider Changes to Hypertensive Medication Regimen According to Medical Indication

Medical Indication	ACE/ARB	CCB	BB	Diuretic
Admission				
Hypertension	0	1	4	2
Renal Outcomes	2	0	0	0
During Project				
Hypertension	0	2	3	0
Renal Outcomes	5	0	0	0

Note. ACE = angiotensin-converting enzyme blocker; ARB = angiotensin II receptor blocker; CCB = calcium channel blocker; BB = beta blocker.

Overall, providers appropriately managed antihypertensives regimens for most patients by either increasing dosing and/or adding second- and third-line agents for those patients with continued need for blood pressure control. Providers also decreased dosing and discontinued

medication throughout the project for those patients not able to tolerate ordered regimens because of hypotension or patient symptomology, as follows. One patient was initially placed on a BB because of chest pain complaints, an appropriate guideline supported choice in the setting of angina. Yet, the patient required further blood pressure control, so an ACE inhibitor and diuretic were added with eventual discontinuation of the diuretic agent due to hypotension. Both of these antihypertensives were suitable additions per ADA's cardiovascular disease and risk management guideline (2022a) in the setting of coronary artery disease concerns. There was one other patient on a BB due to heart failure (HF) and an ACE inhibitor for albuminuria prior to admission, yet, despite being placed on guideline-supported medications for each medical condition, both had to be discontinued due to continued borderline hypotension throughout admission.

Another patient was already on an ARB due to albuminuria history as well as a BB, however it was not evident, from a medical standpoint, as to why the patient had been placed on a BB prior to hospital admission. Providers within the hospital did attempt to add a diuretic as supported by ADA guidelines, but the medication was subsequently discontinued due to patient complaints of dizziness. Another patient had been similarly placed on a BB and a CCB prior to admission, although, again, this patient did not have an immediate medical indication for the BB. A diuretic was never attempted with this patient due to poor renal function, as expected, so the patient was subsequently placed on an ACE inhibitor to improve renal outcomes as supported by ADA guidelines (2022a). Two patients required the addition of an antihypertensive agent in the setting of albuminuria, so each had an ACE inhibitor initiated in order to improve renal outcomes as suggested by ADA guidelines. Finally, one patient did not have any renal indication or medical history suggestive for particular antihypertensive agent, so the providers appropriately

placed the patient on a CCB rather than an ACE inhibitor or ARB therapy. Table 1 illustrates the number of antihypertensive agents utilized in the sample population. As shown in the table, the biggest change to antihypertensive management was placing all patients who either had pre-existing or new evidence of albuminuria on an ACE inhibitor or ARB therapy as per guidelines. Those patients who did not have such indication were placed on alternate guideline directed therapy.

Table 2

Provider Changes to Statin Lipid Medication Management

Group	Not on therapy	Low Intensity	Moderate Intensity	High Intensity
Admission				
Prediabetes	5	0	1	0
Diabetes	8	0	2	0
During Project				
Prediabetes	5	0	0	0
Diabetes	6	0	2	2

The management of patients on lipid therapy was less consistent as not every patient with prediabetes and diabetes had lipid values assessed upon admission despite ADA guideline recommendations. Within the group with prediabetes, there was only one patient with a known history of HLD, and, because of their age, prior medical history, and several atherosclerotic cardiovascular disease (ASCVD) risk factors, should have been placed on a high intensity statin. Instead, the patient was placed on moderate intensity, which was later discontinued due to worsening renal status, a proper cautionary step. The remaining patients in this group did not require lipid lowering medication per laboratory values or major ASCVD risk factors indicators.

In the group with diabetes, only six out of 10 patients were assessed for lipid values upon admission. A possible reason for this could have been that the patients had this laboratory

examination performed at another facility prior to transferring to the tuberculosis hospital, yet reasons were not clearly evident in the providers' notes. Nevertheless, all of the patients with diabetes had an age range between 43 to 88 years. Therefore, the majority of these patients should have been placed, at a minimum, on moderate intensity statin therapy per ADA guidelines even though only three of these patients showed a clear laboratory indication for statin therapy either through elevated cholesterol, LDL, and/or triglyceride levels. Table 2 shows the number of statins prescribed by providers categorized by therapy intensity. As the table illustrates, six patients with diabetes were never placed on any moderate or high intensity statin therapy as suggested by guidelines given their diabetes status, age, and/or multiple ASCVD risk factors. There was one patient above 75 years of age who was not tolerating the bile acid sequestrant that had been ordered prior to admission. However, because of clear laboratory indication and longstanding diabetes and HLD history, the patient was correctly switched to moderate statin therapy instead. Out of the remaining patients on statin therapy, one was newly placed into a high intensity therapy while another remained on moderate intensity therapy. The remaining patient on statin therapy was switched from moderate to high intensity. However, because of their very high-risk ASCVD history and continued LDL levels ≥70 mg/dL, the patient should have also been considered for additional LDL lowering medications per ADA recommendations. It was unclear, after reviewing provider notes, whether this was ever considered.

Table 3

Provider Changes to Aspirin Therapy for Cardiovascular (CVD) Risk Management

Group	Not on Therapy	On Primary Prevention	On Secondary Prevention
Admission			
Prediabetes	4	0	2
Diabetes	4	5	1
During Project			
Prediabetes	4	0	2
Diabetes	4	5	1

Table 3 shows the number of patients on or off aspirin therapy along with the medical indication for such therapy. Collectively, there were no changes observed between the start and end of the project regarding CVD risk management with aspirin therapy for either primary or secondary prevention. Among those with prediabetes, three patients had an indication for aspirin therapy as part of secondary cardiovascular prevention per ADA guidelines, either because of a prior cerebrovascular accident (CVA) or deep vein thrombosis history. However, one of these patients had multiple falls throughout their hospital stay and, due to this high risk, was correctly deemed inappropriate for aspirin therapy by providers.

Unlike the group with prediabetes, patients with diabetes were managed less consistently according to ADA guidelines. There were two patients on primary prevention, however, because both had risk factors for increased bleeding (renal disease and age >70 years with frequent falls), it would have been more suitable to discontinue aspirin therapy as suggested by guidelines. Three patients were on appropriate primary prevention due to age >50 years and ASCVD risk factors (HTN, HLD, or albuminuria). Two other patients were not placed on aspirin therapy, as suggested by guidelines, because of either advanced age (>70 years) or there were no identified ASCVD risk factors. On the other hand, there were two patients with ASCVD risk factors (HTN,

HLD, and smoking) with no contraindications that could have benefitted from primary prevention, but were subsequently not placed on aspirin therapy. The lone patient with significant ASCVD history was correctly placed on aspirin therapy as part of secondary prevention per ADA guideline recommendations.

Table 4

Provider Changes to Dietary Management per ADA Guidelines

Group	Regular Diet	Renal Diet	ADA Diabetic	Consistent Carbohydrate
Admission				
Prediabetes	6	0	0	0
Diabetes	4	0	5	1
During Project				
Prediabetes	4	1	1	0
Diabetes	3	0	4	3

It should be noted that providers often do not place patients immediately on a specialized diet since many are admitted emaciated, severely malnourished, and/or underweight. It is only after patients improve physically and clinically that providers transition to more relevant, specialty diets. Table 4 enumerates the number of patients prescribed a regular or specialty diet. As shown in the table, the majority of patients with prediabetes started and remained on a regular diet. Only two patients in this group later developed complications that required making dietary changes. For example, one patient continued to deteriorate from a renal standpoint, hence their meal plan was changed to a renal diet. The other patient's blood sugars became wildly uncontrolled due to steroid therapy necessitating a change to an ADA diet. Both of these dietary changes were supported by ADA guidelines for patients with kidney disease and hyperglycemic management when fluctuations in glycemic control should initiate an immediate change in diet (ADA, 2022b; ADA, 2022c).

For patients with diabetes, dietary management is more complicated given that multiple studies examining the ideal amount of carbohydrate intake are inconclusive nor has there been an established ideal percentage of calories that should come from carbohydrates, proteins, and fats (ADA, 2021d). For patients receiving care in a hospital, the ADA does support the use of consistent carbohydrate meal plans in order to facilitate insulin dosing and carbohydrate consumption (ADA, 2022c). To this end, the hospital has two different diet orders for patients with diabetes: the traditional kcal ADA diet that does not consider the unique nutritional requirements of each patient and the newer consistent carbohydrate diet that creates an individualized carbohydrate meal plan for each patient. Out of the four patients with diabetes who were initially placed on regular diets, only one was switched to a standard ADA diet. The sole patient who started with a consistent carbohydrate diet remained on such diet throughout the entire project. Out of the five patients who began on an ADA diet, two were eventually transitioned to a consistent carbohydrate diet while the other three remained on their original diets. As shown in Table 4, seven of the 10 patients with diabetes ended up with some form of a carbohydrate-controlled diet, which was an improvement from the original six patients on a similar diet.

Objective 3

Tracking dietary changes due to metabolic markers like blood sugar levels in patients with prediabetes was difficult seeing how the majority of the sample, four out of six, did not have regular blood sugar checks. One patient in particular, though, had such an enormous deterioration in blood sugar control (daily >300 mg/dL), due in large part to steroid therapy, that their diet was quickly changed to an ADA diabetic diet, which did little to assist their glycemic control. Evaluating other metabolic indicators like individual lipid values was also not beneficial

as only three patients with prediabetes had lipid profiles assessed upon admission, none of which were remarkable. Looking at A_1C values was also noncontributory in elucidating any changes to dietary plans as all but one of the patients in this group had this lab value repeated. And, despite this patient's significant increase in A_1C (5.3% to 6.7%), severe renal complications overruled any diabetes concern, which is why a renal diet was ordered instead. However, this dietary plan was sufficient as this patient was able to increase the amount of blood sugars within range from 20% to 43%.

It was more difficult to evaluate changes to diet orders based on lipid markers in patients with diabetes as some of the patients with clinically relevant lipid values (cholesterol >200 mg/dL, triglycerides >170 mg/dL, LDL >170 mg/dL) were some of the best and worst in regards to glycemic control. Moreover, only one patient with dyslipidemia had their lipid markers repeated along with a change from an ADA diabetic diet to a consistent carbohydrate diet. This helped to produce an improvement in all lipid values and glycemic control as the majority of blood sugars were <140 mg/dL despite an increase in A_1C from 6.4% to 7.1%. Interestingly, out of the top five patients with the most hyperglycemic events (defined by the ADA (2022c) as blood sugars >180 mg/dL in hospitalized patients), three were on a regular diet, yet only two were transitioned to an ADA diabetic diet. This dietary change assisted in producing two favorable glycemic outcomes in one of these patients by increasing the time in range (defined here as the amount of blood sugars between 140-180 mg/dL) from 24% to 39% and decreasing the A_1C from 8% to 7.7%. The same effects were not observed on the other patient with the aforementioned dietary change as it decreased their time in range from 17% to 15% with an unknown effect to their A_1C and lipid values (labs not reassessed). The remaining three patients with the most hyperglycemic events were left on their original diets with the following

associated effects: a) the patient on an ADA diet decreased their time in range from 44% to 23% with an unknown effect on lipid values or A_1C (labs not reassessed), b) the patient on a regular diet maintained their A_1C at 7.7% but decreased their time in range from 29% to 18% with an unknown effect on lipid values (lab not reassessed), and c) the patient on a consistent carbohydrate diet slightly improved both their time in range from 16% to 18% and all of their lipid values but increased their A_1C from 7.9% to 9.2%.

The remaining four patients with diabetes had the least number of hyperglycemic events of which three maintained their original diets. One patient was on a regular diet with time in range dropping from 22% to 9%, however this was due to the majority of blood sugars being <140 mg/dL. There was another patient on a regular diet with similar results as their time in range dropped from 5% to 0% since all of their blood sugars were <120 mg/dL. For both of these patients, the effects on A_1C and lipid profile could not be determined since these lab values were not repeated. The other patient with an unchanged nutrition plan was on an ADA diabetic diet, yet their A_1C rose from 6% to 6.2%. Lipid values and time in range could not be verified for this patient since blood sugars checks were stopped and dyslipidemia was never determined on admission. The only patient who did have a change in diet, in this last grouping, went from an ADA diabetic to a consistent carbohydrate diet. Their resulting time in range was 27% with the majority of blood sugars <140 mg/dL, however dietary effects on A_1C could not be verified since this laboratory was not repeated and lipid profile was not assessed upon admission.

Overall, providers did monitor and tried to match dietary intake with glycemic control as stated by ADA guidelines, which is quite an arduous task at this facility as patients frequently have a change in oral tolerance due to the unavoidable, harsh effects of the tuberculosis medication regimen.

Table 5

Provider Changes to Oral Hypoglycemic Agents Based on Metabolic Markers

Group	Biguanides	Sulfonylureas	SGLT2	DPP4
Admission				
Prediabetes	0	0	0	0
Diabetes	9	0	2	0
During Project				
Prediabetes	0	0	0	0
Diabetes	8	1	5	2

Note: SGLT2 = sodium-glucose cotransporter-2; DPP4 = dipeptidyl peptidase-4 inhibitor

Table 5 shows the number of oral hypoglycemic agents prescribed in the sample. As is recommended by ADA guidelines, none of the patients with prediabetes were on any oral hypoglycemic agents as lifestyle modifications are considered first line treatment (ADA, 2020b). On the other hand, individuals with diabetes should be immediately placed on an oral agent as first-line therapy, preferably with metformin or in combination with an SGLT2 or glucagon-like peptide-1 agonist (GLP1) for patients with ASCVD or risk indicators for ASCVD, HF, or chronic kidney disease (CKD) (ADA, 2022f). The majority of patients with diabetes were started or continued on guideline supported metformin monotherapy or metformin and an SGLT2 dual therapy when managing continued hyperglycemia.

Throughout hospitalization, various patients required adjustments to oral hypoglycemic agents due to continued hyperglycemia. Among those patients with prediabetes, two patients in particular had dramatic shifts in their glycemic markers (blood sugar levels or A_1C), yet oral hypoglycemic agents were never initiated despite having a clear indication. One of these patients increased their A_1C from 5.3% to 6.7%, and, per ADA guidelines, should have been initiated on oral hypoglycemic therapy. However, the patient also has CKD with a low glomerular filtration rate (GFR) and albuminuria (>300 mg/g) creating difficulties in choosing an ideal oral agent. Because metformin is contraindicated in the face of poor renal status, the ADA's guidelines

suggest the use of an SGLT2 like Jardiance as it slows CKD progression (ADA, 2022b). A GLP1 like Victoza could have also been chosen as it does not require renal adjustments, slows CKD progression, improves renal outcomes, and reduces risks for CVD events (patient had a prior CVA) (ADA, 2022b). Why these medications or other types of hypoglycemic agents like insulin, which is indicated in hospitalized patients with blood sugars ≥180 mg/dL (ADA, 2022c), were not initiated was not documented by providers. The other patient with prediabetes who also had severe hyperglycemia with consistent blood sugars >300 mg/dL was placed on both short and long-acting insulins (see Table 6). Because this patient had inconsistent oral intake due to encephalopathy, the initiation of insulin therapy is warranted in this situation by ADA guidelines until nutritional intake improves and stabilizes (ADA, 2022c).

Like patients with prediabetes, those with diabetes also required modifications to oral hypoglycemic agents. There were two patients who had been placed on guideline recommended metformin, but therapy was discontinued for both patients due to gastrointestinal complaints. One of these patients was not trialed on another oral agent, though could have benefitted from an SGLT2 (due to albuminuria) since their blood sugars remained elevated and time in range dropped from 29% to 18% while having the fourth most hyperglycemic events in the sample. Rather, the patient was placed on both rapid and long-acting insulin therapy with frequent adjustments to compensate for dysglycemia. The other patient's metformin was switched to an SGLT2 with dosing increased due to continued poor glycemic control (A_1C climbed >9%). Furthermore, providers were unable to start beneficial injection modalities like insulins or GLP1s since this patient vehemently refused injections and wanted a simplified medication regimen. Hence, additional oral hypoglycemic agents using a DPP4 (intermediate efficacy) and a sulfonylurea (high efficacy) with no added CVD benefits (patient has history of HTN) were

chosen as next options. With increased dosing to both of these agents, there was a noted increase in time in range from 16% to 18%. It should be stated that the addition of a sulfonylurea was unusual since this patient had the second most hypoglycemic events in the sample.

There were two patients with diabetes not on oral hypoglycemic agents who were eventually started on metformin for initial therapy as recommended by ADA guidelines. One of these patients had adequate glycemic control with 100% of blood sugars <120 mg/dL. This was the best time in range out of the entire sample, without needing to adjust metformin dosing. The other patient also had adequate glycemic control with the majority of blood sugars <140 mg/dL. Good for the second-best time in range in the sample, but had the assistance of frequently dose-adjusted glargine as dual therapy to metformin. Another patient likewise was also on metformin and both short and long-acting insulin with dosing adjustments to all three medications to improve glycemic control since this patient had the third most hyperglycemic events. With this regimen, there was a noted reduction in time in range from 17% to 15%. The only other patient on metformin monotherapy did not require dosing adjustments since blood sugars were well controlled, majority were <140 mg/dL, good for the third best time in range in the sample.

There were two patients who started with metformin, but required the addition of an SGLT2 to further control blood sugar levels. And, even though one of these patients was also on short and long-acting insulin with the highest initial A_1C >10% prior to the addition of the SGLT2, the patient continued to have hyperglycemia with the most precipitous reduction in time in range value in the entire sample (44% to 23%) and the second most hyperglycemic events despite increasing dosing on all medications. The other patient also did not have an improvement in glycemic control despite the SGLT2 addition as there was an increase in A_1C from 6% to 6.2%. From the beginning, two patients were on metformin and SGLT2 dual therapy with dosing

increased to further control dysglycemia. The continued use of an SGLT2 was appropriate since one patient has a history of HF and CKD while the other has a history of CKD. However, one of these patients had a rise in A_1C value (6.4% to 7.1%) with eventual improvement in time in range when dosing was increased to both medications. The other patient had the most hyperglycemic events in the sample, hence the addition of a third agent, a DPP4. This addition helped the patient achieve the only reduction in A_1C value out of the entire sample. Although, a GLP1 like liraglutide would have been a better choice due to its higher efficacy, beneficial effects on the cardiovascular system, and improved renal outcomes (patient has a history of HTN and albuminuria) without the need for renal adjustment (ADA, 2022b). However, this medication class is not being utilized in the hospital, perhaps since it is cost prohibitive in this vulnerable population.

Table 6

Provider Changes to Insulin Class Based on Metabolic Markers

Group	Humalog (Rapid-Acting)	Lantus (Long-Acting)
Admission		
Prediabetes	0	0
Diabetes	6	7
During Project		
Prediabetes	1	1
Diabetes	3	4

Table 6 depicts the number of ordered rapid and long-acting insulins among the sample population. For most patients, providers correctly initiated rapid-acting correction sliding scale insulin (Humalog) and basal, long-acting insulin (Lantus) in patients with diabetes per ADA guidelines that had continued dysglycemia with either good or poor oral intake. Yet, how basal and rapid-acting correction sliding scale was matched up to control dysglycemia could have been improved. For example, five patients had initial poor oral intake necessitating either basal or

basal plus rapid-acting correction sliding scale insulin coverage per ADA guidelines. Instead, two patients were placed on rapid-acting correction sliding scale insulin only, which is discouraged by the ADA (2022c). The remaining three patients were correctly placed on either basal or basal plus rapid-acting correction sliding scale insulin regimens as suggested by guidelines. Two patients with consistent oral intake should have been placed on a basal, prandial, and correctional sliding scale insulin regimen as suggested by ADA guidelines, but were only placed on dual rapid-acting correctional sliding scale plus basal insulin. To be fair, because nutritional oral intake among patients is so variable within the hospital, as previously mentioned, prescribing a prandial, basal, and correctional sliding scale is rather difficult in practice. The remaining two patients had the same home regimen continued during hospitalization, which is supported by the ADA.

Eventually, changes to patient's insulin regimen were made with considerations to both nutrition intake and blood sugar readings. There were two patients whose rapid-acting correction sliding scales were discontinued once oral intake improved while blood sugar levels remained well-controlled (<140 mg/dL) with oral hypoglycemic agents. Two other patients who maintained good oral intake required different strategies. One of these patients had continued rise in A_1C values (6.4% to 7.7%), which necessitated increasing the frequency and dosing of both rapid-acting correction sliding scale and basal insulin after a failed attempt with oral hypoglycemic agents. The other patient had both rapid-acting correction sliding scale and basal insulins discontinued once three oral hypoglycemic agents were added to their therapy with blood sugars maintaining <140 mg/dL. The two patients whose home regimens were continued had the frequency and dosing of both rapid-acting correction sliding scale and basal insulins adjusted up and down depending on blood sugar readings. Both of these patients had the second

and fourth most hyperglycemic events during the project and the first and second worst initial A_1C values. Another patient was on dual rapid-acting correction sliding scale and basal insulins and could have benefitted from continued use of insulins (A_1C >9%, fifth worst hyperglycemic events), but the patient refused further fingersticks and injection medications. One patient had been placed on additional basal insulin to assist with A_1C >10%, but, once additional oral hypoglycemic agents were added to regimen, A_1Cs decreased <8% and time in range increased to 39%. Despite these laboratory improvements, this patient had the most hyperglycemic events during the project. The last remaining patient had been having poor oral intake, so their basal insulin was adjusted up and down based on their blood sugars that were predominantly <140 mg/dL.

As is the case with oral hypoglycemic agents, patients with prediabetes are also not routinely prescribed insulin therapy. However, there was one patient whose glycemic control worsened after the initiation of high-dose steroids, as previously mentioned, that insulin therapy was necessary as recommended by ADA guidelines in hospitalized patients with blood sugars ≥180 mg/dL (ADA, 2022c). The patient could have also benefitted from oral hypoglycemic agents, but their inconsistent nutritional intake precluded the initiation of such therapy. The dosing for both the rapid and long-acting insulins prescribed for this patient were constantly increased with additional rapid-acting insulin administered on certain days to assist with dysglycemia.

Objective 4

Table 7

Change in Hemoglobin A_1C Levels

Group	Before Project	Post Project	Change in A_1C
Prediabetes			
Patient 1	5.3%	6.7%	1.4%
Diabetes			
Patient 2	7.7%	7.7%	0%
Patient 3	7.9%	9.2%	1.3%
Patient 4	6.4%	7.1%	0.7%
Patient 5	8.0%	7.7%	-0.3%
Patient 6	6.0%	6.2%	0.2%

Table 7 exhibits A_1C values for only six of the patients in the sample, mostly those with diabetes, who had these values repeated at the end of the project. It just so happened that these six patients had pre-ordered A_1C levels that coincided with the end of the project. The other patients in the sample had values pending either at a much later time frame set by providers when reassessing glycemic control for patients with diabetes or there was no immediate indication for reassessment (i.e., patients with prediabetes with no evidence of hyperglycemia). The table also shows the change in A_1C value that was calculated by simply subtracting the ending A_1C value from the initial one. As seen in the table, there was only one patient who managed to improve their A_1C value by 0.3%, while the majority had increases to varying degrees. Only one patient managed to maintain their A_1C value throughout the entire project. Curiously, patients were most interested in learning how their A_1C values changed, far beyond any other laboratory marker, as a result of their behavioral efforts.

Table 8

Time in Range Calculations per Blood Sugars Measurements

Group	0-10%	11-20%	21-30%	31-40%
Before Project				
Prediabetes	0	1	0	0
Diabetes	1	3	3	1
During Project				
Prediabetes	0	0	0	1
Diabetes	2	5	0	1

Table 8 shows the time in range for the majority of the project sample as there needed to be an alternate method of assessing glycemic control since over half of the patients did not have repeat A_1C values. Time in range was chosen since this parameter is utilized to assess glycemic control in patients with continuous glucose monitors (Advani, 2020), even though only one patient in the sample had such a device. The manner in which time in range was calculated involved summing the number of blood sugars between 140-180 mg/dL, determined by the ADA as the glycemic target for most hospitalized patients (ADA, 2022c), and then dividing that value by the total number of blood sugars taken during the same time period in order to arrive at the percentages seen in Table 8. Only patients with blood sugars before and during the project are displayed. Collectively, one patient with prediabetes was excluded since there were numerous blood sugars taken during the project when blood sugars went unstable, but none prior to the start of the project when blood sugars were not assessed. Only two patients with diabetes were excluded as one was admitted shortly before the project started and did not have blood sugars to compare too, and the other had blood sugars stopped during the project so there was no way to evaluate post values.

Out of the eight patients with diabetes, six managed to decrease their time in range. Three of these patients remained within the same percentage category, one managed to decrease by one

category, and two decreased their time in range by two categories. However, three out of these six patients displayed greater blood sugar control than that set by the ADA as the majority of blood sugars were <140 mg/dL, hence their poor time in range calculations. Only two patients displayed had an increase in time in range, one remaining within the same category while the other improved by one category. Therefore, five out of eight patients with diabetes (63% of the sample) showed some improvement in blood sugar control. The same can be said of one of the patients with prediabetes as they were able to increase their time in range by two categories.

Table 9

Number of Hyperglycemic and Hypoglycemic Events

Group	Before Project	During Project	Percent Change
Prediabetes			
Hypoglycemia	0	0	0%
Hyperglycemia	3	65	2,067%
Diabetes			
Hypoglycemia	50	5	-90%
Hyperglycemia	783	694	-11%

Table 9 shows the number of hypo- and hyperglycemic episodes before and during the project. This measure was chosen as these events were the initial impetus in pursuing this diabetes educational project plus dysglycemic events have such detrimental outcomes in those with diabetes further complicating medical management (ADA, 2022e). The percentage change formula was performed using [(new value-old value)]/old value] * 100% in order to arrive at the percentages depicted in Table 9. Within the group with prediabetes, there was a vast increase in the number of hyperglycemic events, which are all attributed to the one patient on high dose steroid therapy. There were no changes to the number of hypoglycemic events in this group before or during the project. In those with diabetes, both hypo- and hyperglycemic events decreased with the hypoglycemic events having the greatest observed change, a 90% decrease in

hypoglycemic events compared to the 11% decrease in hyperglycemic events. It should be noted that there was a paradoxical effect observed in the hyperglycemic events in patients with diabetes. Patients who were responsible for the most hyperglycemic events prior to the project managed to decrease these events during the project, while some of the patients with the lowest events prior to the project ended up having the most during the project.

Objective 5

Table 10

Change in Lipid Values

Lipid Panel	Before Project	Post Project
Cholesterol	155	123
High Density Lipoprotein (HDL)	63	45
Low Density Lipoprotein (LDL)	71	51
Triglycerides	103	133

Unfortunately, there was only one patient with diabetes who had repeat lipid values post project. Much like the issue encountered with A_1C values, there was difficulty in getting providers to repeat lipid markers. The same could be said about initial lipid assessment as four patients in the sample never had a lipid panel performed on admission, as previously mentioned. Table 10 illustrates the lipid markers for one of the patients in the diabetes group. This particular patient was switched from moderate intensity statin, pravastatin, to a high intensity statin, rosuvastatin. The change in medication assisted in improving cholesterol and LDL levels while decreasing HDL levels and increasing triglycerides. Overall, there was a mixed effect regarding lipid value improvements.

Table 11

Changes to Patient Body Mass Index (BMI)

Category	Before Project	Post Project
Underweight	1	1
Healthy Weight	9	8
Overweight	6	6
Obese	0	1

Table 11 represents the number of patients in the entire sample by BMI category. This parameter was chosen as another alternate method of assessing metabolic changes since lipid values could not be assessed on all patients. Furthermore, weight plays a large risk factor in diabetes development for those with prediabetes and is an integral part in the medical management for those with diabetes (ADA, 2022d) providing more support for its assessment. The majority of patients remained within their initial weight category at the end of the project. There were only two patients with diabetes that increased their weight, one moving from a healthy weight to the overweight category while the other moved from the overweight to obese category. The results showed that all but two patients were able to at least maintain their weights during the project with healthy weight being the predominant category.

Objective 6, Objective 8, Objective 9, Objective 10, and Objective 11

Table 12

Percentage of Patients Able to Verbalize Knowledge Post Educational Intervention

Questions	Prior Knowledge	Able to Verbalize Post Project	Not Able to Verbalize Post Project
Verbalize ADA guideline-supported exercise recommendations	27%	80%	20%
Correctly verbalize signs and symptoms of hyperglycemia per ADA guidelines	47%	77%	33%
Verbalize provider ordered hyperglycemia dietary management	40%	73%	27%
Correctly verbalize ADA guideline-supported signs and symptoms of hypoglycemia	53%	80%	20%
Correctly verbalize ADA guideline-supported hypoglycemia dietary management	53%	73%	27%

Table 12 shows the percentage of patients able to verbalize understanding the educational material provided after performing one-on-one sessions with each patient. Prior to these individual educational sessions, each patient was queried to assess any pre-existing knowledge in each subject matter depicted in Table 12. The majority of the sample had some partial knowledge regarding the topics chosen as seen from the percentages hovering between 47% to 53%. These percentages increased after patients were educated, although four out of the five educational topics did not achieve the set percentage goals (85-100%) in the original objectives. Only one question regarding the ADA exercise recommendations exceeded the original objective goal of having 75% of the sample recall the information. This was interesting since patients showed the least amount of knowledge in this topic prior to the education session. Around a quarter to a third of patients still had difficulty recalling the information provided for most of the topics. In

general, there was an increase in the amount of information understood by patients after performing one-on-one sessions with each patient.

Objective 7

Table 13

Number of Patients Engaged in Lifestyle and Behavioral Changes

Category	Before Project	During Project	Percent Change
Aerobic Exercise	8	9	13%
Resistance Exercise	1	6	500%
Following Diabetic Diet	2	5	150%
Smoking Incidents (inside)	4	2	-50%
Smoking Incidents (outside)	26	4	-85%
Smokers	8	5	-38%
Alcohol Incidents	7	0	-100%
Illicit Drug Use	2	0	-100%

Table 13 displays the number of patients engaging in various lifestyle and behavioral changes throughout the project. Half of the patients were already engaged in regular, consistent walking exercise several days per week. One additional patient managed to engaged in this activity because of the encouragement received during the project. There were also four additional patients who expressed interest in eventually engaging in a walking activity, however they were precluded from doing so during the project due to their physical debility brought about from their acute tuberculosis illness. To further encourage patients to walk, a walk-a-thon competition was created with the winner ultimately walking 111 miles in 3 months. There was also a greater increase in the number of patients performing resistance exercises, a 500% percentage change, as six patients regularly attended the programmed yoga classes. Another benefit of the yoga classes was that patients were observed by staff practicing stress management techniques like meditation outside of class.

Other behavioral changes reported by patients included an increase in the number of patients following some sort of diabetic diet, an increase from two to five patients. Two additional patients were very interested in learning more about improving their diet despite not making changes to their dietary habits during the project. Perhaps the biggest behavioral change, beneficial to both the facility and patients, was a reduction in the number of smokers as three patients managed to quit all together. Two patients reported decreasing the amount of smoking and eight patients reported an interest in quitting. Although, three patients did not report any changes to their smoking habit. There was also a noted decrease in the number of smoking related events both inside (50% reduction) and outside (85% reduction) the hospital, with the latter being particularly important and dangerous situation. Substance use also experienced a decrease in the number of events as there was a 100% decrease in both alcohol and illicit drug use among patients during the project. The patients initially involved in the alcohol and illicit drug use incidents abstained from such substances during the project and reported never wanting to use drugs and alcohol again.

Discussion

Summary of Project Outcomes

The most successful interventions were the one-on-one interactive sessions with patients. Several patients commented on how grateful they were with the staff in giving them this personalized time and attention as many of them do not have good relations with their own family members nor have very many people rooting for them in life. These individual sessions even helped uncover a dangerous situation involving one of the patients. This happened during the week that mental health and prediabetes/diabetes care was discussed. One patient felt so empowered after hearing the information that was presented that she was able to speak out about

the abusive relationship she has been enduring for the past 10 years with her husband. Although it was not the intent of this intervention to uncover individuals experiencing domestic abuse, this educational session was able to give this patient the permission to speak up and the strength and willpower to finally change her predicament. After this encounter with the patient, the charge nurse was updated on this new finding and the case manager and social worker were notified in order to provide the patient with the necessary support and resources.

Another important success, also relating to the educational interventions, was another week that substance abuse was discussed. Patients were more engaged with this topic more than any other, and it showed since there was a noted decrease in the number of smoking, alcohol, and illicit drug use within the hospital. This was a big win for the facility, most notably with smoking incidents, since this is such a polemic issue amongst the patients and staff. And the fact that the education was offered in both English and Spanish was very beneficial for the large Hispanic population treated at the facility as the providers in the facility expressed concern that any education provided should be able to accommodate both languages.

There were two big difficulties regarding implementing the CCTV and the computer lab interventions. Both of these interventions never came into fruition for different reasons. In regard to the CCTV intervention, there were too many components outside of the project lead's control that needed to come together in time in order for the hospital to approve it. Some of which involved a third-party member that went silent during the early phase of the approval process and was never heard from again. Unfortunately, this person was very important to the success of this intervention as they were going to handle the audio-visual component. Yet, because it was taking so long for all of the other pieces to come together, the hospital finally put this part of the project aside as there were other community projects eagerly awaiting approval. The hospital

representative who has been in charge of handling this intervention did state that she will resubmit this intervention in the fall during the next round of hospital approvals. The computer lab intervention experienced a delay in the beginning as the facility manager involved in the approval process resigned from their position and the hospital did not have someone to replace them until halfway through the project. After this intervention was finally approved, the hospital was able to procure the supplies and equipment necessary to move forward with this intervention. As this is being written, the hospital continues to work on prepping the future computer lab with a tentative completion date sometime in the early fall.

Another difficulty in project interventions were the classes. Only one patient attended the first week with no one attending classes for the remainder of the project. This was not surprising as diabetes DSMEs are incredibly unpopular state-side and worldwide. (Nassar et al., 2019). However, the one patient who attended was very pleased with the information received and even stated he would assist the staff in motivating other patients to come to the following classes, so it was a bit surprising that a better turnout did not ensue in the following classes. Motivation amongst the patients was also infectious as some of the hospital staff also had a lack of motivation to complete the one-on-one educational sessions with the patients. This meant the project lead had to step in to assist with completing the weekly educational material with each patient.

The main consistent changes that were seen were behavioral in nature, which is exactly what one wants to observe at the end of a DSME. After receiving the information in a DSME, the next step is for patients to assimilate this information into permanent knowledge at which point the knowledge can then be applied to enact permanent behavioral changes. These behavioral changes are the key to success that manifest as improved health outcomes in each

patient's diabetes management. The behavioral components most changed involved the increase in exercise and less reliance on substance use, namely smoking. Patients' ability to maintain their weight was also huge since food is exceedingly abundant at the facility and patients are well-known for hoarding food in their rooms. Therefore, their ability to maintain a healthy weight as the predominant category in the sample speaks highly in their efforts to sustaining a healthy nutritional lifestyle as dietary management is the cornerstone of diabetes management (Boocock et al., 2021).

Another behavioral change worth mentioning was a slight improvement in the medication refusal rate, a highly prevalent and challenging problem among patients with diabetes that is directly related to glycemic control (Batais & Schantter, 2016). During the project, there was a 9% reduction in medication refusals. Any positive change in regard to this problem is considered a success given that adherence to treatment prevents long-term complications thus improving health outcomes (Hashimoto et al., 2019).

One of the biggest strengths to the project was flexibility to mold the DSME to fit within the particular environment of the hospital. National standards regarding DSMEs have several topics that should be covered like understanding what diabetes is along with its treatments, importance of healthy eating and physical activity, taking medications and checking blood sugars, learning ways to cope, and several others (Beck et al., 2017). Yet, how one delivers such education is up to the instructors. In fact, these standards stress to be unique and different in how education is delivered (Beck et al., 2017), which is why multiple modalities were chosen in this project including classes, infographics and lecture handouts, and one-on-one instruction. To further exemplify the flexibility of the project, one can look at the success of the exercise interventions. Initially beginning as a walking trail exercise and weekly yoga classes, the hospital

has since added water aerobics and water walking classes, which have been wildly popular, with more unique classes to come thanks in great part to the recreation team members spearheading this campaign. Another example of flexibility are the live classes that, although will not be continuing at the present time due to staffing difficulties, the material that would have been covered in these classes will be converted into a series of pamphlets and handouts that staff will give to patients on a monthly basis as part of their mandatory patient education. This way the information will continue to live on in a different format. And, once the computer lab is fully operational, patients will be able to access even more educational information.

Relation to Other Evidence

A multitude of studies have investigated the changes to metabolic endpoints and its association to DSMEs. By far, the most studied metabolic marker has been hemoglobin A_1C, however the changes associated with this parameter could not be more dissimilar as some studies from Adam et al., 2018 and Jansink et al., 2013 report no changes in A_1C values, while others from Carpenter et al., 2018, Chrvala et al., 201, Kumah et al., 2018, and Power et al., 2021 report varying degrees of improvements post DSME instruction. If a positive change is to occur, these studies suggest that as much as an 0.88-1% reduction in A_1C value may be seen. Contrary to this finding, the results of this project did not align as well in comparison to the literature given that the majority of the sample who had repeat A_1C values managed to increase, to varying degrees, rather than decrease their A_1Cs as studies suggest. Only two patients managed to replicate typical research findings by either decreasing by 0.3% or maintaining their A_1C values.

Other common metabolic markers measured in the literature have been lipid values and BMIs. Research by Adachi et al. (2013), Merakou et al. (2015), Moncrieft et al. (2016), and Tang (2015) have shown significant reductions in BMIs with an average decrease between 0.7-

0.8 kg/m^2. This was not observed in the sample as the majority of the patients did not lose or gain weight sufficiently enough to change BMI categories, effectively maintaining their weights. Those that did change BMI categories actually gained rather than lost weight unlike what studies have suggested. DSMEs effects on lipid values are more conflicting in the literature as studies by Merakou et al. showed reductions in triglycerides and LDL levels by 21.1 mg/dL and 10 mg/dL respectively, Tang (2015) found only reductions in LDLs by 15 mg/dL, and McGowan (2015) found a slight increase in HDL levels with no changes to LDL levels. Odgers-Jewell et al. (2017) found mixed results among all three parameters while Carrasquillo et al. (2017) did not find any significant difference in any of the lipid parameters. The lone patient who had repeat lipid values displayed a decrease in HDL, an increase in triglycerides by 30 mg/dL, and a decrease in LDL by 20 mg/dL. These results corroborate the mixed results found in previous studies.

Results from a large behavioral risk factor surveillance study indicated that receipt of diabetes education is associated with an increase in several self-care practices. Principally among these were smoking abstinence, engagement in physical activity, and daily glucose testing (Mendez et al., 2022). Two of these activities were observed in this project as a small portion of the sample (38%), abstained from smoking and more patients participated in consistent weekly exercise. In contrast, the sample differed from this study in regards to daily glucose monitoring as the number of patients refusing daily glucose checks actually increased by 58% during the project. Other studies by Carmienke et al. (2022) and Hailu et al. (2019) assessed behavioral changes post DSME instruction and found patients were more likely to follow a diet plan than those who did not attend this education. In this project, there was a 150% increase in the number of patients reporting following a diabetic diet. This number would have been even larger had the four additional patients who expressed interest in changing their diet actually had done so during

the project. Regarding substance use, studies by Jansink et al. (2013) and Hailu et al. (2019) found no change in alcohol consumption among patients attending DSME instruction. These results differ from that found in this project as the two patients involved in alcohol intake completely abstained throughout the project, and, at the end, were very vocal about never wanting to use any type of substances again.

It was a little more difficult to compare changes in knowledge acquisition as many studies utilized specific validated scales and surveys that were not approved, in the end, for use in this project. Moreover, these studies tested specific questions that somewhat differed from those tested in this project, though questions related to topics in diabetes cause, treatments, exercise, and care visits were very similar. Nevertheless, research findings from Hailu et al. (2019), Adam et al. (2018), Heise et al. (2022), and Odgers-Jewell et al. (2017) point to an increase in general diabetes knowledge after a DSME. Likewise, this project found an increase in knowledge related to the shared topics among these prior studies.

Limitations

One of the biggest limitations of the project was the small sample size. This sample was further reduced when assessing glycemic and lipid control through A_1C and lipid profiles. Therefore, drawing a solid conclusion as to the effects of the project interventions in relation to the literature is difficult when only one or a handful of patients show changes to laboratory evidence. The demographics of the patient sample could also be considered a limitation since this population is not often found in such abundance among other healthcare systems. This vulnerable population is one that has many uncontrolled comorbidities with very little education and resources to assist them in making and sustaining the necessary changes that other demographic groups may be more adept at accommodating. The long-term care hospital

environment also favored the establishment of a DSME as patients normally stay for 6 months or greater. At many other acute care facilities, patients do not have such lengthy admissions, therefore shorter patient stays may prove problematic when instituting a DSME. There was also a limited interprofessional involvement since patients did not come to class as formally planned. Instead, each professional had to individually address patients on their own time to discuss information that may have deviated from the topics planned for that week. One last limitation is the time frame of the project. Three months is sufficient to see changes in metabolic markers along with certain behavioral modifications and knowledge acquisition, but the effects of DSME instruction can last up to 6 months or more (Hermanns et al., 2020; Hildebrand et al., 2020; Odgers-Jewell et al., 2017), so it would have been interesting to see whether patients were able to newly establish and sustain changes over a longer time period.

Recommendations

The hospital should develop a coordinated system in regard to laboratory orders in order to better assess metabolic improvements that result from DSME education. This may be difficult since patients are continuously admitted to the hospital, so keeping track of when each patient has received sufficient educational material to enact change before initiating laboratory work can be complicated. To assist in this effort, the hospital will need to assign an employee, perhaps the patient care coordinators, that tracks patient admission and progress through educational interventions. A computer tracking system would also work well in this situation, though the hospital will be going through an information technology change in the near future, so adding yet another software change may not be feasible. Whichever system is created, providers will need to be informed regularly of patient progress so that they may order the necessary blood work in a timely manner. The hospital may not favor or see the need in repeating laboratory orders to

assess the effectiveness of their DSME as they consider themselves a transitioning point for admitted patients from a clinical and administrative viewpoint. Yet, patients are interested in these values, as evidenced in this project, and deserve to be made aware of the positive changes that are taking place as they achieve new lifestyle behaviors.

There are several suggestions that could potentially improve the educational interventions. One modification that may assist with continuing the live classes would be to offer this educational intervention on a monthly basis or every other month. This would match what is normally seen in the community as DSMEs are not offered every week (Chrvala et al., 2016). This could also alleviate the staffing strain that precludes current employees from continuing the classes. Also, the infographics can easily be expanded to cover a host of other topics that where not originally covered during the 12-week project as the hospital has an account to the software program that was utilized to create them. Yet, the hospital would need to assign a faithful employee to this task to serve as the quasi-diabetes educator, a role that will be difficult to fill as the nursing staff did not express any desire in this role during the needs assessment phase of the project. As an alternate, the Nursing Manager could serve in this capacity as they are in charge of patient education. Another suggestion would be to translate the educational material into more languages other than English and Spanish. Towards the end of the project, there were a few new admissions with patients who spoke Vietnamese along with other Southeast Asian languages. The hospital does have the capacity to accommodate other languages as they offer a language line for employees and patients to utilize.

For the other interventions, it is difficult to suggest any improvements since the CCTV and computer lab were never put into action during the project. Thinking prospectively, in order to make the CCTV intervention more effective, patients should be encouraged to tune-in to the

channel through both verbal encouragement from the staff as well as posters that can be placed along the hallways and pamphlets that can be easily created and handed to patients as part of their admission paperwork. Nurses may even need to physically go into each patient room and place the TVs on the appropriate channel when patients are not watching anything in particular on the TV. To encourage viewership, the CCTV intervention can also be recorded with productive, fun activities that also aid in improving diabetes outcomes like a virtual exercise class. Moreover, patients who have participated in classes and other hospital-sanctioned diabetes educational activities can be recorded in a sort of testimonial format where they talk about how the educational interventions have helped to improve their diabetes. This may serve as a powerful motivating tool for other patients to hear from their own peers in order to buy into the educational interventions. One idea for the computer lab intervention would be to have a hospital employee, like a member from the recreation team, assigned to the room that could assist patients in navigating the internet apart from the manual that was created informing patients on how to access the various educational websites.

Diabetes is nondiscriminatory in the sense that populations worldwide are affected by this condition. It is no wonder that DSME are currently offered in various countries among different populations with beneficial effects (Hailu et al., 2019; Hildebrand et al., 2020; Mikhael et al., 2020; Mohamed et al., 2019; Riemenschneider et al., 2018). Acknowledging that different healthcare systems also cater to specific populations, it would be prudent for other hospitals to follow suit in remembrance that hospital admission is an opportune time for patient education (Nassar et al., 2019). However, as previously stated, a DSME at a long-term care facility may be more feasible than at acute care facilities. Perhaps, a way to circumvent the admissions issue is

for hospitals to invest in creating an outpatient DSME program that patients are educated about and are referred to upon discharge.

Sustainability

The prediabetes and diabetes education assessment sheet, previously created, is being incorporated into the admission packet. This way, when patients are admitted, nurses will be responsible for assessing the knowledge and skills for patients with either of these conditions. Nurses will then address the different topics on prediabetes/diabetes care utilizing the same project infographics. These topics will be placed on a monthly rotating basis much like the schedule that was established during the project. Activity wise, the recreational team has already been given the go-ahead to continue to offer as many unique classes as possible to maintain patient activity. Because the new aquatic classes have been popular, the recreational team has been busy creating other interesting classes like a biking program later in the fall.

The live class unfortunately has been placed on hold as the hospital does not currently have the manpower to sustain them on a recurrent basis. If the hospital is unable to coordinate formal classes, a potential alternate would be to transfer the class information into a pamphlet format with the nursing staff responsible for teaching this information on a monthly basis much like the infographics. Although, the hospital currently holds sporadic community meetings with patients that are geared towards addressing patient concerns. If these meetings are possible, live educational classes could also be held using the same format perhaps on alternating months to alleviate staffing strains. Once the computer lab is ready, the classes could be held there as well as this will be utilized as an educational center for the patients. The advantage to this approach is that patients could be assisted in navigating websites by the individual who is holding the class. In order to get the CCTV intervention operational, the hospital would need to have another third-

party volunteer capable of managing the audio-visual components. Because the hospital has a community outreach program that works with several community organizations, I am confident that the facility will be able to find someone who can serve in this capacity.

Implications for Practice

Diabetes prevention and complication mitigation should be the prerogative of any healthcare system in order to improve diabetes health outcomes. The truth is that is that diabetes is a complex condition, ubiquitous among the world's population with multiple detrimental outcomes that has quickly become an epidemic (Whitehouse et al., 2021; Zimmet, 2017). Statistics in the United States show that, since 2018, 13% of all adults are living with diabetes with forecasts estimating an increase in prevalence to over 54.9 million by 2030 (Rowley et al., 2017). One way to quell the increasing tide of patients diagnosed with while simultaneously arming every patient with or at risk of developing diabetes is to provide essential diabetes education through DSMEs.

The time is now to enact changes to our healthcare system through policy changes that prioritize and enforce patient diabetes education. Indeed, standards in medical care, national standards in DSMEs, and practice guidelines from multiple reputable associations and organizations like the ADA, the Association of Diabetes Care & Education Specialists (ADCES), the Academy of Nutrition and Dietetics, the American Academy of Family Physicians, the American Academy of Physician Assistants, the American Association of Nurse Practitioners, and the American Pharmacists Association already advocate for the increased utilization and dissemination of DSMEs among patient populations with diabetes (Beck et al., 2017). National or state policies should also move towards incentivizing healthcare systems for conducting DSMEs much like the Centers for Medicare & Medicaid Services (CMS) currently does in

emphasizing quality care for its beneficiaries (U.S. Centers for Medicare & Medicaid Services, 2022a). Afterall, financial rewards are quite motivating in our current healthcare payer system (Dai, 2015).

DSMEs also make sense from an economic perspective. Multiple studies have associated diabetes education with either decreased costs, cost savings, cost-effectiveness, or positive return on investment (Whitehouse et al., 2021). This places DSMEs as an alluring proposition given that the United States spent, in 2017 alone, $327 billion in diabetes care including $237 billion in direct medical costs and $90 billion in reduced productivity (ADA, 2018a). The hospital, likewise, has also been experiencing an increase in expenditures from year end with outside medical services costing $683,014, some of which were related to diabetes care. Along with cost savings, CMS reimburses for DSMEs who meet certain conditions, and, in Texas, state laws require private insurance plans to cover diabetes education (The Policy Surveillance Program, 2017; U.S. Centers for Medicare & Medicaid Services, 2022b) further providing financial incentives. DSME resources for healthcare systems are also available without negatively affecting healthcare utilization (Whitehouse et al., 2021). The ADA and ADCES furnish DSME certification (U.S. Centers for Medicare & Medicaid Services, 2022b) and the CDC (2021a) provides a toolkit for organizations to utilize as a resource when implementing a DSME. It is clear then that healthcare systems have the tools, support, and directives necessary to establish successful DSMEs.

Diabetes education should not be made an option but rather an absolute requirement as patients cannot be expected to achieve improved health outcomes without it. Patients must also be motivated to accept responsibility and take control of their diabetes. There are rewards in achieving such a feat as greater patient engagement has the potential to transform and improve

health care value (O'Kane et al., 2012). Diabetes management is also more successful when patients are able to manage their condition through education, partnership, anticipatory guidance, and self-management training (Palmer, 2017). Providers should also become more involved in encouraging patient participation, which continues to lag as demonstrated in this project and other studies (Allory et al., 2020; Kumah et al., 2018; McSharry et al., 2018). Practitioners need to be more proactive, as suggested by studies (Heter, 2019; Kumah et al., 2018; Power et al., 2016), moving beyond the office setting into teaching or creating DSME content since patient outcomes improve even further when providers are involved (Kumah et al., 2018).

No other health care professional is so perfectly poised to usher in the propagation of DSMEs all the while serving as the champion of such an educational venture like nurse practitioners. These professionals have the advanced education and training to serve as stewards in DSME development in a cost-effective and evidence-based manner (Robertson, 2012). Through collaboration with other healthcare disciplines, nurse practitioners have a much greater impact and potential to conduct quality improvement projects much like this one using theory and evidence-based practice to manage chronic diseases in an effort to improve patient outcomes and safety (Watts & Yelverton, 2021). These clinicians are also trained to analyze and develop healthcare policy with the dual capacity of influencing individuals and the power to change health care (Chilton, 2015). These are necessary skills when calling for a robust expansion of DSMEs. Furthermore, as patient advocates, nurse practitioners are key in providing emotional and behavioral support so often missing in many DSMEs (Funnell & Piatt, 2017). Lastly, nurse practitioners are innovators of educational interventions capable of implementing tailored educational strategies comparable to any other health professional (Walls et al., 2016; Wolley & Kinner, 2016).

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