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Evaluation of the Effectiveness of an Established Glycemic Monitoring Program in a High School Setting for Adolescents With Type I and Type II Diabetes Mellitus

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MSN, FNP–C, University of North Carolina at Wilmington, 2010

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Doctor of Nursing Practice

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Abstract

Adolescents with Type 1 and Type II Diabetes need to monitor their blood glucose and food intake, administer insulin, and participate in all activities including physical education and sports during school hours to maintain glycemic control. Concerns for adolescents with diabetes and their parents include the knowledge and support of school personnel and classmates, physical education, school lunches, and the medical directive plan. Glycemic management programs (GMP) exist for the improvement of diabetes management during school hours. The purpose of this project was to evaluate a GMP in a school system in a rural area in the Southeastern United States. The goal was to determine if the existing GMP had met its objectives and make recommendations for continuation, revision, or discontinuation. The logic model provided the basic framework for the evaluation of the GMP by use of a graphic flowchart depicting the health outcomes prior to and after the implementation of the program. A *t*-test outcome evaluation found the updated GMP was associated with the lowering of hemoglobin A1c readings. The mean A1c in 2009 was 8.6% (180 – 190 mg/dl), with the mean decreasing to 7.2% (150 mg/d) in 2015. The changes in the program led to one-to-one care management based on the child's individual needs and allowed parents more involvement in their child's care. These findings suggest that the updated GMP improved glycemic management with empowerment and individualizing care. This project study contributes to social change by contributing to data from the Diabetes Prevention Program Research Group study showing that prevention of onset of Type II diabetes mellitus in adults and adolescents are successful by way of early detection of prediabetes in childhood (Haemer et al. 2014).

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Table of Contents

List of Tables

List of Figures

Section 1: Introduction

Introduction

Type 1 and Type II diabetes are both types of endocrine disorders that greatly increase an individual's risk for a range of metabolic complications such as kidney failure, heart disease, stroke, and peripheral vascular disease if not properly monitored or managed (American Diabetes Association [ADA], 2013). Type 1 diabetes is one of the most common childhood diseases in the United States currently affecting one in every 400 children (Freeborn, Loucks, Dyches, Roper, & Mandelco, 2013). Type 1 diabetes, also known as juvenile diabetes, is a disease wherein the body does not produce the hormone insulin that is needed to move glucose from the blood stream into the cells so that carbohydrates are converted into energy needed for activities of daily living. According to the ADA (2013), only 5% of the population has this form of diabetes. Young individuals with diabetes mellitus face higher medical cost than children without the disease. According to the Centers for Disease Control and Prevention (CDC; 2011), medical expenses for youth with diabetes are $9,061 per year compared to $1,468 per year for youth without the disease. Those children and adolescents requiring insulin administration had an annual medical cost of $9,333 compared to $5,683 of those requiring only oral medications to control blood glucose (CDC, 2011). The basic treatment therapy for Type 1 diabetes is eating healthy, physical activity, and insulin injections or pump based on carbohydrate intake and glucose levels throughout the day. The basic treatment therapy for Type II diabetes is similar to Type 1 diabetes except without the requirement of insulin or insulin pump injections.

According to the National Diabetes Education Program (NDEP; 2014), based on data from 2012, approximately 208,000 young people under that age of 20 years old were diagnosed

with Type 1 or Type II diabetes mellitus. Type II diabetes has become increasingly common in American Indians, African Americans, Latinos, Hispanics, Asians, and Pacific islanders. Type II diabetes occurs predominantly in the obese adult population older than 40 years of age but is becoming more prevalent in children and adolescents in the United States due to their obesity rates and sedentary lifestyles (CDC, 2013). Children and adolescents diagnosed with Type II diabetes are among the ages of 10 to 19 years old, diagnosed with obesity, have insulin resistance, and with a strong family history of Type II Diabetes (CDC, 2013). Because of the complexity of diabetes mellitus Type I and Type II, a plan for management of the condition must span from home to school, where adolescents spend many hours of the day. In order to address the problem of diabetes among adolescents in a rural school system, a program for glycemic management was developed.

Background

The glycemic management program (GMP) has been officially in place since September 5, 2002, when it became law as the Senate Bill 911: Care of School Children with Diabetes (General Assembly of NC, 2002).). The Senate Bill 911 provides a standardized diabetic care plan for children with diabetes, and parents must request in writing that the care plan be developed. Each school with a diabetic student must have at least two individuals trained as a diabetic care manager, and the students are allowed to carry the necessary supplies for their treatment at all times and have access to water and the bathroom at all times.

According to the high school in the rural school district of the southeastern area of North Carolina's nurse and the county's health services supervisor, the evaluated GMP was updated in the year 2010 secondary to the reported average A1c of 10% among 77 adolescents with

diagnoses of diabetes mellitus. The updated GMP allows more participation from adolescents and their parents along with in-service requirements for school personnel. The ADA recommends a more stringent target of an A1c less than 6.5% to reduce microvascular complications, microvascular disease, and mortality (National Diabetes Education Initiative, 2016). Early recognition and treatment of childhood diabetes would prove cost effective for the government and families and decrease the mortality rate.

Problem Statement

The problems addressed in this project were the lack of resources, lack compliance with the program, the need to ensure adolescents safety, the need to ensure awareness (by school personnel, adolescents, and parents) and need to minimize comorbidities. In 1975, the enactment of the Education for all Handicapped Children Act increased awareness that children with handicapping conditions may have special needs that must be met in school (U.S. Department of Education, 2007). As a consequence of this enactment, children must be placed in the least restrictive individualized environmental programs constructed on the basis of individual needs. Children with conditions including asthma, cystic fibrosis, hemophilia, leukemia, seizures, sickle cell anemia, heart disease, tuberculosis, rheumatic fever, and diabetes were referred to as either "handicapped" or "other health impaired." Under this federal law, diabetes is considered to be a disability making it illegal for schools to discriminate against children with disabilities (U.S. Department of Education, 2007). Any school receiving federal funding must accommodate the special needs of children with disabilities in the usual school setting with as little disruption to the school's and the child's routine as possible, allowing the child full participation in all school activities. According to the ADA (2014), "some day care centers may refuse admission to

children with diabetes, and children in the classroom may not be provided the assistance necessary to monitor blood glucose and may be prohibited from eating needed snacks" (p. 1). Prior evaluations have indicated that school personnel are underprepared to deal with chronic conditions including childhood obesity, diabetes mellitus, hypertension, asthma, heart disease, and sickle cell anemia that adversely affect healthy living of adolescents. This calls for extensive training in managing children with chronic illnesses. According to The National Center for Education Statistics almost 70% of all public school teachers feel underprepared to meet the challenges of working with children with disabilities and lack confidence in their ability to educate and care for these young children (University of North Carolina at Chapel Hill, 2006). The goal of evaluating the GMP was to ensure that school personnel, families, and peers are aware of the diabetic needs of school-aged children.

In order for adolescents and their parents to adhere to treatment and have proper glucose control, and depending on the severity of their disease, the program requires strict daily monitoring at home as well as during school hours. On average, adolescents spend approximately 7 hours each weekday and 1.1 hours each day on the weekend on education activities. During these hours it is necessary to monitor blood glucose, food intake, insulin administration, and participation in physical education (U.S. Department of Health & Human Services, 2016). The objective of this project was to evaluate the updated GMP used in the school and use it as a resource method to increase awareness and effectiveness among the diabetic adolescents. Parents assume the major role in treatment-related activities and make the day-to-day decisions about their children's health and well-being. However; school personnel,

classmates, physical education, school lunches, child behavior, and the MDP can all be obstacles to glycemic control for adolescents and their parents due to lack of awareness.

The concerns of school personnel have to do with the reluctance of being involved in insulin administration and dealing with student behavior changes through fluctuation of blood glucose (Freeborn et al., 2013). Federal law mandates schools to complete a 504 Medical Directive Plan (MDP) for eligible students with medical needs. The school that this proposal evaluated does have an MDP plan in place and the evaluation concluded whether or not the school personnel, adolescents, and their parents were aware of this plan. School personnel faced challenges with glycemic control for diabetic students due to breakfast and lunch scheduling as well as the dietary choices that may consistently rise or lower blood sugar levels. These factors may result in the need for additional blood glucose monitoring and insulin administration. Hypoglycemic episodes secondary to physical activity were also a concern of school personnel and parents. The school already had the means, resources, and support of a GMP as suggested by the MDP; however, the school personnel, parents, and students lacked sufficient awareness to take advantage of the full potential of this resource.

Purpose Statement, Goals and Outcomes

The purpose of this DNP project was to evaluate the updated GMP among a rural high school in Southeastern North Carolina for adolescents with Type 1 and Type II diabetes. The outcome was to decrease incidents of hyperglycemia, hypoglycemia, obesity, comorbidities, and mortality rates, and reduce healthcare costs by way of glycemic control. The ADA reported that costs of diabetes increased by 41% from 2007 to 2012 and recommended improvement in

diabetes care with reductions in chronic complications of coronary artery disease, stroke, renal failure, and amputation reducing the per patient cost of hospitalizations (ADA, 2013).

Significance/Relevance to Practice

Type II diabetes mellitus have increased in prevalence among overweight and obese children, with significant association with long-term health outcomes. Evidence supports lifestyle modifications such as nutritious meals, exercise, education, and diabetes monitoring at school and home can have beneficial results. The increased prevalence of obesity in all pediatric age groups has been accompanied by an increase in Type II diabetes mellitus and insulin resistance (Haemer et al. (2014). Along with other comorbidities of obesity, including hypertension, dyslipidemia, fatty liver disease, musculoskeletal disorders, and cardiovascular disease, Type II diabetes mellitus and its complications represent a significant cause of long-term disability within the U.S. population and a challenge to the resources of the U.S. healthcare system. It is estimated that one third of the United States youth are overweight or obese, and up to 15% of adolescents may have diabetes (Haemer et al. (2014). Adolescents and young adults with Type II diabetes mellitus are expected to lose 15 years from their life expectancy and may experience severe, chronic complications by their 40s such as coronary artery disease, hypertension, obstructive sleep apnea, peripheral vascular disease, and others.

Barriers to healthy family meals include busy schedules, socioeconomic factors, lack of nutritional education and cooking skills, insufficient space to eat as a family, and meal planning deficiencies. This can result in families eating more meals at fast food restaurants, which may lead to obesity and insulin resistance (Fruh et al., 2013). Obese children are more likely to have bone and joint problems, sleep apnea, and social and psychological problems such as low self-

esteem (CDC, 2013). Obesity is more prevalent in low-income areas and minority populations; however, studies have found that children who participate in family meals have greater intakes of nutrients, grains, fruits, and vegetables, and fewer of fried foods and sodas. Participation in meal planning is important for diabetic children because it allows children who pack their lunches to carry a healthy meal that contains whole grains, fresh fruits, and vegetables, along with replacing high-fat foods with low-fat options such as low-fat turkey, reduced-fat cheese, and skim milk (CDC, 2013). In turn, children who do not pack their lunches can also look at the cafeteria menu, if offered by the school, to help them make choices that fit a healthy meal plan. Parents can assist by requesting school menus from the school personnel and share with their children meal time preparation. The importance of having a GMP was to assemble a health team consisting of the parent or guardian, the school nurse, and other key school personnel. This health team monitors diet, exercise, accucheck, medication administration, and emergency plans.

Project Question

The project answered the following question: To what extent has the target population's A1c changed following the implementation of the updated GMP in 2010?

Evidence-Based Significance of the Project

The school system is a significant environment for children with diabetes because they spend between 6 and 10 hours a day in school and doing school-related activities. The main obstacles to glycemic management in the school system included lack of informed and trained staff, lack of equipment, and lack of management policies. Since 2002, ADA has set forth recommendations for schools including training of at least two school personnel in diabetes care and obtaining student permission to monitor and treat out-of-range blood glucose levels (Pansier,

& Schulz, 2015). Diabetes education from childhood to adulthood is ongoing due to differing needs at different stages of growth and development. In caring for children with diabetes, professionals should involve parents, caregivers and school personnel in the child's diabetes management. The goal should be a gradual approach and transition toward independence for students in management of their conditions through middle school and high school (ADA, 2014). There are also many contributing variables that should be addressed to avoid uncontrolled diabetes, for example, self-care behaviors, school personnel diabetes awareness, dietary awareness, classmate awareness, existence of an MDP, and physical education, all of which can influence blood glucose values and glycemic control with diabetic students (Pansier, & Schulz, 2015).

School-aged children naturally want to be accepted by their peers, so they may be at risk for difficulties with social competence and hypo/hyperglycemic episodes due to participation in unhealthy eating habits, sports during glycemic episodes, and avoiding blood sugar monitoring out of embarrassment. One study performed by Schwartz, Denham, Heh, Wapner, and Shubrook (2010), reported that school-aged diabetic children feel that they are treated differently in school because of their condition. Nearly 70% of the school-aged children with diabetes reported that they felt they were treated differently at least some of the time; 14.6% felt this way frequently; 31.2% reported feeling this way sometimes; and 22.9% reported feeling this way rarely. Children usually spend up to 12 hours a day in school and after school care (Schwartz et al., 2010). Managing the child's diabetes appropriately requires school personnel to be knowledgeable about diabetes care issues and allowing children to participate fully in school activities without viewing them as being handicapped or incapable. According to Schwartz et al. (2010), parents

reported that schools do not always provide adequate time for diabetes self-care; only 41.5% responded that their child was always granted adequate time for self-care. However in response to the school personnel, 65% of them felt that their schools were very supportive of the self-care needs of school-aged children, 31.4% thought they were somewhat supportive, and only 4% felt that their schools were not at all supportive of students' needs (Schwartz et al., 2010).

The NDEP contains a diabetes medical management plan for schools and their personnel to use as a guideline to measure blood glucose levels, recognize and treat hypoglycemia, administer glucagon, and recognize impending diabetic ketoacidosis (NDEP, 2011). School nurses and other school personnel should build their competencies in educating and caring for diabetic children (Wang, Brown, & Horner, 2010).

Implications for Social Change in Practice

The purpose of this DNP project was to evaluate the updated GMP in the school system for adolescents with Type 1 and Type II Diabetes. Obese children are more likely to have prediabetes, bone and joint problems, sleep apnea, and social and psychological problems such as low self-esteem (CDC, 2013). Adolescents with a chronic disease have been found to be at increased risk for anxiety and depression. The ADA recommends that all youths with diabetes be screened for depression once a year. The researchers found that 11% of 150 adolescents and young adults with diabetes had depression, 21% had anxiety, and 20% had an eating disorder. Prevalence of depression in adolescents with diabetes is reported to be two to three fold higher compared to adolescents without diabetes (Soren, & Grey, 2015). The combination of diabetes and depression in adolescents has led to increased rates of suicidal ideations. Obesity is more prevalent in low-income areas and minority populations; however studies have found that

children who participate in family meals have greater intakes of nutrients, grains, fruits, vegetables, and fewer fried foods and sodas (Soren, & Grey, 2015). Data from adult and adolescent studies have shown that prediabetes, particularly in those with an elevated BMI, significantly increases the risk of developing diabetes. In one study, up to 50% of severely obese adolescents with prediabetes returned to normal glucose tolerance over 20 months, whereas 24% showed progression from prediabetes to diabetes, and those with the highest BMI had the highest risk of disease progression (Soren, & Grey, 2015). Data from the Diabetes Prevention Program Research Group study showed successful prevention of onset of Type II diabetes mellitus in adults and adolescents by way of early detection of prediabetes in childhood (Haemer et al. 2014).

Definitions of Terms

Adolescence: The development of children ages 12 through 18 years of age (National Institutes of Health, 2014).

American Diabetes Association (ADA): A United States-based association working to battle the consequences of diabetes and to help those affected by it (ADA, 2013).

Blood sugar: The amount of glucose present in the blood from foods eaten to supply energy to the body's cells (National Institutes of Health, 2014).

Compliance: The process of following a recommended course of treatment and management (National Institutes of Health s, 2014).

Coronary artery disease: Disease that develops when the major vessels that supply the heart with blood, oxygen, and nutrients become damaged or diseased by way of plaque buildup and inflammation (Mayo Clinic, 2014).

Diabetic ketoacidosis: A life threatening complication predominantly in patients with Type I diabetes but that can occur in those with Type II diabetes in which the body has a shortage of insulin and therefore switches to burning fatty acids and producing acidic ketones (Mayo Clinic, 2014).

Glucagon: A hormone produced by the pancreas causing an increase in blood sugar levels, therefore opposing the action of insulin (National Institutes of Health, 2014).

Glycemic management program (GMP): A generalization for diabetes programs for inpatient and outpatient with the following goals: (a) prevent harm from hypo and hyperglycemia, (b) optimize individual experience and outcome, and (c) eliminate health care waste (Mathioudakis, Pronovost, Cosgrove, Hager,, & Golden, 2015).

Insulin: A polypeptide hormone secreted by the islets of Langerhans and regulating the metabolism of carbohydrates and fats to convert glucose to glycogen to lower blood glucose levels (Mayo Clinic, 2014).

Medical Directive Plan (MDP): A federal law that requires school on an individual state basis to address the child's health care needs according to the plan (Freeborn et al., 2013).

Metabolic syndrome: A combination of medical disorders (elevated blood pressure, high blood glucose levels, excess body weight around the waist, and abnormal cholesterol levels) that occur together, increasing the risk of cardiovascular disease, diabetes, and stroke (Mayo Clinic, 2014).

National Diabetes Education Program (NDEP): A program started in 1997 to educate the public about risks of diabetes with the goal to reduce illness and death caused by diabetes and its complications (NDEP, 2011).

Obesity: A condition of having increased body weight caused by excessive accumulation of fat (National Institutes of Health, 2014).

Self-perception: The awareness of the characteristics that consist of a person's self; self-knowledge (Self-perception, 2014).

Social pressure: Coercion from peers to behave in a manner similar to them, which may include unhealthy eating habits, sedentary lifestyle, and videogame playing rather than exercising and sports participation (Freeborn et al., 2013).

Type I diabetes mellitus (insulin dependent diabetes): A severe form of diabetes mellitus with an early onset requiring insulin injections and diet management to control the disease. It is characterized by polyuria, excessive thirst, increased appetite, weight loss, and episodic diabetic ketoacidosis (Mayo Clinic, 2014).

Type II diabetes mellitus (noninsulin dependent diabetes): A mild form of diabetes that typically appears first in childhood and is exacerbated by obesity and an inactive lifestyle (Mayo Clinic, 2014).

Assumptions and Limitations

The main assumption of this study was that by evaluating the updated GMP, I would find data that showed accurate measures quantifying glycemic control in adolescents. This means that either through the updated program the studied group of diabetic students' overall hemoglobin A1c continued to improve or that the studied group of adolescents were more compliant and health conscious.

Limitations of this study included the small, nonrandom sample from a single local setting. Another limitation was that multiple school nurses and health care professionals obtained

the data over the years studied and participated in updating the GMP, resulting in some variability of the program strategies and results.

Summary

In conclusion, a prevention GMP is based on interventions from a group consisting of adolescents, parents, school personnel, and school nurse. The goal of the GMP is to motivate the adolescent with diabetes or at risk for diabetes to self-manage their diabetes and lifestyle changes with assistance (Schwarz, Schwarz, Schuppenies, Bornstein, & Schulze, 2007). Health intervention in the school system does not have to solely pertain to diabetes, but can have the potential to prevent a number of comorbidities, for instance, metabolic syndrome, cardiovascular disease, cancer, emphysema, and osteoporosis. The GMP was updated in 2010 and evaluated for its effectiveness in helping students keep their A1c levels at or near the goal of 7.0% or below.

Section 2: Review of Scholarly Evidence

Purpose

The purpose of this quality improvement project was to evaluate an updated GMP in a rural high school with adolescents diagnosed with diabetes mellitus to ensure the goal of improvement in health and to deter the progression of chronic complications. I chose the specific literature based on the rural area evaluated and the general literature based on needs to improve glycemic monitoring compliance.

Literature Search Strategy

The search for literature was conducted electronically from the following databases: public county records, CINAHL, Medline, ProQuest, PubMed, Cochrane Library, and Google Scholar. Articles older than 10 years were discarded with the exception of one classic research publication. Terms used for the search were: *American Diabetes Association, blood sugar, glucose, compliance, coronary artery disease, Diabetic Ketoacidosis (DKA), glucagon, insulin, medical directive plan, metabolic syndrome, National Diabetes Education Program (NDEP), obesity, self-perception, social pressure, Type 1 diabetes mellitus, Type II diabetes mellitus,* and *glycemic management program.*

Specific Literature

My project population was located in a rural community in a county in the southeastern portion of North Carolina, consisting of a variety of, ethnicities, including immigrants, and homes with both parents' working as well as single parent homes.

Although statistics are not available for adolescents or by individual age groups, the rates used for this project were based on the adult statistics. If prevention and awareness were not

supported in the school system, these adolescents will become adults who will eventually be included in these statistics. The county's age-adjusted diabetes death rate in the year 2007 was 52.7 per 100,000 as compared to the state (North Carolina) at 23.8 per 100,000 (Robeson County Health Department, 2010). Trend data indicates that Robeson County's diabetes death rates have remained significantly higher than the state rates but have decreased since 2006. Another pertinent statistic is that Robeson County's obesity rate in the year of 2008 was 43.1 per 100,000 as compared to the state at 29.5 per 100,000.

According to the 2015 census, the population of Robeson County was 130,866 with the median age of 34. Robeson County's median household income was $29,594, and the average household net worth was $280,015 (National Association of Realtors, 1995–2015). In Robeson County, 59% of people were married, 41% were single, 41% of residents 18 and over graduated from high school, and 13% completed a bachelor's degree or higher. According to the census of 2015, Robeson County had approximately 38,143 children from ages of 0–19 and approximately 41,629 of elders 50 years of age and older out of the county's 130,866 population. These numbers are important to know for providers of care and education to a relatively young community with such complex health problems. The incidence of Type II diabetes in the poor population was 20.4 per 1,000 person per year compared with their middle-income counterparts. Poor, underserved persons with diabetes were less likely to visit a diabetes clinic (Hsu et al., 2012).

The high school evaluated was located in a rural, underserved county in which adolescents had a complex health history. The school had a GMP that was modified in July of 2010. The modified GMP consisted of parental request for individual diabetes care plans,

diabetes physician orders, and request for medication administration in school, self-care, 911 emergency action plan, and diabetes training requirements. According to the lead supervising nurse at the Board of Education, each adolescent had one-to-one care and were dealt with on an individual basis (Public Schools of Robeson County, 2015). The modified GMP was different from the old form of the plan because it consisted of an individualized diabetic care plan at the request of the parents, an emergency care plan for students without an individualized care plan, provider's order sets, and request for medication administration in school.

General Literature

Since 2002, ADA has set forth recommendations for schools including training of at least two school personnel in diabetes and student permission to monitor and treat out-of-range blood glucose levels (Pansier, & Schulz, 2015). Diabetes education from childhood to adulthood is ongoing because of the changes of needs at different stages of growth and development. In order to ensure education, compliance, and avoidance of challenges at home and school, a team approach consisting of high-level medical and nursing care should be used to provide dietary advice, evaluation of self-care, and emotional support (Lowes, 2008). There are also many contributing variables that should be addressed to avoid uncontrolled diabetes, for example, self-care behaviors, school personnel diabetes awareness, dietary awareness, classmate awareness, existence of a MDP, and physical education, all of which can all influence blood glucose values and glycemic control (Pansier, & Schulz, 2015). School-aged children naturally want to be accepted by their peers so they may be at risk for difficulties with social competence and hypo/hyperglycemic episodes due to participation in unhealthy eating habits, sports during glycemic episodes, and avoiding blood sugar monitoring out of embarrassment. One study

performed by Schwartz et al. (2010) reported that school-aged children feel that they are treated differently in school because of their diabetes. Nearly 70% of the school-aged children reported that they felt like they were treated differently at least some of the time; 14.6% felt this way frequently; 31.2% reported feeling this way sometimes; and 22.9% reported feeling this way rarely. Children usually spend up to 12 hours a day in school and after school care (Schwartz et al., 2010). Managing the child's diabetes appropriately requires personnel to be knowledgeable about diabetes care issues and allow children to participate fully in school activities without viewing the children as being handicapped or incapable. According to Schwartz et al. (2010), parents reported that schools do not always provide adequate time for diabetes self-care; only 41.5% responded that their child was always granted adequate time for self-care. However in response to the school personnel, 65% of them felt that their schools were very supportive of the self-care needs of school-aged children, 31.4% thought they were somewhat supportive, and only 4% felt that their schools were not at all supportive of students' needs (Schwartz et al., 2010).

To address the issue of school challenges, ADA (2014) developed a position statement, *Care of Children with Diabetes in the School and Day Care Setting,* that outlines the responsibilities of not only the school personnel but the child and the parents to ensure a safe learning environment for the child. The NDEP also contains a diabetes medical management plan for schools and their personnel to use as a guideline to measure blood glucose levels, recognize and treat hypoglycemia, administer glucagon, and recognize impending diabetic ketoacidosis (NDEP, 2011). Self-perception and social pressures are other factors contributing to the challenges that children with Type 1 and Type II diabetes are facing because of their risk of developing co morbidities such as anxiety, depression, and other behavioral disorders, including

risk-taking behaviors. School nurses, personnel, and student body members should build their competencies in educating and caring for diabetic children with regards to Type I and Type II Diabetes and its management (Wang et al., 2010).

The School Bill of Rights for Children with Diabetes requires that diabetic children be allowed to check their blood sugar, use emergency sugar to treat hypoglycemia, inject insulin, eat snacks, drink water, use the restroom whenever necessary, eat lunch at appropriate times, and participate fully in all activities (DiabetesInfo, n.d.). It is up to the parents to make sure that school personnel are fully educated and comply with the child's needs. Children who feel they can overcome obstacles and have a positive outlook on their future are more likely to do better academically. According to Perfect & Jaramillo (2012), children who reported fewer diabetes-related worries performed better in school. Therefore, diabetes management in school-aged children would lead to diabetes management in adulthood, decreasing risks for coronary artery disease, metabolic syndrome, diabetic ketoacidosis, and other life-threatening complications.

One study evaluated parents perspectives of diabetes management in schools by exploring 309 parents of ethnically heterogeneous children with diabetes by recruitment from a community-based and a university-based diabetes outpatient clinic (Jacquez et al., 2008). During this study many children did not have a written care plan or a nurse at school; however, it was found that of those children who did have a plan, more White children had support than the non-White children. According to the parents in this study, children received inadequate diabetes management support in schools, but most of the parents did not have the knowledge of the federal laws necessary to protect their children.

Another study from 2007 evaluated a GMP that used the TUMAINI concept (in hope to prevent diabetes) to achieve a proportional slower diabetes incidence increase with the intervention and with metabolic changes maintained after discontinuation of the intervention (Schwarz et al., 2007). To achieve normoglycemic goals, individuals must answer the following: (a) Who is at risk for diabetes? (b) How do people at risk receive the necessary information and motivation to change their lifestyle? (c) What is the best way to maintain lifestyle changes over a long time? This study concluded that the only way to reduce the personal and socioeconomic burden of diabetes and its associated complications is to prevent diabetes. The implementation and continued evaluation of a glycemic program will require an integrated, international approach if significant reduction is to be successful against the premature morbidity and mortality diabetes causes.

According to the National Association of School Nurses, managing diabetes at a school through an appropriate glycemic program is most effective when there is a partnership among students, parents, health care providers, school nurses, teachers, coaches and ancillary school personnel (National Association of School Nurses, 2012). The school nurse provides health expertise and coordination and is required to develop a health care plan for each student with diabetes and provide continued oversight for implementation and evaluation of the effectiveness of the plan in the school setting.

Conceptual Model

This project sought to evaluate a previous change in practice by exploring health outcomes prior to and after revision of the program. A logic model provided the basic framework for an evaluation of a program such as the GMP. It is a visual presentation that describes the

program in evaluation terms by illustrating a program's theory of change by way of showing how day-to-day activities connect to the outcomes that the program is attempting to achieve. A graphic depicting a flowchart lays out program activities and outcomes using boxes and arrows to connect the boxes in relation to the activities and outcomes (Grantcraft, 2006)). The term "program" is used throughout the project; however, the logic model is equally useful for describing group work, team work, community-based collaboration, and other complex organizational processes (University of Wisconsin–Extension, 2014).

The logic model used to depict the health outcomes prior to and after implementation of the GMP was a local evaluation project. This evaluation project was used to assist in building capacity in program evaluation just like the local GMP being evaluated. The local evaluation project includes five core components of the program action: (a) inputs: resources and investments; (b) outputs: activities, services, and events; (c) outcomes: results for groups and communities; (d) assumptions: the way we think the program will work; and (e) external factors: public health initiatives and outcome mandates (see Figure 1; University of Wisconsin–Extension, 2014).

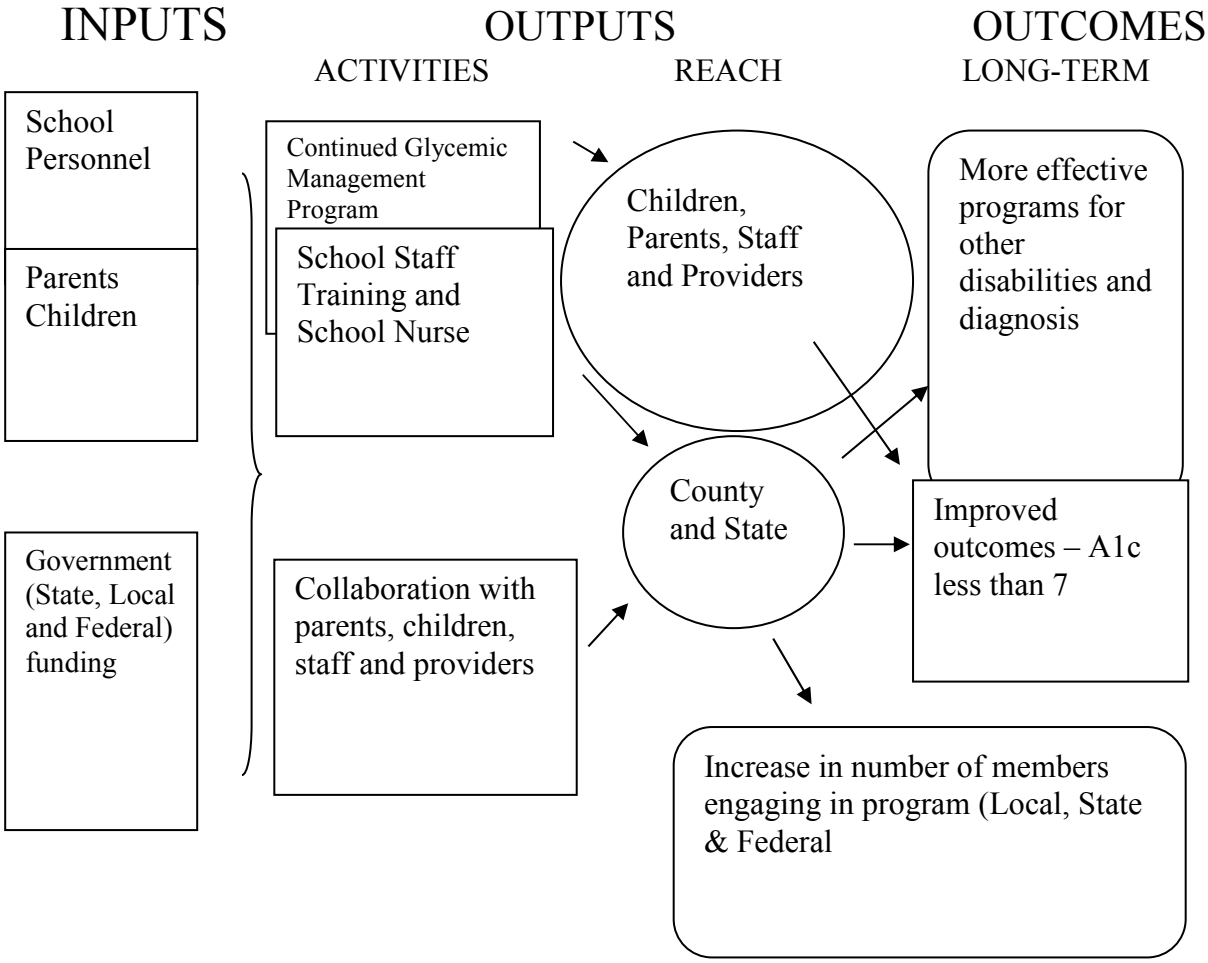

Figure 1. Local evaluation project: Glycemic management program. Shapes and arrows to depict the flow of the local evaluation project including 5 core components of the program action: (1) inputs, (2) outputs, (3) outcomes, (4) assumptions, (5) external factors. Adapted from the "Local Evaluation Project" by the University of Wisconsin – Extension, 2014.

Most of the literature review of the logic model revealed studies that employed a pre- and post- program evaluation with use of external factors and their impact on program outcomes (Rehfuses, & Rohwer, 2013). The use of the logic model allows authors to focus on the system in which the intervention is introduced by recognition of the underlying assumptions, theories, and contextual factors that play a role in the relationship between the intervention and the outcomes (Rehfuses, & Rohwer, 2013). Logic models support design, planning, communication, evaluation and learning when used to explain an idea, resolving a challenge, and/or assessing progress. The logic model is a graphic way to organize information and display thinking all persons use a visual approach in our minds on how the world functions. There are also challenges to logic models as they are graphically displayed and typically do not take unintended consequences into account; every program can have side effects and consequences. In other words, the modeling process usually does not include program critics, and most stakeholders are not grounded in the study.

Section 3: Approach

Project Design/Methods

The problem addressed in this DNP project was the high prevalence of childhood diabetes in the school system and how the school's GMP was utilized to maintain control. The purpose of this DNP project was to evaluate the established GMP in the school system for adolescents with Type I and Type II diabetes. The School Bill of Rights for Children with Diabetes requires that diabetic children be allowed to check their blood sugar, use emergency sugar to treat hypoglycemia, inject insulin, eat snacks, drink water, use the restroom whenever necessary, eat lunch at appropriate times, and participate fully in all activities (DiabetesInfo, n.d.).

The design most appropriate for this project was a quantitative evaluation method through use of a retrospective analysis of archival data collected from the school's database. I used a quantitative evaluation method in measuring how the average hemoglobin A1C changed after implementation of the updated GMP in 2010. Quantitative evaluation methods consist of frequencies, percentages, or statistics that document actual existence or absence of problems, behaviors, or occurrences (Babbie, 2010). This method is typically objective and requires use of standardized measures so that varying experiences can fit into a limited number of categorical responses (Babbie, 2010). The standardized measure used was the independent sample *t* test to compare pre- and post hemoglobin A1c of the updated GMP. The independent sample *t* test compares one measured characteristic between two groups of measurements. The *t* test is sometimes called Student's *t*; however "Student" is a fictitious name used by W. S. Gossett in 1908 to publish the *t* distribution based on his variable findings on the height and length of the

left middle finger of criminals in a local prison (Encyclopedia.com, 2008). Gosset's belief was that small samples would specify a high impression of how accurate the population mean is estimated. This study used a small population with fewer than 100 samples of each year evaluated.

Population and Sampling

My project population was located within a rural community in Southeastern North Carolina consisting of a variety of ethnicities, including immigrants, and homes with both parents working as well as single parent homes. Robeson county's age-adjusted diabetes death rate in the year 2007 was 52.7 per 100,000 as compared to the state (North Carolina) at 23.8 per 100,000 (Robeson County Health Department, 2010). Trend data indicates that Robeson County's diabetes death rates have remained significantly higher than the state rates but have decreased since 2006. Another pertinent statistic is that Robeson County's obesity rate in the year of 2008 was 43.1 per 100,000 as compared to the state at 29.5 per 100,000.

The pre-evaluation period occurred from January 2009 to December 2010 and during this time data was collected for evaluation of the adolescents with diabetes, hemoglobin A1c values at the rural high school in the southeastern part of North Carolina. The GMP was then updated in 2010 and following the update, the post-evaluation period occurred from January of 2015 to December of 2015 to provide a chance for the program to get utilized. During the year of 2015, evaluation focused on the adolescents with diabetes and their hemoglobin A1c results.

Data Collection

The data were collected by the institution and consisted of approximately 2,100 students from 9th to 12th grades, and out of those students, there was an average of approximately 83

students from the evaluated years of 2009 and 2015 who had diabetes. The data consisted of a hemoglobin A1c before and after the year of 2010 in which the GMP was revised. The pre- and post-A1c values allow for a comparison to the national average. This comparison assisted in determining any variations between the national A1c averages to the local A1c averages. The ages of the study sample ranged from 15 to 18 years old, and other demographic variables were discussed in the local background and context section. To protect the individual adolescents, there were no identifiable information available throughout this study, therefore requiring no informed consent.

Data Analysis

Data analysis began by aggregating the pre-hemoglobin A1c values (means) and then the post-A1c values (means) from the years 2009 and 2015. The use of the independent *t* test was carried out using the SPSS statistics. A limitation of SPSS was that it lacked vigorous survey methods however this was not used within this project. The benefit of utilizing SPSS was that it is a powerful program for analyzing numerical data rather than manipulating it by hand. SPSS also allows for thorough exploration of data by way of distribution, correlation, and frequencies (Stumm, 2011).

As a result of this data aggregation, there was a pretest overall mean and standard deviation and one posttest overall mean and standard deviation for each of the two years, 2009 and 2015 in the study. These findings were used to determine the efficacy of the revision of the GMP.

Project Evaluation Plan

The evaluation of the established GMP was performed using a retrospective analysis of archival data and as in every project evaluation, there is potential for change by way of improvement or potential for biases. There are mediating variables that could contribute to the biases, for example, self-care behaviors, school personnel diabetes awareness, dietary awareness, classmate awareness, existence of an MDP, and physical education, which can all influence blood glucose values and glycemic control (Pansier & Schulz, 2015).

The assessment of program efficacy was accomplished using two independent samples *t* tests, one from each year, to compare pretest and posttest hemoglobin A1c. The *t* statistics were evaluated using a two-tailed test at the 0.05 level of significance regardless of the direction of the relationship hypothesized but on the possibility of the relationship in both directions. If the posttest hemoglobin A1c was significantly lower than the pretest, then revision of the GMP demonstrated efficacy.

Summary

Appropriate glycemic control in the school system requires an appropriate functioning GMP to increase awareness of school personnel, adolescents involved, and parents so that glycemic control is also extended into the home. School personnel are underprepared to deal with chronic medical conditions adversely affecting children. This calls for more extensive training in chronic illnesses. An appropriate GMP ensures that each adolescent with chronic medical conditions such as diabetes mellitus, hypertension, and asthma will have a specific federal law-mandated MDP specifically for their needs and well-trained school personnel to assist in carrying out planned goals.

The School Bill of Rights for Children with Diabetes requires that diabetic children be allowed to check their blood sugar, use emergency sugar to treat hypoglycemia, inject insulin, eat snacks, drink water, use the restroom whenever necessary, eat lunch at appropriate times, and participate fully in all activities (DiabetesInfo, n.d.). It is up to the parents to make sure that school personnel are fully educated and comply with the child's needs. Children who feel they can overcome obstacles and have a positive outlook on their future are more likely to do better academically. According to Perfect & Jaramillo (2012), children who reported fewer diabetes-related worries performed better in school. Furthermore, diabetes management in school-aged children would lead to diabetes management in adulthood, decreasing risks for coronary artery disease, metabolic syndrome, diabetic ketoacidosis, and other life-threatening complications.

In conclusion, data from pre- and post-average hemoglobin A1C were obtained from the school's data base from 2010 until 2015 to evaluate the effectiveness of the GMP. The logic model of outcome evaluation was used to assess the relationship between the elements of the program.

Section 4: Discussion and Implications

Summary and Evaluation

Adolescents with Type 1 and Type II diabetes should monitor their blood glucose, food intake, administer insulin, and participate in all activities including physical education and sports during school hours to maintain glycemic control. The problem addressed in this DNP project was the lack of resources, compliance to the program, need to ensure adolescents' safety, need to ensure awareness, and need to minimize comorbidities. The goal was to determine if an existing GMP has met its objectives and make recommendations for continuation, revision, or discontinuation. A quantitative evaluation method called an independent sample *t* test was used to compare pre- and post-hemoglobin A1c of the updated GMP to determine if the updated program was successful.

Discussion of Findings: Literature and Framework

The problem addressed in this DNP project was the high prevalence of childhood diabetes in the school system and how effective the school's GMP was in maintaining control. The data consisted of approximately 2,100 students from 9th to 12th grade, and out of those students there were 77 participants from 2010 and 89 participants from 2015 with diagnosis of diabetes. The data consist of a hemoglobin A1c before and after the year of 2010 in which the GMP was revised. A *t* test for independent samples was conducted using SPSS to determine differences between the groups. Levene's test for homogeneity of variance between groups found: $t\ obt(164) = -4.24,\ p > .05.$ The relevant *t* test procedures yielded findings of $p = 0.000$ and $t = 164$. The *p* value is less than or equal to .05; therefore there is a statistically significant difference between the two conditions (A1c in 2010 and A1c in 2015). I concluded

that the differences between both condition means are not likely due to change and are probably due to the updated GMP.

Table 1

Group Statistics t-*Test*

	A1c 09	N	Mean	Std. deviation	Std. error mean
DV 2015	1.00 Group1 – 2010	77	8.6506	2.48806	.28354
	2.00 Group 2 – 2015	89	7.2955	1.58809	.16834

Note. The group consisted of 77 participants from 2010 and 89 participants from 2015 with diagnosis of diabetes.

The independent sample *t* test provided verification that the updated GMP from 2010 had met its objectives and goals. The independent sample *t* test was conducted to compare the A1c of 77 students from 2009 (A1c09) prior to the updated GMP and A1c of 89 students from 2015 (DV2015) after updated GMP. There was a significant difference in the scores for A1c09 level 1(M = 8.6506, SD = 2.48806) and DC2015 level 2 (M = 7.2955, SD = 1.58809). The relevant *t*-test procedures yielded findings of p = 0.000.

For the independent samples *t* test, Cohen's *d* was determined by calculating the mean difference between the two groups and then dividing the results by the pooled standard deviation. The effect size for this analysis (d = 0.65) was found to be equal to Cohen's convention for a medium size effect meaning that Group 1 was in the 73rd percentile of Group 2, and there was a no overlap of 38.2% in the two distributions. These results indicated that the first group (M = 8.6, SD = 2.48) had a moderate higher A1c average than the second group (M = 7.29, SD = 1.58) of

adolescents. These results suggest that the updated GMP was associated with an improvement in the A1c percentages of adolescents. Students with diabetes should have a written care plan put in place to provide the appropriate care needed. A diabetes Medical Management Plan is the basis for an Individualized Education Program (IEP) and should be written by a school team consisting of parents, school staff, and the student (ADA, 2014).

Implications

A GMP is based on group intervention consisting of adolescents, parents, school personnel and school nurse. The goal is to motivate adolescents with diabetes and at risk for diabetes to self-manage their diabetes and make lifestyle changes with assistance (Schwarz et al., 2007). Health intervention in the school system does not have to solely pertain to diabetes but has the potential to prevent a number of co morbidities such as metabolic syndrome, cardiovascular disease, cancer, emphysema, and osteoporosis.

In 2012, over 29 million Americans had diabetes, and this number has increased by over a million newly diagnosed cases each year. There are an additional 86 million Americans who have prediabetes, which means they are at increased risk for developing Type II diabetes (Community Guide, 2017). The implication for increased awareness in the schools is that it is important for preventing the increase in diabetes and prediabetes and the increase in health care costs related to these diagnoses. The GMP allows for case management and self-management interventions including coaching and counseling on lifestyle behaviors, diet, and exercise.

Strengths and Limitations

The main assumption of this study was that by evaluating the updated GMP, I would find data that showed accurate measures quantifying glycemic control in adolescents. Limitations of

this study included the small, nonrandom sample from a single local setting, resulting in a reduction of data to numbers results in a loss of information. Another limitation was that multiple school nurses and health care professionals obtained the data over the years studied and participated in updating the GMP, resulting in some variability of the program strategies and results. The strengths of the project presentation were that issues could be examined in detail with a more holistic focus. Research findings are generalized to the population about which information is required. The research samples were selected to ensure that the results were representative of the population studied.

Analysis of Self

During my DNP project journey, I have grown as a practitioner and a researcher on a personal and a professional level. My experience as a DNP student and a family nurse practitioner has taught me to become more "multi-tasked" by providing care to my patients, continuing my education, and performing research over the last 4 years. I have proven that I deserve this DNP title. When starting this DNP course I was confident I did not need to spend time on courses and was a procrastinator. Procrastinating, working full-time, and being a full-time parent did not allow enough time to properly proofread, resulting in repeated need for editing. Before this class, my strengths were that I had the ability to pick out good content and concentrate on my research topic; however, when I chose this study topic, I did not realize that it could have been approached in so many ways. My weakness is statistics and sustaining the flow of the paper without elaborating on multiple topics.

Summary and Conclusions

The school's GMP was updated in 2010 to improve diabetes management among high school adolescents. The changes in the program allowed more one-to-one care management based on the child's individual needs. This program allowed parents more involvement in their child's care. The research determined that the updated GMP was successful in glycemic management as evident by the lowering of the hemoglobin A1c readings in the year 2015. For clarification to the readers, an A1c is the percentage average blood sugar over 3 months. For instance, in 2009 the mean average A1c was 8.6% (180 – 190 mg/dl) and the mean average in 2015 was 7.2% (150 mg/d). These statistics suggest that the updated GMP has improved glycemic management via empowerment and individualizing care.

Section 5: Scholarly Product for Dissemination

Adolescents with Type 1 and Type II diabetes need to monitor their blood glucose and food intake, administer insulin, and participate in all activities including physical education and sports during school hours to maintain glycemic control. Concerns for adolescents and their parents include the knowledge and support of school personnel and classmates, physical education, school lunches, and the MDP. Local boards of education, school personnel, adolescents, and their parents should take an active role in advocating for appropriate GMPs for the improvement of diabetes management during school hours. The purpose of this project was to evaluate a GMP in a school system in a rural area in the Southeastern United States. The goal was to determine if the existing GMP had met its objectives, and then make recommendations for continuation, revision, or discontinuation. The logic model provided the basic framework for the evaluation of the GMP by use of a graphic flowchart depicting the health outcomes prior to and after the implementation of the program. An outcome evaluation found the updated GMP was associated with the lowering of hemoglobin A1c readings. The mean A1c in 2009 was 8.6% (180 – 190 mg/dl), with the mean decreasing to 7.2% (150 mg/d) in 2015. The relevant *t*-test procedures yielded findings of $p = 0.000$. The effect size for this analysis ($d = 0.65$) was found to be equal to Cohen's convention for a medium size effect meaning that Group 1 (2010) was in the 73rd percentile of Group 2 (2015), and there was a nonoverlap of 38.2% in the two distributions. These results indicated that the first group ($M = 8.6$, $SD = 2.48$) had a slightly higher A1c average than the second group ($M = 7.29$, $SD = 1.58$) of adolescents suggesting that the updated GMP was associated with an improvement in the A1c percentages of adolescents. It is unknown whether this reflects a causal relationship; however, the program should be continued in its

current context, and consideration should be given to expansion into similar contexts to determine if outcome improvements can be replicated. The changes in the program allowed for one-to-one care management based on the child's individual needs. This program allowed parents more involvement in their child's care. In 2009, the mean average A1c was 8.6% (180 – 190 mg/dl) and the mean average in 2015 was 7.2% (150 mg/d). These statistics suggest that the updated GMP has improved glycemic management with empowerment and individualizing care.

My project population was located in a rural community in Robeson County, North Carolina consisting of a variety ethnicities, including of immigrants, and homes with both parents working as well as single parent homes.

Although statistics are not available for adolescents or by individual age groups, the rates used for this project were be based on the adult statistics. I assumed that if prevention and awareness were not supported in the school system, these adolescents will become adults who will eventually be included in these statistics. Robeson county's age-adjusted diabetes death rate in the year 2007 was 52.7 per 100,000 as compared to the state (North Carolina) at 23.8 per 100,000 (Robeson County Health Department, 2010). Trend data indicated that Robeson County's diabetes death rates have remained significantly higher than the state rates but have decreased since 2006. Another pertinent statistic is that Robeson County's obesity rate in the year of 2008 was 43.1 per 100,000 as compared to the state at 29.5 per 100,000.

According to the 2015 census, the population of Robeson County was 130,866 with the median age of 34. Robeson County's median household income was $29,594, and the average household net worth was $280,015 (National Association of Realtors, 1995–2015). In Robeson County, 59% of people were married, 41% were single, 41% of residents 18 and over graduated

from high school, and 13% completed a bachelor's degree or higher. According to the census of 2015, Robeson County had approximately 38,143 children from ages of 0–19 and approximately 41,629 of elders 50 years of age and older out of the county's 130,866 population. These numbers are very important to know for providers of care and education to a relatively young community with such complex health problems. The incidence of Type II diabetes in the poor population was 20.4 per 1,000 person per year compared with their middle-income counterparts. Poor, underserved persons with diabetes were less likely to visit a diabetes clinic (Hsu et al., 2012).

A GMP is based on group intervention consisting of adolescents, parents, school personnel and school nurse. The goal is to motivate adolescents with diabetes or at risk for diabetes to self-manage their diabetes and make lifestyle changes with assistance (Schwarz et al., 2007). Health intervention in the school system does not have to solely pertain to diabetes but has the potential to prevent a number of co morbidities such as metabolic syndrome, cardiovascular disease, cancer, emphysema and osteoporosis.

Glycemic control in all schools would be cost effective to the county and the United States if all school personnel would adhere to the healthcare guidelines and care plans already existing throughout each state. Diabetes was the seventh leading cause of death in 2006. Diabetes remains the leading cause of end stage renal disease, amputations, and blindness. Direct health care costs at approximately $116 billion annually are attributable to diabetes; therefore, the goal is to improve treatment and prevention of diabetes among our younger population (ADA, 2014).

In 2012, over 29 million Americans had diabetes, and this number has increased by over a million newly diagnosed cases each year. There are an additional 86 million Americans who

have prediabetes which means they are at increased risk for developing Type II diabetes (Community Guide, 2017). The implication for increased awareness in the schools is that it is important for preventing the increase in diabetes and prediabetes and the increase in health care cost related to these diagnoses. The GMP allows for case management and self-management interventions including coaching and counseling on lifestyle behaviors, diet, and exercise.

According to the NDEP (2014), based on the data from 2012, approximately 208,000 young people under that age of 20 years old were diagnosed with Type 1 or Type II diabetes mellitus. According to the ADA (2014), "some day care centers may refuse admission to children with diabetes, and children in the classroom may not be provided the assistance necessary to monitor blood glucose and may be prohibited from eating needed snacks" (p. 1).

Prior evaluations have indicated that school personnel are underprepared to deal with chronic conditions including childhood obesity, diabetes mellitus, hypertension, asthma, heart disease, and sickle cell anemia that adversely affect healthy living of adolescents. This calls for extensive training in managing children with chronic illnesses. According to The National Center for Education Statistics almost 70% of all public school teachers feel underprepared to meet the challenges of working with children with disabilities and lack confidence in their ability to educate and care for these young children (University of North Carolina at Chapel Hill, 2006). The goal of evaluating the GMP was to ensure that school personnel, families, and peers are aware of the diabetic needs of school-aged children.

One study evaluated parents' perspectives of diabetes management in schools by exploring 309 parents of ethnically heterogeneous children with diabetes recruited from a community-based and a university-based diabetes outpatient clinic (Jacquez et al., 2008). During

this study many children did not have a written care plan or a nurse at school; however, it was found that of those children who did have a plan, more White children had support than the non-White children. According to the parents in this study, children received inadequate diabetes management support in schools but most of the parents did not have the knowledge of the federal laws necessary to protect their children.

Another study from 2007 evaluated a GMP that used the TUMAINI concept (hope to prevent diabetes) to achieve a proportional slower diabetes incidence increase with the intervention and with metabolic changes maintained after discontinuation of the intervention (Schwarz et al., 2007). To achieve normoglycemic goals individuals must answer the following: (1) who is at risk for diabetes? (2) How do people at risk receive the necessary information and motivation to change their lifestyle? (3) What is the best way to maintain lifestyle changes over a long time? This study concluded that the only way to reduce the personal and socioeconomic burden of diabetes and its associated complications is to prevent diabetes. The implementation and continued evaluation of a glycemic program will require an integrated, international approach if significant reduction is successful in the premature morbidity and mortality it causes.

According to the National Association of School Nurses, managing diabetes at a school through an appropriate glycemic program is most effective when there is a partnership among students, parents, health care providers, school nurses, teachers, coaches and ancillary school personnel (National Association of School Nurses, 2012). The school nurse provides health expertise and coordination as well as required to develop a health care plan for each student with diabetes, provide continued oversight for implementation and evaluation of the effectiveness of the plan in the school setting.

The GMP has been officially in place since September 5, 2002 when it became law as the *Senate Bill 911: Care of School Children with Diabetes* (Public Schools of Robeson County, 2015). The *Senate Bill 911* provides a standardized diabetic care plan for children with diabetes and parents must request in writing that the care plan be developed. According to the high school's nurse and the county's health services supervisor, the evaluated GMP was updated in the year 2010 secondary to the reported average A1c of 10% among 77 adolescents with diagnosis of diabetes mellitus. The updated GMP allows more participation from adolescents and their parents along with in-service requirements for school personnel. The ADA recommends a more stringent target of an A1c less than 6.5% to reduce microvascular complications, microvascular disease and mortality National Diabetes Education Initiative, 2016).

The project sought to evaluate a previous change in practice by exploring health outcomes prior to and after revision of the program. A logic model provides the basic framework for an evaluation of a program such as the GMP. It is a visual presentation that describes the program in evaluation terms by illustrating a program's 'theory of change' by way of showing how day to day activities connect to the outcomes that the program is attempting to achieve. A graphic depicting a flowchart lays out program activities and outcomes using boxes and arrows to connect the boxes in relations to the activities and outcomes (Grantcraft, 2006)). The term "program" is used throughout the project however the logic model is equally useful for describing group work, team work, community-based collaboration and other complex organizational processes (University of Wisconsin – Extension, 2014).

The logic model was used to depict the health outcomes prior to and after implementation of the GMP was a local evaluation project. This evaluation project is used to assist in building

capacity in program evaluation just like the local GMP being evaluated. The local evaluation project includes 5 core components of the program action: (1) inputs: resources and investments, (2) outputs: activities, services, and events, (3) outcomes: results for groups and communities, (4) assumptions: the way we think the program will work, and (5) external factors; public health initiatives and outcome mandates (see Figure 1) (University of Wisconsin – Extension, 2014).

The problem addressed in this DNP project was the high prevalence of childhood diabetes within the school system and how the school's GMP is utilized to maintain control. The purpose of this DNP project was to evaluate the established glycemic monitoring program (GMP) within the school system for adolescents with Type I and Type II diabetes. The design most appropriate for this project was a quantitative evaluation method through use of a retrospective analysis of archival data collected from the school's database. This method is typically objective and requires use of standardized measures so that varying experiences can fit into a limited number of categorical responses (Babbie, E. R., 2010). The standardized measure used was the independent sample t-test to compare pre and post hemoglobin A1c of the updated GMP. The independent sample t-test compares one measured characteristic between two groups of measurements. Data analysis began by aggregating the pre-hemoglobin A1c values (means) and then the post-A1c values (means) from the years 2009 and 2015. The use of the independent t-test was carried out using the SPSS statistics. A limitation of SPSS was that it lacked robust and survey methods however this was not used within this proposal. The benefit of utilizing SPSS was that it is a powerful program for analyzing numerical data rather than manipulating it by hand. SPSS also allows for thorough exploration of data by way of distribution, correlation and frequencies (Stumm, 2011).

As a result of this data aggregation, there was a pretest overall mean and standard deviation and one posttest overall mean and standard deviation for each of the two years, 2009 and 2015 in the study. These findings were used to determine the efficacy of the revision of the GMP.

My project population is located within a rural community in the southeastern area of North Carolina consisting of a variety of immigrants, ethnicities, both parent working homes, and single parent homes. Robeson county's age-adjusted diabetes death rate in the year 2007 was 52.7 per 100,000 as compared to the state (North Carolina) at 23.8 per 100,000 (Robeson County Health Department, 2010). Trend data indicates that Robeson County's diabetes death rates have remained significantly higher than the state rates but have decreased since 2006. Another pertinent statistic is that Robeson County's obesity rate in the year of 2008 was 43.1 per 100,000 as compared to the state at 29.5 per 100,000.

The pre-evaluation period occurred from January 2009 to December 2010 and during this time data was collected for evaluation of the adolescents with diabetes, hemoglobin A1c values at the rural high school in the southeastern part of North Carolina. The GMP was then updated in 2010 and following the update the post-evaluation period occurred from January of 2015 to December of 2015 to provide a chance for the program to get utilized. During the year of 2015 evaluation focused on the adolescents with diabetes and their hemoglobin A1c results. The ages of the study sample ranged from fifteen to eighteen years old and other demographic variables were discussed in the local background and context section.

The assessment of program efficacy was accomplished using two independent samples *t*-tests, one from each year, to compare pretest and posttest hemoglobin A1c. The *t* statistics was

evaluated using a two - tailed test at the 0.05 level of significance regardless of the direction of the relationship hypothesized but on the possibility of the relationship in both directions. If the posttest hemoglobin A1c was significantly lower than the pretest then revision of the GMP demonstrated efficacy.

Appropriate glycemic control within the school system requires an appropriate functioning GMP to increase awareness of school personnel, adolescents involved and parents so that glycemic control is also extended into the home. School personnel are underprepared to deal with chronic medical conditions adversely affecting children therefore calling for more extensive training in chronic illnesses. An appropriate GMP would ensure that each adolescent with chronic medical conditions for instance, Diabetes Mellitus, Hypertension and Asthma will have a specific federally law mandated MDP specifically for their needs and well-trained school personnel to assist in carrying out planned goals.

The problem addressed in this DNP project was the high prevalence of childhood diabetes within the school system and how the school's GMP is utilized to maintain control. The data consisted of approximately 2,100 students from 9th to 12th grade and out of those students there were 77 participants from 2010 and 89 participants from 2015 with diagnosis of diabetes. The data consist of a hemoglobin A1c before and after the year of 2010 in which the GMP was revised. A t-test for independent samples was conducted using SPSS to determine differences between the groups. Levene's test for homogeneity of variance between groups found: $t\ obt(164) = -4.24,\ p > .05.$ The relevant t-test procedures yielded findings of p = 0.000 and t = 164.

The independent sample t-test provided verification that the updated GMP from 2010 has met its objectives and goals. The independent sample t-test was conducted to compare the A1c of 77 students from 2009 (A1c09) prior to the updated GMP and A1c of 89 students from 2015 (DV2015) after updated GMP. There was a significant difference in the scores for A1c09 level 1(M=8.6506, SD=2.48806) and DC2015 level 2 (M=7.2955, SD=1.58809). The relevant t-test procedures yielded findings of p = 0.000.

For the independent samples T-test, Cohen's d was determined by calculating the mean difference between the two groups, and then dividing the results by the pooled standard deviation. The effect size for this analysis (d = 0.65) was found to be equal to Cohen's convention for a medium size effect meaning that Group 1 was in the 73 percentile of Group 2, and there was a nonoverlap of 38.2% in the two distributions. These results indicated that the first group (M=8.6, SD = 2.48) had a slight higher A1c average than the second group (M = 7.29, SD = 1.58) of adolescents. These results suggest that the updated GMP succeeded in improving the A1c percentages of adolescents. Students with diabetes should have a written care plan put in place to provide the appropriate care needed. A Diabetes Medical Management Plan is the basis for an IEP and should be written by a school team consisting of parents, school staff, and the student (ADA, 2014).

Limitations of this study included the small, non-random sample from a single local setting therefore resulting in a reduction of data to numbers results in a loss of information. Another limitation was that multiple school nurses and health care professionals obtained the data over the years studied and participated in updating the GMP resulting in some variability of the

program strategies and results. The strengths of the project presentation were that issues could be examined in detail and a more holistic focus.

In conclusion, the school's GMP was updated in 2010 to improve diabetes management among high school adolescents. The changes in the program allowed one to one care management basing it on the child's individual needs. This program allowed parents more involvement in their child's care. The research determined that the updated GMP was successful in glycemic management as evident by the lowering of the hemoglobin A1c readings in the year 2015. An A1c is the percentage average that a blood sugar has been for 3 months. For instance, in 2009 the mean average A1c was 8.6% (180 – 190 mg/dl) and the mean average in 2015 was 7.2% (150 mg/d). These statistics suggest that the updated GMP has improved Glycemic management with empowerment and individualizing care.

References

American Diabetes Association. (2014). Diabetes care: Care of children with diabetes in the school and day care setting. Retrieved from http://care.diabetesjournals.org/content/26/suppl_1/s131.full.

Babbie, E. R. (2010). *The practice of social research* (12th ed.). Belmont, CA: Wadsworth Cengage.

Benefits of. (2012). Benefits of SPSS. Retrieved from http://benefitof.net/benefits-of-spss/.

Carroll, A. E. & Marrero, D. G. (2006). How do parents perceive their adolescent's diabetes: A qualitative study. *Diabetic Medicine, 23*, 1222-1224. doi:10.1111/j.1464-5491.2006.01961.x.

Centers for Disease Control and Prevention. (2013). Childhood obesity facts. Retrieved from www.cdc.gov/healthyyouth/obesity/facts.htm.

Centers for Disease Control and Prevention. (2011). CDC newsroom. Retrieved from www.cdc.gov/media/releases/2011/p0427_youthdiabetes.html.

Centers for Disease Control and Prevention. (2013). Evaluation planning: What is it and how do you do it? Retrieved from www.cdc.gov/healthcommunication/research/evaluationplanning.pdf.

Community Guide. (2017). *What works: Diabetes prevention and control: Evidence-based interventions for your community.* Retrieved from https://www.thecommunityguide.org/sites/default/files/assets/What-Works-Diabetes-factsheet-and-insert.pdf.

Creative Research Systems (2013). The survey system. Retrieved from www.surveysystem.com/sdesign.htm.

DiabetesInfo. (n.d.). Social issues: Social issues for the type 1 diabetic. Retrieved from www.diabetes-info.co.uk/managing-diabetes/social-issues.html.

Dixon, L. (2003). A normal lifestyle? Challenges facing children with diabetes and their families. *Paediatric Nursing, 15*(8), 35-38. doi:10.7748/paed2003.10.15.8.35.c878Doody, C. M., & Doody, O. (2011). Introducing evidence into nursing practice: using the IOWA model. *PubMed, 20*(11), 661-664. doi:10.12968/bjon.2011.20.11.661.

Encyclopedia.com (2008). Gosset, William Sealy: International encyclopedia of the social sciences. Retrieved from http://www.encyclopedia.com.

Freeborn, D., Loucks, C. A., Dyches, T., Roper, S. O., & Mandelco, B. (2013). Addressing school challenges for children and adolescents with type 1 diabetes: The nurse practitioner's role. *Journal for Nurse Practitioners 9*(1), 11–16.doi:10.1016/j.nurpra.2012.11.005.

Fruh, S. M., Mulekar, M. S., Hall, H. R., Fulkerson, J. A., Hanks, R. S., Lemley, T., . . . Dierking, J. (2013). Perspectives of community health advocates: Barriers to healthy family eating patterns. *Journal for Nurse Practitioners, 9*(7), 416 – 421. doi:10.1016/j.nurpra.2013.04.010.

General Assembly of NC (2002). Session law 2002 – 103: Senate bill 911. Retrieved from https://www.ncleg.net/sessions/2001/bills/senate/html/s911v4.html.

Grantcraft (2006). *Mapping change: Using a theory of change to guide planning and evaluation.* Retrieved from http://www.grantcraft.org/assets/content/resources/theory_change.pdf.

Guthrie, D. W., Bartsocas, C., Jarosz-Chabot, P., & Konstantinova, M. (2003). Psychosocial issues for children and adolescents with diabetes: Overview and recommendations. *American Diabetes Association: Diabetes Spectrum,* 16(1), 7-12. doi:10.2337/diaspect.16.1.7.

Haemer, M. A., Grow, H. M., Fernandez, C., Lukasiewicz, G. J., Rhodes, E. T., Shaffer, . . . Estrada, E. (2014). Addressing prediabetes in childhood obesity treatment programs: Support from research and current practice. *Childhood Obesity, 10*(4): 292–303. doi:10.1089/chi.2013.0158.

Harvard Family Research Project (2005). Promising practices: Eight outcomes models. Retrieved from http://www.hfrp.org/evaluatiiionnn/the-evaluation-exchange/issue-archive/evaluation-methodology/eight-outcome-models

HowTo.gov (2013). Helping agencies deliver a great customer experience. Retrieved from www.howto.gov.

Hsu, C.-C., Lee, C.-H., Wahlqvist, M. L., Huang, H.-L., Chang, H.-Y., Chen, L., . . . Cheng, J.-C. (2012). Poverty increases type 2 diabetes incidence and inequality of care despite universal health coverage. *Diabetes Care, 35*(11), 2286-2292. doi:10.2337/dc11-2052.

Innovations Insights (2006). Using surveys for data collection in continuous improvement (Series no. 14). Office of Planning and Institutional Assessment, mennsylvania State University. Retrieved from http://www.virginia.edu/processsimplification/resources/PennState%20Surveys.pdf.

Jacquez, F., Stout, S., Alvarez-Salvat, R., Fernandez, M., Villa, M., Sanchez, J., . . . Delamater, A. (2008). Parent perspectives of diabetes management in schools. *Diabetes Educator, 34*(6), 996–1003. doi:10.1177/0145721708325155.

Kettner, P. M., Moroney, R. M., & Martin, L. L. (2008). *Designing and managing programs: An effectiveness-based approach* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Kitzinger, J. (1995). Qualitative research: Introducing focus groups. *BMJ, 311*(7000), 299-302. doi:10.1136/bmj.311.7000.299.

LoBiondo, G. & Haber, J. (2014). Nursing research: Methods and critical appraisal for evidence-based practice (8th ed.). St. Louis, MO: Mosby.

Lowes (2008). Managing type 1 diabetes in childhood and adolescence. *Nurs Stand,* Jul 9 – 15, 44 (50). https://www.ncbi.nlm.nih.gov/pubmed/18686400.

Main, E. (2012). Obesity problem and children: School lunch program makes kids fat. *Rodale News*. Retrieved from www.rodalenews.com.

Mathioudakis, N., Pronovost, P. J., Cosgrove, S. E., Hager, D., & Golden, S. H., (2015). Modeling inpatient glucose management programs on hospital infection control programs: An infrastructural model of excellence. *Joint Commission Journal on Quality and Patient Safety, 41*(7), 325-336. doi:10.1016/s1553-7250(15)41043-8

Mayo Clinic (2014). Diseases and conditions. Retrieved from www.mayoclinic.org.

National Association of Realtors. (1995 – 2015). Robeson county, NC: lifestyle & demographics. Retrieved from http://www.realtor.com/local/Robeson-County_NC/lifestyle?v7+1.

National Association of School Nurses. (2012). Diabetes management in school settings. Retrieved from

https://www.nasn.org/PolicyAdvocacy/PositionPapersandReports/NASNPositionStatementsFullView/tabid/462/ArticleId/22/Diabetes-Management-in-the-School-Setting-Adopted-January-2012.

National Diabetes Education Initiative. (2016). *Diabetes management guidelines: American diabetes association (ADA) 2016 guidelines.* Retrieved http://www.ndei.org/ADA-diabetes-management-guidelines-diagnosis-A1C-testing.aspx.html.

National Diabetes Education Program. (2014). Overview of diabetes in children and adolescents. Retrieved from http://www.niddk.nih.gov/health-information/health-communication-programs/ndep/living-with-diabetes/youth-teens/diabetes-children-adolescents/Documents/overview-of-diabetes-children-508_2014.pdf.

National Institutes of Health. (2014).Blood sugar. Retrieved from the U.S. Library of Medicine MedlinePlus website: www.nlm.nih.gov/medlineplus/mplusdictionary.html.

Pansier, B. & Schulz, P. J., (2015). School-based diabetes interventions and their outcomes: A systematic literature review. *Journal of Public Health Research,* 4(1), 467. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4407044/.

Perfect, M. M. & Jaramillo, E. (2012). Relations between resiliency, diabetes-related quality of life, and disease markers to school-related outcomes in adolescents with diabetes. *School Psychology Quarterly, 27*(1), 29-40.

Polit, D. F. & Beck, C. T. (2008). Nursing Research. *Generating and assessing evidence for nursing practice* (3rd ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Rehfuses, E., & Rohwer, A. (2013). Logic model templates for systematic reviews of complex health interventions. Retrieved from http:///www.integrate-hta.edu.

Robeson County Health Department (2010). State of the county's health. Retrieved from www.publichealth.southernregionalahec.org/Robeson/docs/210%20SOTCH.pdf.

Schwartz, F. L., Denham, S., Heh, V., Wapner, A., & Shubrook J. (2010). Experiences of children and adolescents with type 1 diabetes in school: Survey of children, parents, and schools. *Diabetes Spectrum 23*(1), 47-55. Retrieved from www.joslin.org.

Schwarz, P.E., Schwarz, J., Schuppenies, A., Bornstein, S. & Schulze, J., (2007). Development of a diabetes prevention management program for clinical practice. *Public Health Reports, 122*(2), 258-263. doi:10.1177/003335490712200216.

School Digger (2014). Lumberton senior high. Retrieved from www.schooldigger.com/go/NC/schools/0393002237/school.aspx.

Self-perception (2014). *Merriam-Webster's online dictionary* (11th ed.). Retrieved from www.merriam-webster.com/dictionary/self-perception.

Shuttleworth, M. (2008). Descriptive research design. Retrieved from explorable.com/descriptive-research-design.

Silverstein, J., Klingensmith, G., Copeland, K., Plotnick, L., Kaufman, F., Laffel, L., Deeb, L., Grey, M., Anderson, B., Holzmeister, L. A., & Clark, N. (2005). Care of children and adolescents with type 1 diabetes: A statement of the american diabetes association. *Diabetes Care, 28*, p. 186-2012. Retrieved from www.care.diabetes.journals.org/citmgr?gca=diacare'28/1/186.

Social research methods (2006). Research methods knowledge base: Statistics solutions consulting. Retrieved from www.socialresearchmethods.net/kb/index.php.

Soren, K., & Grey, M. (2015). Depression, anxiety, and eating disorders are common in teens and young adults with type 1 diabetes. *Endocrineweb.* Retrieved from http://www.endocrineweb.com/news/diabetes/14504-depression-anxiety-eating-disorders-are-common-teens-young-adults-type-1-diabetes.

Stumm, S. V. (2011). The pros and cons of using SPSS as a research tool to explore individual differences: SPSS user group meeting. Retrieved from www.spssusers.com.uk.

Terry, A. J. (2012). *Clinical research for the doctor of nursing practice.* Sudbury, MA: Jones & Bartlett Learning.

United States Census Bureau (2014). State & county quickfacts: Robeson county, north carolina. Retrieved from www.quickfacts.census.gov/qfd/states/37/37155.html.

University of North Carolina at Chapel Hill FPG Child Development Institute (2006). Early childhood teachers often ill prepared to care for children with disabilities: FPG snapshot #31. Retrieved from http://fpg.unc.edu/sites/fpg.unc.edu/files/resources/snapshots/FPG_Snapshot31_2006.pdf.

University of Wisconsin – Extension (2014). Program development and evaluation. Retrieved from http://www.uwex.edu/ces/pdande/index.html.

U.S. Department of Education (2007). Laws & guidance/special education & rehabilitative services: Archived: A 25 year history of the IDEA. Retrieved from http://www.2.ed.gov/policy/speced/leg/idea/history.html.

U.S. Department of Health & Human Services (2016). Office of adolescent health: A day in the life. Retrieved from http://hhs.gov/ash/oah/adolescent-health-topics/americas-adolescents/day.html#.

Wales, S., Nadew, K., & Crisp, J. (2007). Parents' and school-aged children's views on managing treatment adherence in asthma or diabetes. *Neonatal, Paediatric & Child Health Nursing, 10*(3), 26-30. Retrieved from the Walden University Library Database.

Wang, Y. L., Brown, S. A., & Horner, S. D. (2010). School-based lived experiences of adolescents with type 1 diabetes: A preliminary study. *Journal of Nursing Research 18* (4). Retrieved dsok.net/wp-content/uploads/2012/02/Adolescents-w-type-1-diabetes.pdf.