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The Effects of Diabetes Education on Long-Term Complications

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Abstract

The purpose of the scholarly project is to: a) Evaluate if diabetes education can improve a patient's overall condition; b) Measure the chances of reducing long-term complications if a person is to participate in diabetes education and continue to follow up; c) Demonstrate that with effective Diabetes Self-Management Education (DSME) hemoglobin A1c can be reduced. The project design and target population were selected based on research performed on diabetes and diabetes education and the effects that it has on improving self-management in turn creating better glycemic control and fewer complications. This study will focus on type 2 diabetes, which is a chronic disease that requires long-term treatment and self-management skills. The American Diabetes Association recommends the hemoglobin A1c be less than 7.0%, blood pressure be less than 140/90, LDL cholesterol be less than 70, be on a statin medication, and have a BMI of less than 25% [1]. The data was obtained from a retrospective chart review. With the review of data from a rural diabetes specialty clinic, it was determined if type 2 diabetic patients benefit from diabetes education to increase self-management skills in order to prevent long-term complications. The study found the average hemoglobin A1c for the patients that had participated in DSME was 7.3% whereas the patients that did not attend diabetes education was 8.6%. ADA recommends an A1c of less than 7% in order to reduce the risk of long-term complications. The average blood pressure of the patients that attended DSME met the recommendations provided by the ADA whereas the patients that did not attend DSME did not. Both groups met the ADA recommendations for LDL according to the average. There was a reduction of hemoglobin A1c in patients that attended DSME by 27% which is an average of a 2.02 hemoglobin A1c point reduction. There was a 2.2% reduction in BMI for those that attended DSME and a 27% reduction in LDL. When comparing blood pressure for the patients that attended DSME there was a 17% improvement in systolic blood pressure and a 13% reduction in diastolic blood pressure. The improvements seen in patients with DSME were significant when compared to the patients that did not attend DSME. The method used for this study was a retrospective chart analysis. A possibility for bias was that the sample was only looked at over a year's timeframe and therefore may have had better or worse disease management if a different time frame was analyzed. Another limitation is that the sample evaluated may not reflect the type 2 diabetic population as a whole. With the data analysis, finding the mean of each variable studied was the best method to compare each sample against one another. This allowed for seeing the mean of each variable for both samples as well as the mean reduction for each sample. All diabetics should attend DSME at diagnosis and throughout the disease process to promote good health and good disease management. Healthcare providers should talk positively with their patients about DSME and the effects that it can have on their health and the management of the disease process. Advanced practice nurses should be well educated in DSME and the effects it can have on the patient's future health and outcomes and encourage the patient to attend DSME and send any appropriate referral.

The advanced practice nurse should also ensure to follow up on the referral to see if the patient attended and if the patient did not attend, then what were the barriers to attending. Discussing educational opportunities and the importance of education is crucial for the patient's success. Advance practice nurses have the opportunity to decrease health care costs, promote good outcomes, and reduce the risk of long-term complications if pursue DSME with their patients.

Introduction

Diabetes is the seventh leading cause of death in America [2]. The diagnosis of diabetes is life changing for patients and can greatly affect their life span, quality of life, and overall health status based on how the disease is managed. If diabetes is poorly managed, the patient can be greatly affected, and their health may be put at risk for other serious conditions including death. Diabetes education has been found to be successful with improving outcomes and decreasing the risk for long-term complications [3].

Problem/Issue

In 2017, there were 451 million people age 18 to 99 with diabetes worldwide [4]. Diabetes is a complicated disease that is very much affected by a patient's every day choices. Diabetics often do not go through diabetes education or have follow ups with diabetes education, which in turn leads to a high risk for long-term complications. Diabetes Self-Management Education (DSME) is vital component of diabetes care to ensure that patients have the information and skills needed to adequately self-manage their diabetes [5]. Many patients do not have the knowledge about diabetes in order to make healthier choices that could have an impact on their life expectancy and decrease the chances of them developing long-term complications. DSME can increase the rates of good outcomes and decrease long-term complications. Diabetes care is important given the extensive morbidity and mortality the disease can have, its high costs, and the increasing prevalence of diabetes and prediabetes [6]. Therefore, diabetes education should be available to all diabetics and promoted throughout the disease process and not just at diagnosis to decrease long-term complications and increase life expectancy.

Significance

An estimated 25.8 million people in the United States were reported to have diabetes in 2010 [6]. The same year an additional 79 million Americans that were 20 years or older had prediabetes. The prevalence of diabetes is predicted to increase by 33% by 2050, if current trends continue [6]. According to national standards, all patients with diabetes should attend DSME in order to have the skills to successfully manage the disease. Diabetes care is important given the extensive morbidity and mortality the disease can have, its high costs, and the increasing prevalence of diabetes and prediabetes [6]. DSME is vital to ensure that patients have the information and skills needed to adequately self-manage their diabetes [5]. Effective self-management of diabetes can allow for better health outcomes, reduction in hemoglobin A1c, a healthier diet, weight loss, and overall less risk for complications. DSME and support provides patients with the knowledge and skills to achieve optimal outcomes while incorporating the patient's goals, life experiences, and desires [3]. Diabetes education includes an interdisciplinary team tactic taught by a certified diabetes educator [6]. These classes should continue throughout the lifetime to allow the patient to adapt to new challenges or changes in treatment. A patient should attend these classes when first diagnosed, yearly to assess for new needs, when a transition in care occurs, and when new complications arise. This method of education is based on patient empowerment to give patients the resources needed to make informed decisions to better self-manage their disease. DSME has been found to improve patients' knowledge on diabetes and promote selfcare, while helping patients lose weight, improve quality of life, reduce A1c levels, promoting coping with the condition in a healthier manner, and reducing overall healthcare costs. Diabetes education is proven to decrease hospitalizations and increase use of primary care providers [3].

Specific Aims/Purpose

The purpose of the scholarly project is to: a) Evaluate if diabetes education can improve a patient's overall condition; b) Measure the chances of reducing long-term complications if a person is to participate in diabetes education and continue to follow up and c) Demonstrate that with effective DSME hemoglobin A1c can be reduced. This project will allow for healthcare to see how diabetes education can affect diabetes management and the risk for long-term complications. It will also determine the effectiveness of DSME in decreasing hemoglobin A1c levels and the patients need for medication.

Theoretical Framework

The theoretical framework is Sister Callista Roy's theory of adaptation that consists of four elements: person, health, environment, and nursing. This theory is one that believes health is a continuous part of life and is affected by many aspects such as if a person can adapt to their surroundings and situation, then their health will be better. If a person responds in a positive manner to their surroundings, adaptation can occur. There are different levels of adaptation in a person's life process, and it is consistently changing [7]. Roy's model shows people are bio-psycho-social beings in continuous contact with a changing environment and that he or she uses innate and acquired mechanisms to adapt [7]. Diabetes is a disease that is highly based on self-management and affected by human choices. There are many long-term complications that can develop if an individual with diabetes does not adapt properly, including depression, neuropathy, amputations, heart disease, stroke, decreased libido, renal failure, and blindness [8]. Roy's model proves for a person to be able to handle a constantly changing world, an individual must use innate and acquired mechanisms, which come from biological, psychological and social origin [7]. Roy's theoretical model shows that adaptation is necessary to cope with a situation such as being diagnosed with diabetes.

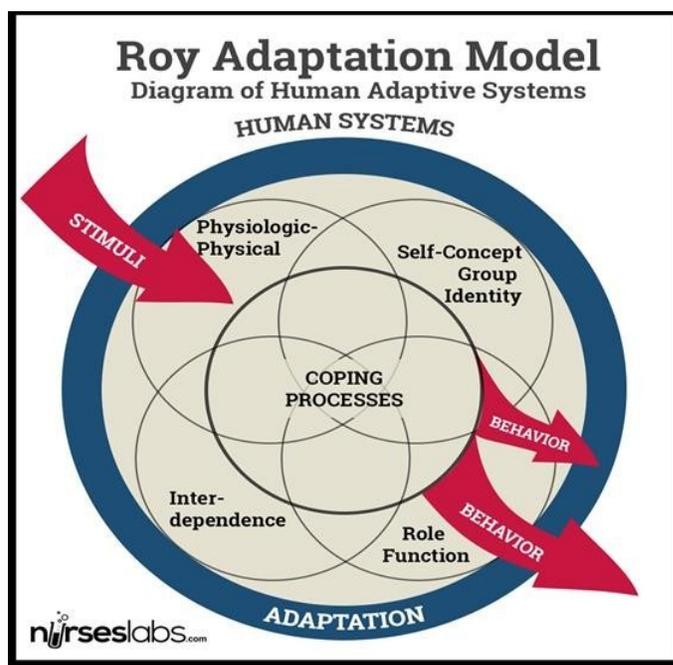


Figure 1: Roy Adaptation Model. Note. Reprinted from Roys Adaptation Model: Diagram of human adaptive systems by Nurselabs [9].

Project Hypothesis

A directional hypothesis would be the most beneficial to this study to show the importance of diabetes education as it predicts the relationship between variables [10].

Directional Hypotheses

If a diabetic attends DSME, then the patient will have a decreased risk of developing long-term complications.

If a diabetic patient attends DSME, then a reduction in hemoglobin A1c levels, a reduction in LDL cholesterol levels, blood pressure level of 140/90 or less, and a healthy BMI can be obtained.

Key Terms/Variables

Components of Diabetes Education: Diet/carb counting, exercising, foot care, eye care, dental care, sexual health, mental health, possible long-term complications, blood sugar monitoring, labs, medication teaching, pump therapy, and self-management skills [11].

DSME: Diabetes Self-Management Education and Support (DSME/S) provides people with diabetes a foundation to navigate decisions and activities and has been proven to improve health outcomes. "Diabetes Self-Management Education (DSME) is the process of facilitating the knowledge, skill, and ability necessary for diabetes self-care". Diabetes Self-Management Support (DSMS) provides the support that is necessary for implementing and maintaining coping skills and behaviors that are needed to self-manage diabetes with continued time [12].

Fasting Plasma Glucose (FPG): This test checks fasting blood glucose levels. "Fasting means after not having anything to eat or drink (except water) for at least 8 hours before the test. This test is done usually done first thing in the morning, before breakfast.

Diabetes is diagnosed at fasting blood glucose of greater than or equal to 126 mg/dl" [13].

Hemoglobin A1c: The hemoglobin A1C test measures your average blood glucose for the past 3 months. This test does not require fasting or drinking a glucose beverage. "Diabetes is diagnosed at an A1C of greater than or equal to 6.5%" [13].

Hyperglycemia (High Blood Glucose): Hyperglycemia is high blood glucose or blood sugar. High blood glucose occurs when the body doesn't have insulin or when the body cannot use the insulin made by the body properly [14].

Lifestyle Changes: variables include, diet, exercise, mental health, smoking cessation, reducing alcohol, and weight loss [15]. **Long-Term Complications:** Foot complications, kidney disease (Nephropathy), high blood pressure, stroke, gastroparesis, neuropathy, retinopathy, and non-healing wounds [16].

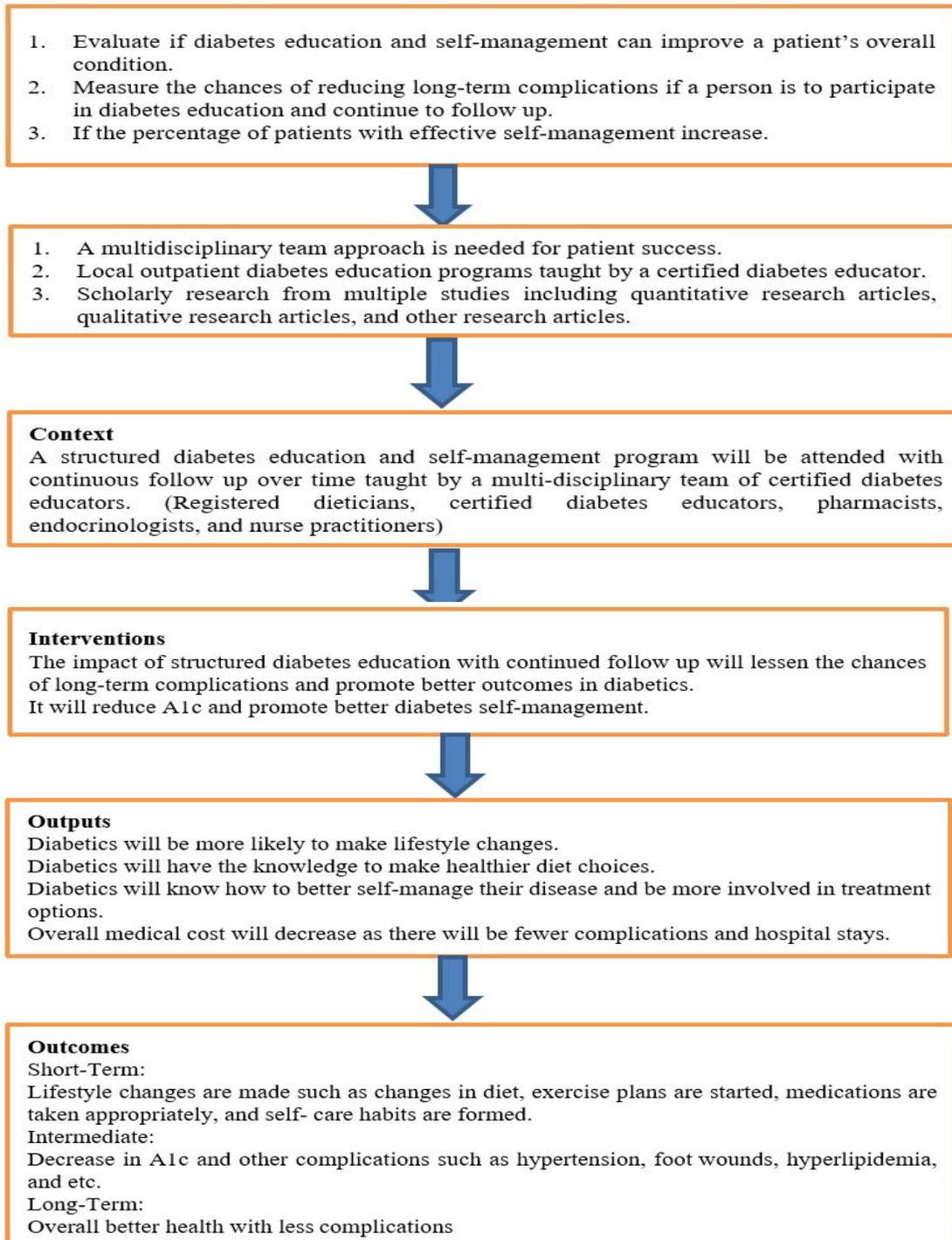
Prediabetes: Blood glucose levels found to be higher than recommended but not elevated to the point to be diagnosed as diabetes. Physicians often refer to prediabetes as Impaired Glucose Tolerance (IGT) or Impaired Fasting Glucose (IFG), depending on what test was performed when the abnormal levels were found. This condition puts you at a higher risk for developing type 2 diabetes and cardiovascular disease [13].

Registered Dietician: “A Registered Dietitian (RD) is a trained nutrition professional who has met the strict educational and experiential standards set forth by the Commission on Dietetic Registration (CDR) of the Academy of Nutrition and Dietetics (AND)” [17].

Type 1 Diabetes: “A form of diabetes mellitus that usually develops during childhood or adolescence and is characterized by a severe deficiency in insulin secretion resulting from atrophy of the islets of Langerhans and causing hyperglycemia and a marked tendency toward ketoacidosis” [18].

Type 2 Diabetes: A term used often for diabetes mellitus that develops, most often in adults and in obese individuals. Type 2 diabetes occurs when hyperglycemia is present, which occurs from impaired insulin use combined with the body’s failure to compensate with increased insulin production [19].

Logic Model



Summary

DSME is a vital component of diabetes management. Diabetes is a serious condition that affects many Americans each day. When not managed and treated properly, diabetes can have serious consequences including death. With diabetes, health promotion and disease prevention are key to slow the occurrence of type 2 diabetes in all ages. Encouraging people throughout their lifespan to maintain a healthy weight, eat a balanced healthy diet, exercise regularly, and have regular screenings is key. Patients with diabetes should be encouraged to self-manage and attend DSME. Self-management classes promote good outcomes and well-managed diabetes with fewer comorbidities and long-term complications. Roy's adaptation model shows the importance of DSME as a diabetic has to be able to adapt to their situation and make healthier lifestyle choices in order to have a decreased risk of long-term complications and comorbidities [9]. This project will make a major contribution to all providers by showing the importance of DSME. It will show the need for patients to be seen for an initial DSME sessions as well as continuous follow ups to improve patient outcomes and decrease the possibilities of long-term complications. It will increase the need for DSME and would allow for more competent self-managing patients with fewer comorbidities. DSME is and always will be a crucial part to effective care of diabetics.

Review of the Literature

Diabetes is the seventh-leading cause of death in America [20]. The diagnosis of diabetes can be life-changing for patients at any age and can greatly affect their life span, quality of life, and overall health status based on how the disease is managed. If diabetes is poorly managed the patient can be greatly affected and their health may be put at risk for other serious conditions including death. DSME has been found to be successful with improving outcomes and decreasing the risk for long term complications. DSME and support are required to meet national standards [14]. There are many tools to manage diabetes that can allow a person to live a happier and healthier life.

This literature review provides an overview of how DSME can provide an impact on a diabetic patient's overall health. DSME is highly recommended by the American Diabetes Association (ADA). This project will use ADA guidelines as a foundation. Successful management of this disease includes Diabetes Self-Management Education (DSME), Diabetes Self-Management Support (DSMS), nutrition therapy, physical activity, counseling on smoking cessation, and psychosocial care [14]. The articles reviewed will demonstrate the importance of diabetes education and how it can affect a patient's self-management skills and risks for long term complications.

Evidence

An estimated 25.8 million people in the United States were reported to have diabetes in 2010 [6]. The same year an additional 79 million Americans that were 20 years or older had prediabetes. The prevalence of diabetes is predicted to increase 33% by 2050, if current trends continue [6]. According to national standards, all patients with diabetes should attend diabetes self-management education in order to develop the skills to successfully manage the disease. Diabetes care is important given the extensive morbidity and mortality the disease can have, its high costs, and the increasing prevalence of diabetes and prediabetes [6]. DSME is vital to ensure that patients have the information and skills needed to adequately self-manage their diabetes [5].

Effective self-management of diabetes can allow for better health outcomes, reduction in A1c, a healthier diet, weight loss, and overall less risks for complications. DSME and support provides patients with the knowledge and skills to achieve optimal outcomes while incorporating the patient's goals, life experiences, and desires [14]. Diabetes education includes an interdisciplinary team tactic taught by a certified diabetes educator [6]. These classes should continue throughout the lifetime to allow the patient to adapt to new challenges or changes in treatment. A patient should attend these classes when first diagnosed, yearly to assess for new needs, when a transition in care occurs, and when new complications arise. This form of education is based on patient empowerment to allow patients the proper means to make informed decisions to better self-manage their disease. DSME has been found to improve patients' knowledge on diabetes and promote self-care, while helping patients lose weight, improve quality of life, reduce A1c levels, promoting coping with the condition in a healthier manner, and reducing overall healthcare costs. DSME is proven to decrease hospitalizations and increase use of primary care providers [14].

Literature Synthesis

A review of the literature was conducted through electronic databases Summon, PubMed, and Google Scholar. The reference list includes literature that was found in addition to the ten research studies to provide additional information. Effectiveness of DSME on an individual is the primary concept reviewed in this synthesis. The concepts of diabetes education, lifestyle changes that can prevent the prevalence of long-term complications in an individual with diabetes, the effects learning effective self-management skills on the disease, and what the barriers are to everyone with diabetes getting the education they need to be successful are also included.

Diabetes Education

Upon evaluation of the studies, most are quantitative in nature and reveal results from the effects of diabetes education and its ability to improve patient's health if used effectively in the patient's life. A few qualitative studies were found as well. Some were both quantitative and qualitative. The studies used different methods to gather their data. Three studies used randomized controlled trials, one a cross-sectional survey by telephone, another used a non-experimental cross design, a retrospective observational study, a pilot study, and lastly, a qualitative study used deductive thematic analysis. All the studies demonstrated DSME being a crucial component of care for an individual with diabetes. Each of the studies evaluated an individual with diabetes and covered a wide range of gender and ethnicity. Certain studies, due to the area that they were performed, only included the gender and ethnicity of the area the study was performed in. A problem often found by the studies was the ability of the researchers to get patients to show up to diabetes education in order to get effective study results which then would limit some studies numbers of participants that had completed their education. There are many areas of DSME that could be evaluated further when it comes to the most effective teaching way, how long follow up is needed for, and getting access to diabetes education for all patients.

Diabetes Education Research

DSME programs provide patients with the skills necessary to make informed decisions towards their care, which in the end can allow for improved outcomes. It has been found that it is important to promote a healthy diet, regular physical activity, and screenings to prevent long-term complications [21]. There are many long-term complications that can affect a person with any form of diabetes. Most of these complications can be prevented with well-managed diabetic care. A person may experience complications throughout the lifespan with diabetes and treatment is available for some complications. Guidelines state the patient should be evaluated at each visit for any rise in blood pressure and should have yearly lipid panels done to prevent cardiovascular complications if possible. Blood tests should be done regularly to check renal function and the patient should report any symptoms that occur [19]. Patients with an A1c of 10% or higher have a 30% higher risk for myocardial infarction when compared with patients of an A1c of 8% or less.

A patient with an A1c of ten percent or higher were found to be younger and have more health problems than those with an A1c of eight percent or less [22]. One strength of McBrien's [22] cross-sectional study is the overall data found. One weakness of the study is that the population of people included in the study decreased from not answering the phone, since it was an over-the-phone survey. In Martin's [6] study, prevention of complications was found to better outcomes and lead to an overall better quality of life. Diabetes care was found to be extremely important due to the high rates of morbidity and mortality of the disease. Diabetes was found to be the leading cause of renal disease, and diabetes education has been found to greatly reduce hospitalizations and amputations while improving overall life [6]. One strength of this study and the importance behind it is the needed expansion of diabetes educators in order to provide more education to patients in need. Exercise has been proven to improve blood glucose control, reduce cardiovascular risk factors, allow for weight loss, and improve the patient's overall wellbeing. In type 1 diabetics, exercise can improve insulin sensitivity [14]. A person that develops diabetes later in life was found to be more likely to experience comorbidities [23].

Beverly's [21] study found that DSME needs to be done at four crucial times during the disease process: at diagnosis, during health maintenance and preventing complications, during early onset of complications, and when complications are present. A weakness of this randomized controlled study is the limitation that only one group was examined with 72% being white and non-Hispanic, making it a less diverse study [21]. The study by Prezio [24] found their intervention group that had participated in six hours of DSME were more likely to have received a dilated retinal examination, and 53% reached a goal of a hemoglobin A1c below 7% when compared with 38% of the control group participants [24]. One strength of this study is the evaluation of the effects of DSME on a person with no insurance, which can limit access to care. This study demonstrated that diabetes care delivered in the clinic setting for uninsured patients was equivalent to the levels of quality achieved in other primary care settings [24].

McBrien's [22] study found that patients who do not reach clinical goals, such as blood sugar control, are put at an elevated risk of long-term complications and ultimately have higher healthcare costs. It is important for a person with diabetes to have close follow ups with their doctor to monitor for any complications that may arise and prevent them from occurring if possible [19]. After structured education, patients were found to test blood sugar more frequently which predicted improvements in hemoglobin A1c after six months [25]. This study by Cooke [25] also found improvement after structured DSME in behavioral changes, which included diabetes knowledge, patient-perceived treatment plan effectiveness, increase in self-care behaviors, increase in blood-sugar testing, decrease in fear of hypoglycemia, and overall improved well-being. Strengths of this study included the number of findings, the number of hospitalized analyzed, and the amount of time the patients were evaluated for. One weakness of the study is most of the information was limited by cross-sectional study designs.

Adaptation is necessary to cope with a situation such as being diagnosed with diabetes. Dorland's [26] study found most of the responsibility of caring for diabetes falls on the patients, as they are responsible for themselves and making lifestyle changes to manage their disease. It was found a patient must monitor their blood sugar, follow a diabetic diet, be physically active, and take medication as prescribed which can be time consuming and overwhelming [26]. The strength of this study was that it evaluated two diabetes education teaching methods using a retrospective observational study. One weakness of this study is that it only evaluated a small number of people in one area of Ontario [27]. The study called challenges of self-management investigated the effects of food insecurity in patients with diabetes. In this study by DeMelo [27], food insecurity negatively impacted diabetes, and it was found that patients need resources, skills, and support which are provided in diabetes education.

Diabetics with food insecurity were found to be more likely to have poor glycemic control, long term complications, and frequent hypoglycemia [27]. The strengths of this study are information it evaluated and there were a good number of people interviewed to get information using a qualitative study with a semi structured interview guide.

Diabetes distress is a common disorder in which a patient experiences emotional distress due to their experience managing this complicated and demanding disease. Many patients become overwhelmed with continuously dosing their medication, monitoring blood sugars, watching food intake and eating patterns, and getting physical activity, which is what can lead to diabetes distress. There are many psychosocial factors that should be assessed when caring for a patient, such as attitude about the disease, expectations of care and outcomes, available resources, and any psychiatric past [14]. Many different races and cultures are affected by diabetes, so culturally competent care for patients is important and can provide patients with care and respect in a holistic manner. Many patients are accustomed to the diet of their culture. With diabetes, some foods a patient may consume in high quantities will have to be changed to manage blood sugars effectively. Working with the patient to set realistic goals and educating them on the importance behind the change can allow for better outcomes [28].

Practice Change Guidelines and Appraisal

There were many different approaches to DSME that were evaluated in the literature review. The guidelines from the American Diabetes Association will be utilized in this scholarly project. This project will hope to demonstrate the effects that DSME can have on a diabetic's health and to encourage providers to promote DSME. Overall, the studies agreed that a multidisciplinary team approach is needed for patient success.

However, different studies found one way of teaching to be more beneficial than others in certain categories. DSME was found to be performed in many different settings: physician offices, outpatient clinics, home health agencies, hospitals, and nursing care facilities [6]. One study by Dorland [26], found that short didactic teaching methods may be equally effective as the longer and more intensive six-hour classes. One study by Magee [5], taught diabetes survival skills education in a hospital setting and found a higher compliance with medication adherence and reduction in emergency room visits and hospitalizations by 8.3 %. The strengths of this nonrandomized pilot study are that it took place over three months and was approved by the MedStar Health Research Institute Review Board. Evaluated the use of kiosks in low- income areas and found 90% of users believed they could better care for their diabetes and 85% planned to make lifestyle changes based from the education they received electronically. Although technology is great there are some issues with kiosks in low-income areas: having good wireless internet access, appropriate placement of the kiosk for use, and having staff to manage the kiosk. This pilot study's strengths were the use of both quantitative and qualitative data using tracking systems on their kiosks. Another study on carbohydrate counting by Reis [29], evaluated the effectiveness of teaching carbohydrate counting in DSME and found an increase in adherence to a healthy-eating program and improved quality of life. This study also found that patients consumed less fast food, sweets or foods with sugar, and fruits while improving understanding of the nutrition labels and how to properly treat a low blood sugar [29]. The strength of this study was the was amount of time the patients were evaluated; although, one weakness was that only sixteen patients were evaluated. All the studies evaluated showed that nutritional education was crucial to diabetes management. Nutrition therapy promotes healthy eating patterns, achieving and maintaining weight loss, reaching glycemic, blood pressure, and lipid goals, and preventing long-term complications of diabetes [14].

Benefits of Diabetes Education

The collaborative development of DSME is vital to improving quality of life and patient's outcomes in the diabetes population [6]. All of the studies indicated that the areas of focus in diabetes education include healthy eating or nutrition, physical activity, proper medication compliance, problem solving, healthy coping, and reducing long-term complications. These studies also showed patient outcomes improved, and healthcare costs were reduced. It was estimated \$94,010 was saved by attending a three- month diabetes education program [6]. Each of the studies evaluated hemoglobin A1c reduction, with all showing at least a small amount of reduction. DSME in all ten studies was found to improve patient knowledge, self-care behaviors, patient outcomes, and reduced costs [5]. Some benefits found in diabetic patients receiving nutrition counseling were decreased hemoglobin A1c and reduced fasting plasma glucose, reducing oral medications or insulin, and reduced overall costs [30].

A study by Beverly [21], on reinforcing self-care for diabetes patients showed an improvement in A1c levels after three months, improved self-care, quality of life, diabetes related distress, and improved frustration with self-care [21]. The only downside to this study is the need for further research on the best method of reinforcement of DSME.

Barriers to Access

There are many barriers to patients getting the DSME needed to be successful in managing their disease. The barriers to a patient seeking nutritional counseling are personal/sociocultural barriers, professional barriers, and cost [30]. Only 38.25% of patients in the study by Alameddine [30] had ever seen a dietician and 50% of the patients were not following a diabetic diet. This non-experimental cross-sectional study's strengths were the sample size of 323 patients that were evaluated. The weakness is only type 2 diabetes in Lebanon were studied. One cross-sectional study by McBrien [22], found barriers to care when evaluating patients with an A1c greater than 10% were more likely to have low self-confidence and lack social support when compared with patients with a A1c of 8% or less. Patients with an A1c of greater than 10% were found to be more likely to not have insurance and to not be receiving the care needed due to cost.

Patients with an A1c of greater than 10% were more likely to not have prescription drug benefits and reported having difficulty affording medical supplies or medications. Twenty-five percent of patients with an A1c of ten percent or greater had not seen an allied health care practitioner for their diabetes care [22]. Prezio's [24] study found DSME improved the quality of diabetes care among uninsured patients [24]. Schäfer's [8] qualitative study found there were four main barriers to patients not following through with diabetes education. These reasons were physicians' influence of statements or behavior towards the education, good health or a comorbidity may deter the patient from going, patients finding diabetes education not of importance or not attending due to implications of the disease, and aspects of the patient's knowledge and activity may allow for them to not attend [8]. The strengths of this study were the categories evaluated. The weaknesses were only 14 patients were interviewed from one district in Germany.

Summary

Diabetes is a serious condition that affects many Americans. It is known diabetes, when not managed and treated properly, can have serious consequences, including death. With diabetes, health promotion and disease prevention are key to slow the occurrence of type 2 diabetes in all ages. Encouraging people throughout the lifespan to maintain a healthy weight, eat a balanced, healthy diet, exercise regularly, and have regular screenings is key. Patients with diabetes should be promoted to self-manage and attend DSME. Self-management classes promote good outcomes and well-managed diabetes with less comorbidities and long-term complications. What is not known is what methods are the best for teaching diabetes education and how more patients can get education affordably. In the future, a project on this phenomenon should evaluate what method of DSME provides the most effective change in a patient's self-management and the development of long-term complications.

This scholarly project will make a major contribution to all providers by showing the importance of DSME referrals and the need for patients to be seen to improve patient outcomes, decrease possibilities of long-term complications, and decrease hospitalizations and healthcare costs. It would increase the need for diabetes educators, and in turn, it would allow for more competent self-managing patients with less comorbidities. DSME is an important part to effectively managing diabetes and improving glycemic control.

Methodology

Diabetes is a disease that affects 34.2 million people which is 10.5% of the US population [31]. This is a multifactorial disease that can cause many complications if not well managed. Type 2 diabetes is a disease that requires self-management in order for success to be achieved. If diabetes is not managed properly many complications can arise that can be very serious or even fatal. DSME is typically highly recommended, but there are still many people who do not go through DSME. These patients continue to self-manage their condition uneducated which can lead to complications.

Project Design

The project design and target population were selected based on research performed on diabetes and DSME and the effects that it has on improving self-management in turn creating better glycemic control and fewer complications. The target population was selected based out of a specialty office in rural Joplin, Missouri, which serves the diabetic needs of Southwest Missouri, Southeast Kansas and Northeast Oklahoma. This study focused on type 2 diabetes, which is a chronic disease that requires long-term treatment and self-management skills. The purpose of this project is to determine if DSME taught by a certified diabetes educator makes an impact on diabetes outcomes by teaching self-management skills and promoting healthy lifestyles that in turn reduce hemoglobin A1cs levels and decreases the chances of developing long-term complications. The American Diabetes Association recommends the hemoglobin A1c be less than 7.0%, blood pressure be less than 140/90, LDL cholesterol be less than 70, be on a statin medication, and have a BMI of less than 25% [1]. Medication compliance, lifestyle changes, and exercise routine were not included in the research as the focus will remain on the impact diabetes self-management education can have on preventing long-term complications. The data was obtained from a retrospective chart review. With the review of data from a rural diabetes specialty clinic, it was determined that type 2 diabetic patients benefit from DSME to increase self-management skills in order to prevent long-term complications. The patient's privacy was protected as the data will be collected from a review of information anonymously.

Sample

Type 2 diabetic patients that have attended DSME were examined based on strict criteria and compared to patients that had not attended diabetes education sessions. A sample of patients were reviewed from the rural specialty clinic where data is already being collected. To be chosen for the study, the patient had to have type 2 diabetes and manage diabetes at the rural clinic where the review of data was performed. Approval was obtained from Pittsburg State University and Mercy Diabetes Specialty clinic and the numbers were reviewed from data collected in 2017-2018. The retrospective chart review included hemoglobin A1c levels, LDL levels, BMI, and blood pressure levels, which was compared to patients that attended DSME versus patients who did not. To avoid researcher bias, the patients were selected at random with no names attached to the files based on their diagnosis of type 2 diabetes.

Target Population

The population used for this study were patients of the Mercy Endocrinology Clinic who have been diagnosed with type 2 diabetes and are over the age of 18. There was no recruitment of patients; the data was obtained from a retrospective chart review. Approximately 120 subject records were reviewed in order to obtain 100 evaluable subjects. Inclusion criteria of the sample included individuals over age 18 with a diagnosis of type 2 diabetes who have had at least two visits (12 months) at Mercy Clinic Endocrinology Joplin and at least 12 months within the system seeing a primary care doctor, ER, or urgent care for diabetes related needs, that has lab work available for review. The charts were confirmed to have a diagnosis of type 2 diabetes and to have had at least two visits to Mercy Clinic Endocrinology Joplin during the period of July 1, 2017- July 1, 2018. Information that was reviewed on the chart included hemoglobin A1c, BMI, blood pressure, and LDL cholesterol. Exclusion criteria included individuals with prediabetes, type 1 diabetes, gestational diabetes, pregnancy, anyone under age 18 years old, anyone with significant mental illness, and anyone who would not be able to independently self-manage.

Protection of Human Subjects

To keep participants anonymous, no patient identifiers was used in the data review. After data was collected, it was put into an Excel sheet, and each participant was given a number at random. All the data collection and reviewing of data took place in the specialty clinic and did not leave the clinic. The data collection was compliant with Mercy's policies and was reviewed by Dr. Zeb. To begin, the patients were seen or referred to the specialty clinic from all over the four-states area. The patients then had appointments and data was extracted from the 2017-2018 calendar year. Prior to being able to use the data, the specialty clinic providers were addressed, and approval was granted. Data was collected and placed into percentages and presented to Dr. Zeb in accordance with hospital policy.

Procedure

Data is collected and updated regularly in the specialty office. This data was collected from July 2017- July 2018, then extracted and reviewed. Reviewing the data also demonstrated the patients that had attended diabetes education with a DSME registered provider versus patients who did not and the difference in their lab levels and BMI. The research was conducted by reviewing patients that had been receiving management for their type 2 diabetes to see if there was an improvement in their blood pressure, A1c, BMI, and LDL cholesterol that had attended DSME versus patients that had not. Mercy Endocrinology in Joplin agreed to allow a review of the data that had been collected from July 2017-July 2018. The timeline of the project phases includes extracting the data anonymously and arranging it into categories to compare to be done before May 2021.

Once gaining approval from Mercy and Pittsburg State University, this author began the retrospective review of data from patients being seen in the specialty clinic. The data was then be placed into an Excel spreadsheet and stats will be run with SPAA software. Once data was interpreted it was presented to the providers within the clinic. The patients were randomly selected and reviewed to see if a change in blood pressure, LDL cholesterol, BMI, and hemoglobin A1c in patients that had attended DSME versus patients that did not. The variables were compared from the first lab levels at the beginning of the calendar year to the end of the year to look for improvement. It has been proven through literature review that a decrease in these variables to acceptable levels leads to a decreased chance of long-term complications. Technology included this author's personal work computer. Electronic access via Mercy's electronic medical recorded was used to obtain information after approval. Resources necessary to conduct the research were minimal and included access to Excel and a calculator. Personnel required to conduct the research included a registered DSME provider and one medical doctor, that also reviewed the data collected. The EMR was reviewed multiple times and data was pulled based on patients that were type 2 diabetics not emphasizing on whether they had attended DSME or not. The charts were confirmed to have a diagnosis of type 2 diabetes and to have had at least two visits to the specialty clinic in the year 2017-2018 with labs including a hemoglobin A1c, cholesterol LDL, BMI, and blood pressure on file. Then, they were chosen to be added to the sample. Data included all labs from July 1 2017 to July 1 2018 to be compared. The patient's that met all the requirements, were added to the sample to be used to extract data and review the differences. All patient information remained anonymous with no identifying factors included when performing the data extraction. IRB approval was gained through Pittsburg State University and Mercy's Research team.

If the data shows a decrease in long-term complications in the patients reviewed, then it can be used to promote diabetic patients to attend DSME at diagnosis and throughout their lifespan by demonstrating the impact that it can have on overall health and reduction in long term complications. The project is of importance as it can provide providers with local information regarding DSME and the improvements in patient hemoglobin A1c levels, which are indicative of the control of their diabetes. Sustainability will continue if providers continue to push for DSME for patients and patients can see a change in their health. In the rural office, where the data was extracted it is feasible for patients to attend DSME as it is directly down the hall and they could attend before or after an appointment. There is also access to diabetes education in smaller communities that have primary care clinics.

The outcome data that was collected was compiled into percentages to see the changes in each category that was studied. The mean of all variables studied was found. The blood pressure levels, BMI, LDL cholesterol, and hemoglobin A1c was placed into independent sample t-tests. Each variable was evaluated for improvement. The numbers were added to the statistical package for the social sciences database. Those percentages were the outcomes of the study that demonstrated efficacy of DSME and the effects that it can have on hemoglobin A1c, cholesterol LDL, BMI, and blood pressure, which have a great impact on long-term complications. This data was reviewed by the health care providers of the rural clinic where it occurred and will be used in the improvement of outcomes of patients in the clinic. The outcomes of the study will be used to promote diabetes education in our rural area and allow providers to see the impact it can make on a patient's overall health and glycemic control, which in turn can lead to less healthcare visits. The hope with this project is to bring awareness to the lack of diabetes education utilization and the impact that DSME can have on the patient's condition.

Limitations

Limitations included sampling charts to pull data. The sample size was relatively low compared to the actual number of patients with diabetes in the US, which may cause for inaccuracy regarding the entire diabetes population. Data was only be collected from one location which can be a limitation as results may be different if different geographical locations throughout the US were added in.

Other limitations include that the research did not take into account any self-improvements the patient does such as exercising, medication changes, and changes in diet. A second limitation includes that there was no set number of DSME visits a patient will have to attend to be included in the comparison group. The last limitation was that once patients have gained glycemic control and are considered stable, they are typically seen in follow up by their primary care provider instead of the specialty clinic. This would be a limitation as data would be difficult to follow once the patient has transferred their diabetes care back to their primary care provider.

Evaluation Plan

The purpose of reviewing the data collected was to evaluate the health of type 2 diabetics with and without DSME intervention. When calculating percentages from variables, they were reviewed from the beginning of 2017 when the patient received care in the specialty clinic to the end of 2018. Change in BMI, blood pressure, hemoglobin A1c, and LDL cholesterol was calculated. The blood pressure levels were entered into an independent sample test and the hemoglobin A1c and BMI were placed into an independent t-test. Notes were made whether the patient had attended DSME or not. The information was compared against each other considering whether the patient had attended diabetes education or not.

The data collected was analyzed and calculated to see the difference in starting data versus data at the end of July 2018 to compare changes the patient has had over the year. The data was divided based on ranges of variables: for example, people that had current blood pressures of less than 140/90 and people that had blood pressures of greater than 140/90. Hemoglobin A1c was evaluated to look for improvement in levels over the year time frame. LDL cholesterol was evaluated as to whether it was in goal range or not. The patients were not divided by age or gender as the American Diabetes Association guidelines apply to all type 2 diabetic patients. The patients were evaluated on variables and then whether they had attended DSME or not and compared against each other. A note was made if patients had been referred to DSME but did not attend or if refused to attend.

A fact sheet was then be made up of the percentage of patients that fell into each category including whether they attended DSME or not. Hemoglobin A1c levels, indicative of a diabetic's blood glucose control, were analyzed by reviewing changes throughout the 2017-2018 year and compared against each other. Critical components of diabetes management that were also be analyzed included BMI, LDL cholesterol, and blood pressure during the 2017-2018 year and compared.

The evaluation measures were linked back to ADA guidelines and recommendations for the 2017-2018 year. Those guidelines change each year based on evidence-based research. The evaluation measures were linked back to the significance of the problem that was analyzed and support the purpose of why this study was performed.

The goal of the outcomes measured was to improve type 2 diabetics overall health, by reducing hemoglobin A1c levels, BMI, LDL cholesterol, and blood pressure, which in turn will lead to a decrease in long term complications.

Plan for Sustainability

The goal of this research was to evaluate type 2 diabetic patients to see if DSME reduced the risks of long-term complications by improving blood pressure, hemoglobin A1c, cholesterol, and BMI. The goals of what numbers would be considered to be acceptable to have a decreased risk of developing long-term complications were set by evidenced-based guidelines provided by the American Diabetes Association. The patients that attended DSME was taught by a diabetes educator certified through the American Diabetes Association. The patients that did not receive DSME were still patients of the specialty clinic where the study will be performed. The clinic studied follows ADA diabetic guidelines. If the variables studied were found to be higher than the recommended guidelines in the patients that did not attend diabetes education compared to the patients that did attend diabetes education, then it would show the importance of DSME and the impact on reducing long-term complications. Research presented to healthcare providers showing the difference in DSME can make should be presented to the patient at the time of diagnosis to prevent long-term complications and promote overall health and diabetes control. Strategies for sustainability would be for the provider to remain in close contact with the diabetes educator that the provider had referred the patient to and to continue to monitor the patient at least twice a year to ensure the patient is practicing self-management skills learned and that the patient's levels are under recommended guidelines. By presenting the information that was found in this study to primary care providers in the four-states area, more referrals to DSME could be placed and more patients could receive the needed information to have success with self- management. The information will be presented to the endocrinologist and her team at Mercy where the study was performed. The information from the study will then be provided to local providers to show the importance that DSME has had in our rural area in improving diabetics glycemic control and overall health.

The sustainability of DSME by a certified diabetes educator to prevent long-term complications could have some barriers. The provider would need to follow up on the patient after the referral was initiated ensuring the patient attended and followed up with the educator for continued visits if needed. Ultimately it is up to the patient to agree to go and to make the lifestyle changes needed to be successful, but it starts with how it is presented to the patient at the time of diagnosis. If the long-term risks associated with diabetes were presented along with the research of the effectiveness of DSME, then the patient would have a higher chance of attending with motivation to make changes. The ADA provides certification for diabetes educators to ensure that DSME is performed based on evidence-based research and guidelines. The guidelines to be used in this project are the ADA guidelines as these are the guidelines followed by Mercy Endocrinology where the study took place. The ADA guidelines were used as the framework for diabetes education with all objectives being met during the diabetes education. The collaboration between primary care providers, nurses, certified diabetes educators, and pharmacists is crucial for type 2 diabetic patients to ensure appropriate management of their condition and improvement glycemic control.

Summary

In this chapter it was discussed the procedure data collection, the population that was studied, and the implications for data review. The data obtained was calculated into percentages based on the four major measurements of health for diabetic's overall well- being, in which it was assessed further to determine what improvements to make to a diabetic's management of health to create better outcomes and less long-term complications. It can then be determined based on the review of the data if the addition of diabetes education would cause improvements in the diabetic's health and lead to a decrease in possible long-term complications. In the coming chapter, analysis of data that was collected and any findings will be presented.

Results

The purpose of the scholarly project is to evaluate if DSME can improve a patient's overall condition, measure the chances of reducing long-term complications if a person is to participate in DSME and continue to follow up, and demonstrate that with effective DSME hemoglobin A1c can be reduced. This project will allow for healthcare workers to see how DSME can affect diabetes management and the risk for long-term complications. It will also determine the effectiveness of DSME in decreasing hemoglobin A1c levels and the patient's need for medication. These objectives will be met by evaluating data to see the changes that DSME has had on the variables studied. If DSME has made improvement in these variables to the evidenced-based guidelines by the American Diabetes Association, then it has been demonstrated to decrease the chances of long-term complications and improve a patient's overall health. In this chapter, there will be discussion of the analysis of data performed as well as the population that was studied into the comparison to the projects purpose.

Data were analyzed and divided into two groups based on if they had attended DMSE or not and then further divided into if improvement was made in the variables studied. The population studied included both male and female subjects with a mix of ethnicities and ages. All subjects were 18 or older and all ethnic groups were included if data were available. The subjects came from a wide variety of educational backgrounds and the only subjects removed from the study were those who had significant mental illness or were not be able to independently self-manage their diabetes. Throughout this chapter, graphs will be shown dividing subjects that had attended DMSE or not and the improvement or decline in variables from the start of July 1 2017 to July 1 2018. The process of analysis began by determining the mean of the Type 2 diabetes mellitus variables that included blood pressure, BMI, LDL cholesterol, and hemoglobin A1c.

Key Terms/ Variables

There were five variables studied for this project. The variables studied included blood pressure, BMI, LDL cholesterol, and hemoglobin A1c. These variables will be divided each into its own category to be evaluated to see the mean and difference through the year time period studied. This project included the difference in variables and the mean to be viewed as the most important variable in analyzing data. In analyzing the data, the variables included hemoglobin A1c, cholesterol LDL, BMI, and blood pressure. Data variables hemoglobin A1c, cholesterol LDL, BMI, and blood pressure are necessary to answer the research question because control of these variables are shown to lessen the chances of long-term complications according to guidelines set by the American Diabetes Association.

Questions/Hypothesis

The American Diabetes Association sets guidelines that are updated each year. If a patient is able to keep the variables studied in this project within the recommended guidelines, then the patient will have a decreased chance of developing long-term complications from type 2 diabetes mellitus. The first hypothesis tested was: there is no difference in the A1c level of those diabetic patients who have attended DSME training and those who have not attended this training. The average difference of those hemoglobin A1c for the patients that had participated in DSME was on average 2.01 points less than those who had not attended diabetes education (mean difference was.427). When these two variables were statistically compared, it was found that there was a significant difference between the group that had attended trainings and those who had not. This hypothesis was tested using an independent sample t-test with a t value of 3.92 (p = .0001) and was rejected (Table 1).

	Difference in A1c level for DSME Group	Difference in A1c level for Non-DSME Group
Mean	2.018367	0.427451
t Stat	3.92	
P(T<=t) two-tail	0.0001	

Table 1: Independent Sample T-test For Difference in Hemoglobin A1c.

The second hypothesis tested included: there was not difference in the LDL cholesterol levels between the DSME group and the non-DSME group. This hypothesis was tested using an independent sample t-test with a t value of 2.20 (p = .030) and was rejected. The DSME group had a statistically lower LDL average of 23.48 points whereas the non-DSME group only saw an average difference of 4.15 points (Table 2).

	Difference in LDL Cholesterol for DSME Group	Difference in LDL cholesterol for Non- DSME Group
Mean	23.48	4.15
t Stat	2.2	
P(T<=t) two-tail	0.03	

Table 2: Independent Sample t-test for difference in LDL Cholesterol.

The second hypothesis tested included: there was not difference in the BMI levels between the DSME group and the non-DSME group. This hypothesis was tested using an independent sample t-test with a t value of 1.38 (p = .171) and was accepted. There was no significant statistical difference between the two groups compared for BMI. The DSME group had a BMI reduction was found to be 0.71, whereas the non-DSME group only saw an average difference of 0.05. Although, the study found that 69 percent of the sample that attended DSME had improvement in BMI, whereas only 51 percent of the sample that did not attend DSME saw improvement (Table 3).

	Difference in BMI level for DSME Group	Difference in BMI for Non- DSME Group
Mean	0.710204	0.054902
t Stat	1.38	
P(T<=t) two-tail	0.171219	

Table 3: Independent Sample T-test Differences in BMI.

The second hypothesis tested included: there was not difference in the systolic blood pressure levels between the DSME group and the non-DSME group. This hypothesis was tested using an independent sample t-test with a t value of 4.06 ($p = .000$) and was rejected. The DSME group had significant systolic blood pressure level reduction was found to be 20.32, whereas the non-DSME group only saw an average difference of 6.17 (Table 4).

	Difference in systolic blood pressure for DSME Group	Difference in systolic blood pressure for Non-DSME Group
Mean	20.32653	6.176471
t Stat	4.06	
P(T<=t) two-tail	0	

Table 4: Independent Sample T-test For Difference in Systolic Blood Pressure.

The second hypothesis tested included: there was not difference in the diastolic blood pressure levels between the DSME group and the non-DSME group. This hypothesis was tested using an independent sample t-test with a t value of 3.45 ($p = .000$) and was rejected. The DSME group had significant diastolic blood pressure level reduction was found to be 8.82, whereas the non-DSME group only saw an average difference of 1.94 (Table 5).

	Difference in diastolic blood pressure for DSME Group	Difference in diastolic blood pressure for Non-DSME Group
Mean	8.816327	1.941176
t Stat	3.45	
P(T<=t) two-tail	0	

Table 5: Independent Sample T-test For Difference in Diastolic Blood Pressure.

Statistical Analyses

The total number of research subjects was 100 individuals. There were 51 individuals that had attended DSME with a certified DSME provider and 49 individuals who had not attended DSME as seen in (Table 6).

Attended DSME	Did Not Attend DSME	Total
51	49	100

Table 6: Research subjects.

Subjects were divided into two groups to be compared, whether they had attended DSME or not. When compared (Table 7), individuals who had attended DSME had a 2.02 point reduction in hemoglobin A1c compared to a 0.43 point reduction in patients who had not. Therefore, there was a 26.54% reduction in hemoglobin A1c in patients that attended DSME and only a 5.29% reduction in patients who had not attended DSME. There was a BMI improvement of 0.71 points for patients who attended DSME and only a 0.05 point reduction in individuals who has not attended. Therefore, individuals attending DSME had a BMI reduction of 2.18% and those individuals who had not had a reduction of 0.15%. When compared, individuals who had attended DSME had a 23.48 point reduction in LDL cholesterol versus a 4.15 point reduction in individuals who did not attend DSME. Therefore, individuals who attended DSME had a 26.59% reduction in LDL cholesterol whereas individuals who did not only had a 4.67% reduction. Individuals who had attended DSME had a 20.33 point reduction in systolic blood pressure and a 8.82 point reduction in diastolic blood pressure whereas individuals who has not had a 6.18 point reduction in systolic blood pressure and a 1.94 point reduction in diastolic blood pressure. The individuals that attended DSME had a 16.68% reduction in systolic blood pressure and a 12.73% reduction in diastolic blood pressure. The individuals that had not attended DSME had a 4.71% reduction in systolic blood pressure and a 2.57% reduction in diastolic blood pressure.

Variable	Average Improvements		Percent of Improvements	
	DSME	No DSME	DSME	No DSME
Hemoglobin A1c	2.02 points	0.43 points	26.54%	5.29%
BMI	0.71	0.05	2.18%	0.15%
LDL Cholesterol	23.48	4.15	26.59%	4.67%
Systolic Blood Pressure	20.33	6.18	16.68%	4.71%
Diastolic Blood Pressure	8.82	1.94	12.73%	2.57%

Table 7: Comparison of Samples.

Individuals that had attended DSME had a greater number of individuals with improvement when compared with those who did not attend DSME (Table 8). The percent of individuals who attended DSME that saw a hemoglobin A1c reduction was 92% whereas only 61% of individuals saw improvement if they did not attend DSME. The percent of individuals who attended DSME that saw a reduction in BMI was 69% whereas the percent of individuals who had not attended DSME that saw a 51% reduction. The percentage of individuals who attended DSME that had a reduction in LDL cholesterol was 65% whereas the percent that had a reduction in LDL cholesterol that did not attend DSME was 51%. There was 94% of individuals that attended DSME that had a reduction in systolic blood pressure and 76% that had a reduction in diastolic blood pressure. There was only 61% of individuals who had a systolic blood pressure reduction, and only 43% individuals had a diastolic blood pressure reduction in individuals who did not attend DSME.

	Percentage of Improvements	
	DSME	No DSME
Hemoglobin A1c	92%	61%
BMI	69%	51%
LDL cholesterol	65%	51%
Systolic Blood Pressure	94%	61%
Diastolic Blood Pressure	76%	43%

Table 8: Percentage of Improvements.

The average hemoglobin A1c for the 51 individuals that had attended DSME was found to be 7.3%. The average hemoglobin for the 49 individuals who did not attend DSME was 8.6%. BMI was compared to the CDC’s standards. The average BMI for the sample that attended DSME was 31.4, which is considered in the obese category. The average BMI for the sample that did not attend DSME was 37.5, which is considered in the extremely obese category. The LDL cholesterol average for the sample that attended DSME was 85 mg/dL whereas the sample that did not attend DSME’s average was 93 mg/dL. ADA recommends the LDL cholesterol to be less than 100. The systolic blood pressure average for the sample that attended DSME was 114, which falls into the recommended range according to the ADA. The systolic blood pressure average for the sample that did not attend DSME was 136, which is above the normal range and considered stage 1 hypertension. The diastolic blood pressure average for the sample that attended DSME was 67, which also falls into the recommended range according to the ADA. The diastolic blood pressure average for the sample that did not attend DSME was 79, which falls into the recommended range according to the ADA (Table 9).

	Average for Each Group	
	DSME	No DSME
Hemoglobin A1c	7.30%	8.60%
BMI	31.4	37.5
LDL Cholesterol	85 mg/dL	93 mg/dL
Systolic Blood Pressure	114	136
Diastolic Blood Pressure	67	79

Table 9: Comparison of Averages of Each Variable.

As can be seen in (Table 10), the number of individuals with an A1c less than the ADA recommended range of 7% for individuals that attended DSME was 23 out of 51, making 45% of the sample within the recommended range. The number of individuals with an A1c less than the ADA recommended range of 7% for individuals that did not attend DSME was 17 out of 49, making 35% of the sample within the recommended range.

	DSME	No DSME
Number of Individuals with A1c less than 7%	23/51	17/49
Percent of Individuals of A1c less than 7%	45%	35%

Table 10: Number of individuals with hemoglobin A1c less than 7%.

Summary

Results from the data analysis revealed findings in the study that related back to the purpose of the research performed. In the previous discussion section, the four variables of importance to be extracted were set and then extracted from the subject's data. The type 2 diabetics data was compared to ADA guidelines for the 2017 year, as this is a predictor of long-term disease management. The ADA recommends that hemoglobin A1c be less than 7% in order to have good glycemic control [1]. The mean hemoglobin A1c for individuals that attended DSME was 7.3%. The mean hemoglobin A1c for individuals that did not attend DSME was 8.6%. The results of the sample that attended DSME were close to the desired hemoglobin A1c levels for the type 2 diabetic population but still over the recommended range provided by the ADA. The sample that did not attend DSME were well over the recommended range set by the ADA. The sample t-test was found to be valid, and the null hypothesis was rejected according to the two-tail p-value of 0.000, which is well below 0.05; thus, the effect of DSME on reducing hemoglobin A1c values is significant. There was a significant reduction in hemoglobin A1c levels averaging 2.02 points in individuals that attended diabetes education in comparison with a 0.43 point reduction of hemoglobin A1c in individuals who did not attend DSME, showing that DSME reduced 92% of the individual's hemoglobin A1c that had attended. Only 61% of individuals that did not attend DSME had a reduction in A1c. This demonstrates that DSME has a greater reduction in A1c points and reduces hemoglobin A1c levels in more people than individuals who do not attend DSME.

It is recommended by the ADA for type 2 diabetics blood pressure to remain at 120/80 or less [1]. The study concluded that the sample of individuals that attended DSME had an average blood pressure of 114/67 with a reduction rate of 16.68% systolic and 12.73% diastolic. This falls within the recommended blood pressure range set by the ADA. The sample that did not attend DSME had an average blood pressure of 136/79 with a reduction rate of 4.71% systolic and 2.57% diastolic. This systolic blood pressure falls into the stage 1 hypertension category and the diastolic blood pressure falls within the recommended ADA range. This can place the patient at higher risk for long-term complications if blood pressure remains greater than the recommended ranges set by the ADA, according to the ADA guidelines. The sample t-test was found to be valid for systolic and diastolic blood pressures, and the null hypothesis was rejected according to the two-tail p-value of 0.000 (systolic) and the two-tail p-value of 0.000 (diastolic), which is well below 0.05, thus the effect of DSME on reducing systolic and diastolic blood pressure values is significant. There was a noticeable difference in the reduction of both systolic and diastolic blood pressure in patients that attended DSME in comparison with the sample that did not attend DSME. Obesity is highly correlated with the development of type 2 diabetes mellitus. The ADA recommends that type 2 diabetics maintain a healthy body weight, eat a nutritious diet, and obtain a normal BMI. The ADA set these recommendations as it has been proven to decrease morbidity and mortality related to the disease [1]. The average BMI for the individuals that attended DSME was 31, which falls into the obese category as it is greater than 30. The average BMI for the individuals that did not attend DSME was 38 which falls into the extremely obese category as it is greater than 36. The average reduction in BMI for the sample that attended DSME was 0.71 points whereas the sample that did not attend DSME only had a 0.05 average point reduction. The sample t-test was valid, and the null hypothesis was accepted according to the p-value of 0.171(two-tail), which is above 0.05; thus, the effect of DSME on reducing BMI values was not significant. Although, the study found that 69 percent of the sample that attended DSME had improvement in BMI, whereas only 51 percent of the sample that did not attend DSME saw improvement. This reduction can benefit the individual but is above the recommended range set by the ADA of less than 25.

The ADA recommends that individuals with type 2 diabetes keep their LDL cholesterol at 100mg/dL or less or under 70mg/dL if the individual has cardiovascular disease [1]. The last variable studied for this project was LDL cholesterol. The average LDL cholesterol for individuals that attended DSME was 85 mg/dL. The average LDL cholesterol for the individuals that attended DSME was 93 mg/dL. Both of the levels fell within the recommended guidelines set by the ADA. The sample t-test was found to be valid, and the null hypothesis was rejected according to the two-tail p-value of 0.030, which is below 0.05; thus, the effect of DSME on reducing LDL cholesterol values is significant. The percent of patients that had a reduction in LDL cholesterol level was 65% of the sample that had attended DSME and 51% of the sample that did not attend DSME. There was a greater reduction found in patients who attended DSME and the average LDL cholesterol level was eight points lower than the sample that did not attend DSME. The purpose of this study was to determine how the sample populations compared to each other and to the recommended ADA guidelines. The rationale for the study was to demonstrate that DSME can reduce the possibilities of long-term complications if attended, and therefore, DSME should be attended by all type 2 diabetics. With this analysis of data, it can be concluded that DSME can have significant reduction rates in hemoglobin A1c levels, BMI, LDL cholesterol, and blood pressure when compared to individuals without DSME. With the reduction of these variables to ADA recommended range, the individual will then have a reduced chance of developing long-term complications.

Discussion

The purpose of the scholarly project is to evaluate if DSME can improve a patient's overall condition, measure the chances of reducing long-term complications if a person is to participate in DSME and continue to follow up, and demonstrate that with effective DSME hemoglobin A1c can be reduced. With the data that was analyzed from a retrospective chart review performed in the Mercy Endocrinology Clinic the support for DSME reducing the risk of long-term complications can be shown. Through data analysis, it was determined that DSME programs reduce BMI, hemoglobin A1c, blood pressure, and LDL cholesterol at significant rates when compared to individuals that did not attend DSME. This provides support for the need for DSME for all type 2 diabetics to promote good outcomes.

Relationship of Outcomes

To reflect on the project hypotheses, a reduction in hemoglobin A1c levels, a reduction in LDL cholesterol levels, blood pressure level of 140/90 or less, and a healthy BMI will lessen the chances of long-term complications according to the American Diabetes Association [1]. The ADA sets evidence-based guidelines of standards of care. There are also national standards that have been developed for DSME that sets a framework to facilitate independent decision making and increase self-management skills. The national standards for DSME sets a step approach, which includes a preassessment and then an individualized education plan is set up. Each of the variables studied supports the ADA guidelines and the hypotheses set. The study found a reduction in each variable studied, which, if reduced to the levels recommended by the ADA, the individual will have a decreased risk of developing long-term complications. The second hypotheses can be met but it is variable depending on the individual and the lifestyle choices that are made. Attending DSME provides the individual with the knowledge and support to make appropriate lifestyle choices and increase the likelihood of reaching ADA standards and decreasing the risk of developing long-term complications.

When analyzing the health status of the type 2 diabetics in the four-states area, the study focused on four variables that the ADA determines to be predictors of good health; these variables included hemoglobin A1c, LDL cholesterol, BMI, and blood pressure. The ADA has set guidelines that if these variables fall within, then they have a reduced chance of long-term complications, cardiovascular disease, and premature death. DSME provides the individual with the necessary tools to increase their overall health. The subjects included in the research that had not attended DSME were over the recommendations provided by the ADA in three out of four variables studied. The mean hemoglobin A1c was 8.6%; this is far from the recommended 7% or less guideline set by the ADA. This groups average blood sugar would be 200mg/dL which is far above the recommended range set by the ADA. The subjects that attended DSME were over the recommendations provided by the ADA in two variables studied, which included hemoglobin A1c and BMI. The mean hemoglobin A1c was 7.3%, which is slightly over the recommended range of 7%. This sample was very close to the desired range set by the ADA. This makes this sample's average blood sugar 163 mg/dL, which is above the ADA recommendations but much closer to goal than the sample that did not attend DSME.

The analysis of blood pressure levels for the sample that did not attend DSME fell into the stage 1 hypertension category. This study did not evaluate how many of the individuals included had a diagnosis of hypertension. High blood pressure over time causes damage to multiple body systems and can contribute to heart attack and stroke. DSME teaches the importance of reducing these risks, appropriate medication management, good nutrition, and the importance of self-care, which could reduce the diabetic's risk factors. The analysis of blood pressure levels for the sample that attended DSME fell within the recommended guidelines set by the ADA. Therefore, this reduces the risks association with high blood pressure.

The mean BMI for both samples were above the recommended guidelines set by the ADA. The sample that did not attend DSME had a mean BMI of 37.5, which falls into the extremely obese category as it is above 36. The sample that attended DSME had a mean BMI of 31.4 which falls into the obese category. Both of the sample groups were well above the recommended BMI of 25 set by the ADA. DSME provides education and support on healthy nutrition, weight loss, and exercise.

The mean LDL cholesterol for both samples fell within the recommended range set by the ADA. It was not taken into account if a patient was on a cholesterol lowering medication or not. The mean LDL cholesterol for the sample that did not attend DSME was 93 mg/dL, and the mean LDL cholesterol for the sample that attended DSME was 85 mg/dL. Both of the findings fall within the recommendation set by the ADA of LDL cholesterol to be less than 100 mg/dL. DSME includes education and support on healthy eating and exercise, which can help reduce LDL cholesterol levels.

Observations

Outcomes were observed through data analysis and found that the sample that had attended DSME met two out of four recommended ranges of the determinants of health, whereas the samples that did not attend DSME only met the LDL cholesterol recommended range. While there were many patients within each sample that did maintain lab values that were within the recommended ranges set by the ADA, the mean levels for certain variables within each group remained over the recommended range.

The study proved to be interesting with many noteworthy points. It was found that many individuals that attended DSME had reduction in the variables studied; this reduction was significantly higher in all variables studied when compared with the group that did not attend DSME. The ADA has evidenced-based guidelines showing that if the variables studied are within recommended ranges, there is a decreased risk of developing long-term complications.

There were many educational moments while performing this project. One educational point taken away was the impact that diabetes education can have on a diabetic's health and risk factors. Another educational point taken away was the impact that a reduction in the variables studied can have in reducing long-term complications. The study instruments used did perform as expected. The outcomes of this project are reassuring that diabetes education can have a positive impact in reducing blood pressure,

BMI, hemoglobin A1c, and LDL cholesterol, which in turn leads to a lesser likelihood of long-term complications.

Evaluation of Theoretical Framework

Results from this research can correlate with the nursing theory of adaptation by Sister Calista Roy by predicting the effects of attending DSME. Roy discusses that health is a continuous part of life and is affected by many aspects, such as if a person can adapt to their surroundings and situation, then their health will be better. If a person responds in a positive manner to their surroundings adaptation can occur. There are different levels of adaptation in a person's life process and it is consistently changing [7]. This theory consists of four elements: person, health, environment, and nursing. This theory is one that believes health is a continuous part of life and is affected by many aspects such as if a person can adapt to their surroundings and situation, then their health will be better. If a person responds in a positive manner to their surroundings adaptation can occur. Therefore, if a diabetic attends DSME the individual will be more likely to adapt successfully as they will be given the tools and support to adapt appropriately.

Roy's model shows people are bio-psycho-social beings in continuous contact with a changing environment and that he or she uses innate and acquired mechanisms to adapt [7]. Diabetes is a disease that is highly based on self-management and affected by human choices. There are many long-term complications that can develop if an individual with diabetes does not adapt properly, including depression, neuropathy, amputations, heart disease, stroke, decreased libido, renal failure, and blindness [8]. Roy's model proves for a person to be able to handle a constantly changing world, an individual must use innate and acquired mechanisms, which come from biological, psychological and social origin [7]. Roy's theoretical model shows that adaptation is necessary to cope with a situation such as being diagnosed with diabetes. DSME provides the tools necessary to support self-management decisions and healthier lifestyles through individualized plans and support.

Evaluation of Logic Model

In the first chapter, a logic model was developed to demonstrate the relationship of DSME to the short-, intermediate-, and long-term outcomes that could occur within the type 2 diabetic population studied. The logic model developed demonstrated the process and implementation of DSME with desired outcomes. A retrospective chart review of the two samples groups was performed and was performed between both groups and the desired lab values in relation to the ADA guidelines. The data analysis concluded DSME is a crucial part of diabetes management and could greatly improve type 2 diabetics health status.

The results of the project support the logic model in chapter 1. The logic model expected a reduction in hemoglobin A1c and less risk for long-term complications. The unknown at this time is whether or not DSME lead to lifestyle changes for sure; it can only be assumed with the research performed. The results demonstrated a relationship between the concepts developed in the logic model. The results showed a decrease in the variables studied including hemoglobin A1c, LDL cholesterol, BMI, and blood pressure. According to the ADA if the variables studied are within recommended limits, then the chances of developing long-term complications are reduced.

Limitations

The method used for this study was a retrospective chart analysis. One possibility for bias was that the sample was only looked at over a year's timeframe and the therefore may have had better or worse disease management if a different time frame was analyzed. Another limitation is that the sample evaluated may not reflect the type 2 diabetic population as a whole. With the data analysis, finding the mean of each variable studied was the best method to compare each sample against one another. This allowed to see the mean of each variable for both samples as well as the mean reduction for each sample. Time was a limitation in data collection and analysis. The information was collected and analyzed by this author and then reviewed by Dr. Zeb. If more time were allowed for additional research, it would be of benefit to analyze if DSME over time had the same benefits with follow up or if an individual attended classes and then stopped would the individual see a regression in their results. This could be conducted by analyzing the individuals used in this sample in the future to see if they continued to follow up with DSME or if they ended their education and what the impacts were on the four determinants of health studied.

Implications for Future Research

The number of type 2 diabetics continues to increase at drastic levels. The continuing rise in type 2 diabetics creates a need for prevention and appropriate management. Statistics in the four-states area of obese individuals and individuals at risk for type 2 diabetes is continuing to increase. The prevalence and increasing numbers of type 2 diabetes mellitus will continue until measures are taken to prevent type 2 diabetes and increase better management of current type 2 diabetics occurs. With the increasing numbers of diabetics and obese individuals there is a need for prevention in the four states area. With the clear need of additional resources for type 2 diabetics and at-risk individuals present, it would be beneficial to develop and implement prevention and management programs in the rural areas of the four-state area. Future plans would include working with local primary care physicians, hospitals, schools, and diabetic educators to develop a DSME program that can be utilized in areas where they are not available. The number of DSME providers compared to the number of diabetics in the area quickly shows need for a program that can reach more individuals. To develop this program, the CDC's community readiness program and resources would be used as a foundation to develop this program for the four-states area. The beginning stages of the development would include stakeholders in the community, including DSME providers, primary care physicians, nurses, and pharmacists. This program would need to reach individuals in very rural areas therefore, the need for telehealth visits may be crucial to success. In order to develop a strong program, an analysis of data from current type 2 diabetic patients who had attended DSME programs in the area would need to be performed. The research performed in this project only shows the sample populations lab values with DSME performed in a specialty care setting.

Implications for Practice/Health Policy/Education

The implications of the project's findings demonstrate that the type 2 diabetic population is not meeting the recommendations set by the ADA in hemoglobin A1c, blood pressure, and BMI. The variables studied showed that if controlled, they can reduce the risks of long-term complications. There has been a drastic increase in type 2 diabetics, and the prediction is that the numbers will continue to grow. Therefore, prevention of type 2 diabetes mellitus is crucial. One suggestion is for all diabetics to attend DSME at diagnosis and throughout the disease process to promote good health and good disease management. Healthcare providers should talk positively with their patients about DSME and the effects that it can have on their health and the management of the disease process. Advanced Practice Nurses should be well educated in DSME and the effects it can have on the patient's future health and outcomes and encourage the patient to attend DSME and send any appropriate referral. The advanced practice nurse should also ensure to follow up on the referral to see if the patient attended and if the patient did not attend, then what were the barriers to attending. Discussing educational opportunities and the importance of education is crucial for the patient's success. Advance practice nurses have the opportunity to decrease health care costs, promote good outcomes, and reduce the risk of long-term complications if pursue DSME with their patients. In the state of Missouri, disease progress is monitored and is something that is looked at closely as the numbers of type 2 diabetics continue to rise. There is a need for health policy reform to make an impact on the drastically increasing numbers of type 2 diabetics and the burden that is supplied to the Department of Health and Human Services. Missouri law 191.990 [32], "Diabetes Goals and Benchmarks," was put into place with the MO HealthNet division and the Department of Health and Senior Services to set goals and benchmarks in order to reduce the incidence of diabetes in Missouri, improve diabetes care, and control complications that can occur with diabetes [32]. This law was put into place due to "the prevalence and financial impact of diabetes of all type on the state of Missouri" [32]. With Missouri focusing on prevention and decreasing the prevalence of diabetes, DSME is crucial. There is a lack of certified DSME providers in the rural areas such as the one that this study occurred in. It is a hope with the push for healthier lifestyles and reducing healthcare costs, there will be an expansion in the number of certified DSME providers in order to support the increasing number of diabetic patients and in turn create the best outcomes possible.

Conclusion

The purpose of the scholarly project was to evaluate if DSME can improve a patient's overall condition, measure the chances of reducing long-term complications if a person is to participate in diabetes education and continue to follow up, and demonstrate that with effective DSME hemoglobin A1c can be reduced. This project will allow for healthcare to see how DSME can affect diabetes management and the risk for long-term complications. This analysis provides evidence that DSME can decrease the chances of long-term complications. Hemoglobin A1c levels are indicative of the diabetic's glycemic control. The individuals BMI, blood pressure, LDL cholesterol can be related to cardiovascular risk, morbidity and premature death. With the data analyzed the sample that did not attend DSME did not meet the recommendations on three out of four the determinants of health set by the ADA. The sample that attended DSME did meet the recommendations for two of the determinants of health and was close to meeting a third. With the information obtained from the study, future plans include to promote referrals for DSME for all diabetic patients at the point of diagnosis. This would include publishing this study for the benefit of the diabetic population in hopes that healthcare providers will push DSME to promote good health and a decrease in the risks of long-term complications. This study has contributed to nursing knowledge by demonstrating education is a crucial component to disease management and outcomes, as many factors that affect good diabetes management are self-management decisions in which the individual needs education to have the tools to make appropriate lifestyle choices. Healthcare providers should be aware of the resources within their communities that can benefit type 2 diabetic patients and should place the referrals needed to ensure the patient gets the assistance needed to reduce their chances of long-term complications.

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