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Assessment of the Knowledge And Skills of School Personnel to Respond to Diabetic Emergencies in Georgia Public Schools

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ASSESSMENT OF THE KNOWLEDGE AND SKILLS OF SCHOOL PERSONNEL TO RESPOND TO DIABETIC EMERGENCIES IN GEORGIA PUBLIC SCHOOLS

by

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ABSTRACT

Diabetes is a common chronic disease that affects children in the United States. As children with diabetes attend school, the ability to appropriately manage their diabetes is essential to preventing life-threatening health complications. The purpose of the study was to assess school personnel's knowledge of diabetes and perceived self-competence in performing diabetes management skills in response to a diabetic emergency. For the present study, a diabetic emergency was operationalized to include hypoglycemia, hyperglycemia, or diabetic ketoacidosis. A cross-sectional survey design, utilizing a fifty-two item self-administered questionnaire that accentuated the causes and symptoms of diabetes, definition of hypoglycemia and hyperglycemia, and the management and treatment of diabetes was administered using an online survey management system (e.g., Qualtrics) and in person. Using convenience sampling, participants were elementary school personnel from five Georgia public schools districts. A total of eight hundred and nine self-administered questionnaires were completed. Descriptive statistics, principal component analysis, and one-way analysis of variance were used to analyze the data. Findings from the study revealed school personnel had limited knowledge of diabetes and inability to perform diabetes management skills as required by Georgia House Bill 879. In addition, statistically significant variations were found among participants performing diabetes management skills. Furthermore, the study informs participating schools on the effectiveness of

current diabetes training among school personnel to deliver optimal diabetes management and implications for public health.

INDEX WORDS: Children, Diabetes, School, Diabetic emergency, Knowledge, Georgia House Bill 879, School personnel, Perceived self-competence, Public health

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DEDICATION

This dissertation is dedicated to my beloved grandmother, Amanda Wright. I know you are smiling down from heaven and I can hear you say “well done my granddaughter, well done Dr. Wright.”

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"I can do all things through Christ which strengthens me." – Philippians 4:13

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thank you for being my inspiration and biggest supporter. There are no words that can express how much I love you.

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CHAPTER 1

INTRODUCTION

Diabetes is a common chronic illness in children. Worldwide, approximately 542,000 youth between the ages of zero and fourteen are living with type 1 diabetes and approximately 86,000 children are estimated to develop the disease annually (International Diabetes Federation, 2015). In the United States, 208,000 (0.25%) youth under twenty years of age have been diagnosed or are living with type 1 or type 2 diabetes (Centers for Disease Control and Prevention [CDC], 2014). The annual incidence of diagnosed diabetes in children from 2008 – 2009 in the United States was 18,436 for type 1 and 5,089 for type 2 (Centers for Disease Control and Prevention [CDC], 2014).

The incidence of diabetes in children varies among racial/ethnic groups. Type 1 diabetes has the highest incidence among all racial/ethnic groups. In contrast, African-American, Hispanic, and American Indian children experience the largest incidence of type 2 diabetes (Dabelea, 2007).

Type 1 diabetes is a condition where the pancreas does not produce insulin, which results in elevated blood glucose (Kaufman, Gallivan, & Warren-Boulton, 2009; Kucera & Sullivan, 2011; Centers for Disease Control and Prevention [CDC], 2011). Type 2 diabetes results when the body is unable to properly utilize insulin (Kaufman et al., 2009; Kucera & Sullivan, 2011). Research has shown an increase in the diagnosis of type 2 diabetes in children due to obesity and physical inactivity (Kaufman et al., 2009; Mandali & Gordon, 2009; Kucera & Sullivan, 2011). Adverse health outcomes associated with diabetes include hypoglycemia, hyperglycemia, cardiovascular disease, nephropathy, retinopathy, and neuropathy (Deshapande, Harris-Haynes, & Schootman, 2008; Kaufman et al., 2009; Centers for Disease Control and Prevention [CDC],

2011). The economic costs related to diabetes include the utilization of preventive and curative health care services, lost days of productivity in the workplace, and disability. In 2012, the estimated economic cost of diabetic cases was $245 billion (American Diabetes Association, 2013). Due to the substantial cost of diabetes, employing public health interventions that are cost-effective can pay a significant role in reducing the incidence and prevalence of diabetes and ultimately, reducing the economic burden of diabetes.

Statement of the Problem

Diabetes is a common chronic disease in children and the number of cases continues to rise. To avert serious health complications, a child with diabetes must effectively manage their disease. The medical management of type 1 or type 2 diabetes is multifaceted and can require daily insulin injections or use of an insulin pump, oral medications, blood glucose monitoring, and nutrition management (Bohn, Sztainer, Mellin, & Patterson, 2004; Kaufman, Gallivan, & Warren-Boulton, 2009; Schwartz, Denham, Heh, Wapner, & Shubrook, 2010; Kucera & Sullivan, 2011). With approximately 160,000 children diagnosed with diabetes in the United States attending school (Schwartz et al., 2010), the school setting is an important venue in managing diabetes.

Section 504 of the Rehabilitation Act of 1973, the Americans with Disabilities Act of 1990, and the Individuals with Disabilities Education Act are three federal regulations that address the responsibility schools have in providing care for children with diabetes (American Diabetes Association, 2013a). Ideally, a school nurse should provide the necessary care for diabetes management (Schwartz et al., 2010). However, studies have proven that schools do not have an adequate number of nurses to provide the care children with diabetes require, specifically children with type 1 diabetes (Guttu, Engelke, & Swanson, 2004; Schwartz et al.,

2010; Engelke, Swanson, Gutta, Warren, & Lovern, 2011). With only 45% of schools in the United States having access to a full-time nurse (National Association of School Nurses, 2010), it is probable other school personnel will encounter a child with a diabetic emergency. In the absence of a school nurse, personnel such as teachers, paraprofessionals, health and physical education coaches, and counselors will play a significant role in this situation and must be competent in their own skills to care for a child during a diabetic emergency. Studies have shown training school personnel on diabetes improve understanding of the disease and improve the overall glycemic management of the disease in children (Wagner & James, 2006; Mandali & Gordon, 2009; Smith et al., 2012).

Knowledge of diabetes is an important indicator for school personnel to assist children with diabetes (Mandali & Gordon, 2009). Recent studies have reported that school personnel lack knowledge on diabetes, diabetes management, and diabetes treatment (Amillategui et al., 2009; Ayan et al., 2012; Pinelli et al., 2011; Schwartz et al., 2010; Tannous et al., 2012). Unfortunately, insufficient knowledge of diabetes may cause apprehension among school personnel to assist the diabetic child in managing their disease or responding to a diabetic emergency.

Due to the risk diabetes can pose on a child's health and safety, the state of Georgia passed House Bill 879 in 2012. This act requires Georgia school districts, including both elementary and secondary schools, to train at least two non-nursing personnel on diabetes management and diabetes treatment. The training is to be provided by a school nurse or a healthcare professional with expertise in diabetes. In addition, the training must be conducted prior to the commencement of the school year, when an enrolled child is newly diagnosed, or when a child with diabetes newly enrolls at the school (Georgia General Assembly, n.d.).

Prior studies have employed diabetes education training to improve disease knowledge and to improve the self-efficacy of school personnel in assisting children with diabetes (Aycan et al., 2012; Radjenovic & Wallace, 2001; Smith et al., 2012). However, there is limited information assessing the long-term effect of diabetes education training on school personnel (Aycan et al., 2012). Additionally, there are no current studies assessing both knowledge of diabetes and perceived self-competence in diabetes management skills in Georgia since the passage of House Bill 879.

Purpose of the Study

The purpose of this study was to assess school personnel's knowledge about diabetes and perceived self-competence in performing diabetes management skills in Georgia from a sample of public schools. A quantitative study design was utilized to enable the researcher to collect numerical data and analyze it using statistical procedures (Creswell, 2009). The quantitative data collection and analyses are to understand both elementary school personnel's knowledge of diabetes and perceived skill competence in responding to a diabetic emergency and also, to advocate for system changes for children with diabetes. A questionnaire was created to measure the current level of diabetes knowledge and skills related to effective diabetes management among school personnel.

Research Questions

The following research questions were used to guide the study:

1. What is the current level of diabetes knowledge among school personnel?
2. What is the level of school personnel's perceived self-competence in performing diabetes management skills as required by Georgia's House Bill 879?
3. Are there significant differences in diabetes knowledge among school personnel?

4. Are there significant differences between perceived skill competence in diabetes management among school personnel?

Significance of the Study

This study is significant because the number of children diagnosed with type 1 and type 2 diabetes continue to rise. Research supports the need for improving school personnel's diabetes knowledge and skills necessary for disease management. A lack of understanding and ability in recognizing signs and symptoms of a diabetic emergency can delay treatment of hypoglycemia and hyperglycemia. Georgia House Bill 879 requires diabetes training for at least two non-nursing school personnel in both elementary and secondary education settings. However, there is paucity within current research on the effectiveness of training school personnel to deliver optimal diabetes care. The researcher believes this will be the first study to assess both diabetes knowledge and skills among school personnel since Georgia House Bill 879 was enacted. Furthermore, findings of this study could strengthen support for increased diabetes management within the school system by encouraging innovative and effective interventions and policies.

Delimitations

The study timeframe was August 2014 - April 2015. The location of the study was five counties' school systems in Southeast Georgia. The study sample consisted of school personnel from 28 public elementary schools who have current or no interactions with one or more diabetic students. A convenience sampling was utilized through questionnaires with school personnel.

Assumptions

The assumptions of the study included: 1) valid and reliable instrument; 2) study sample representative of the total population of school personnel in Georgia's County School Systems;

3) participants completing the questionnaire; and 4) findings can employ innovative interventions and strengthen current school policies.

Definitions

Competency – based on a set criteria, demonstrated level of proficiency to perform a task or set of tasks include but not limited to: (1) speak calmly to student, (2) have student to sit and relax in a safe location, (3) administer glucose (candy or juice) immediately to hypoglycemia student, (4) provide insulin or medication immediately to hyperglycemia student, (5) record blood glucose results, (6) call 9-1-1 or local emergency number if student does not respond to glucose, insulin, or medications, and (7) contact student's parents or healthcare professional (Spiegel, Evert, & Shea, 2009)

Diabetes – metabolic condition characterized by elevated blood glucose levels from the body's inability to produce insulin or properly use insulin (Deshapande, Harris-Haynes, & Schootman, 2008)

Diabetic emergency – a child experiencing hypoglycemia (low blood glucose) that causes symptoms such as shaking, irritability, sweating, and weakness; hyperglycemia (high blood glucose) with symptoms such as fatigue, shortness of breath, and confusion; or diabetic ketoacidosis (body produce ketones) (American Diabetes Association, n.d.)

Glycemic – level of glucose in the blood (American Diabetes Association, 2014)

School personnel – any individual (i.e., teacher, paraprofessional, nurse, counselor, and health and physical education specialist) employed in a school system (American Diabetes Association, 2013a)

Knowledge – an understanding of signs and symptoms, management, and treatment for type 1 and type 2 diabetes (Spiegel, Evert, & Shea, 2009)

Skill – an ability to effectively provide diabetes management to students experiencing a diabetic emergency (American Diabetes Association, 2013a)

Respond – school personnel performs a clear set of tasks that monitor and treat hypoglycemia and hyperglycemia when a student experiences a diabetic emergency (American Diabetes Association, 2013a)

House Bill 879 – Georgia law relating to elementary and secondary schools to provide care for students diagnosed with diabetes (Georgia General Assembly, n.d.)

Summary

Children with diabetes must effectively manage their diabetes while in a school setting to prevent adverse health outcomes. By conducting research to measure school personnel's knowledge of diabetes and their skills in response to a diabetic emergency, school systems are helping to ensure an environment that is capable of addressing the needs of children with diabetes. In the absence of a nurse, school personnel must be able to provide adequate support and diabetes management.

Organization of the Study

The purpose of this study was to assess school personnel's knowledge of diabetes and perceived self-competence in performing diabetes management skills to respond to a diabetes emergency. In chapter two, a review of the current literature on diabetes and diabetes management in schools will be presented. Chapter three describes the quantitative research design and methodology employed for the study. The analyses of the quantitative data are presented in chapter 4. Chapter 5 contains the summary, discussion, implications for public health, recommendations for future research, and conclusions.

CHAPTER 2

LITERATURE REVIEW

Responding to diabetic emergencies in a school setting requires an understanding of diabetes and appropriate training. This chapter provides information on the diabetes disease process, including disease impact and management. It also explores information related to the management of diabetes in schools, followed by interventions necessary for improving care. Lastly, theories utilized in previous research on the management of diabetes among youth will be assessed.

Diabetes

Diabetes is defined as a metabolic condition characterized by elevated blood glucose levels from the body's inability to produce insulin or properly use insulin (Fradkin, 2012; Deshapande, Harris-Haynes, & Schootman, 2008). Insulin is the hormone utilized by the body to get glucose from the bloodstream to the cells in the body for energy (International Diabetes Federation, 2013). Worldwide, approximately, 347 million people have been diagnosed with diabetes (World Health Organization, 2013). Of those, 25.8 million reside in the United States (Centers for Disease Control and Prevention [CDC], n.d.). Annually, ten to fifteen percent of deaths in the United States are attributed to diabetes (Massey, Appel, Buchanan, & Cherrington, 2010). Researchers predict diabetes will increase to 592 million by 2035 (International Diabetes Federation, 2013).

Diabetes is not one disease; rather it includes several types. Three of the most common types of diabetes are type 1, type 2, and gestational diabetes (Kaufman, Gallivan, & Warren-Boulton, 2009). Two of three types most relevant to the current discussion, include type 1 and type 2.

Type 1 Diabetes

Type 1 diabetes, formerly known as juvenile diabetes, is an "autoimmune condition in which the immune system attacks insulin-producing beta cells of the pancreas that help regulate blood glucose levels" (National Diabetes Education Program, 2014, p. 1). This type of diabetes requires daily administration of insulin (American Diabetes Association, 2014a) and accounts for 5 – 10% of diagnosed diabetes cases (Deshapande, Harris-Haynes, & Schootman, 2008). The onset of type 1 diabetes is acute and can occur at any age; however, youth under ten years of age are often diagnosed with type 1 diabetes (National Diabetes Education Program, 2014). Common symptoms present at onset include polydipsia, polyuria, hunger, weight loss, blurred vision, and fatigue (Kaufman et al., 2009). The etiology of type 1 diabetes remain unclear; however, researchers suggest autoimmune, genetics, environmental factors, viruses, and early age feeding practices are causal factors (JDRF, 2014a; International Diabetes Federation, 2013; Fradkin, 2012).

Type 2 Diabetes

Type 2 diabetes, formerly known as adult-onset diabetes, account for approximately 90 - 95% of diagnosed individuals (Deshapande, Harris-Haynes, & Schootman, 2008). This form of diabetes is characterized by insulin resistance or results when the insulin-producing beta cells are unable to produce sufficient amounts of insulin (Fradkin, 2012; Deshapande, Harris-Haynes, & Schootman, 2008). Unlike type 1 diabetes, the onset occurs gradually; however, symptoms of type 2 diabetes are similar to type 1 diabetes (Kaufman et al., 2009; Mandali & Gordon, 2009). Risks factors identified for type 2 diabetes include: being obese, twenty years of age or older, family history of diabetes, environmental factors, and certain racial/ethnic groups including

American Indians, African Americans, and Hispanics (Centers for Disease Control and Prevention [CDC], 2011; National Diabetes Education Program, 2014). Research has shown an increase in the diagnosis of type 2 diabetes in youth due to obesity and physical inactivity (Kaufman et al., 2009; Mandali & Gordon, 2009; Kucera & Sullivan, 2011).

Diabetes in Youth

The number of youth diagnosed with type 1 and type 2 diabetes is increasing significantly worldwide. In 2013, more than 79,000 youth under 15 years of age developed type 1 diabetes (International Diabetes Federation, 2013). The highest prevalence of youth living with type 1 diabetes was observed in Europe, the Caribbean, and North America (International Diabetes Federation, 2013).

In the United States, approximately 215,000 youth under twenty years of age had type 1 or type 2 diabetes in 2010 (Centers for Disease Control and Prevention [CDC], 2011). The annual incidence of diagnosed diabetes in youth from 2002 – 2005 was 15,600 for type 1 diabetes and 3,600 for type 2 diabetes (Centers for Disease Control and Prevention [CDC], 2011). In 2002 – 2003, the highest incidence of type 1 diabetes was among non-Hispanic white youth under ten years of age. In youth older than ten years of age, the incidence of type 1 diabetes was highest among non-Hispanic whites, followed by African Americans and Hispanics (Dabelea, 2007), whereas the incidence of type 2 diabetes in youth older than 10 years of age was highest among American Indians, African Americans, and Asian/Pacific Islanders (Dabelea, 2007).

Georgia

Diabetes is a common chronic disease in Georgia. In 2010, the prevalence of diabetes was 703,289 (9.8%); a 43% increase from 2000 (Georgia Department of Public Health, n.d.).

Approximately, two-thirds of Georgia's 159 counties have diabetes prevalence greater than 11.1% (Georgia Department of Public Health, n.d.). The incidence of diabetes in youth under 20 years of age is not reportable in Georgia. However, the Georgia Juvenile Diabetes Foundation Research estimates that 600 youth are diagnosed per year.

Health Complications

Health complications associated with diabetes in youth include hypoglycemia, hyperglycemia, and microvascular and macrovascular damage (Kaufman et al., 2009). Hypoglycemia or low blood glucose results from too much insulin or other diabetic medications, over consumption of food, and/or strenuous physical activity (Clark et al., 2009; Kaufman et al., 2009). Symptoms of hypoglycemia in youth may include dizziness, trembling, irritability, and unconsciousness (Kucera & Sullivan, 2011). It is important to note that most youth seven years of age or younger are unable to recognize the symptoms of hypoglycemia (Kaufman et al., 2009). Glucose monitoring, education on symptoms, and monitoring or adjusting the dose of insulin as needed are recommended for preventing hypoglycemia (Clark et al., 2009; Kaufman et al., 2009).

Hyperglycemia or high blood glucose can result from insufficient insulin or other diabetic medication, physical inactivity, and illness (Kaufman et al., 2009; Spiegel, Evert, & Shea, 2009). Without proper management, hyperglycemia can progress to ketoacidosis, a life-threatening condition in which the body produces acid (Kaufman et al., 2009). Symptoms of hyperglycemia include polyuria, polydipsia, fatigue, and abdominal pain (Spiegel, Evert, & Shea, 2009; Kucera & Sullivan, 2011).

The microvascular complications associated with diabetes include nephropathy (kidney disease), neuropathy (nervous system disease), and retinopathy (eye disease) (Deshapande,

Harris-Haynes, & Schootman, 2008). These complications are less common in children; however, research has shown that retinopathy is occurring in youth after two years of diabetes onset (Kaufman et al., 2009).

Additional complications include macrovascular damage, such as hypertension. In youth, hypertension is diagnosed when the average blood pressure reading is greater than the 95th percentile for height measured on three separate days (Kaufman et al., 2009). The control of hypertension is crucial in youth to prevent cardiovascular damage (Kaufman et al., 2009).

Economic Cost of Diabetes

In 2012, the estimated economic cost of diagnosed diabetes was $245 billion (American Diabetes Association, 2013). This significant cost related to the utilization of preventative and curative healthcare services, lost days of work, and premature death (Centers for Disease Control and Prevention [CDC], 2014). The medical costs for diabetes are 2.3 times higher than the costs without diabetes (Centers for Disease Control and Prevention [CDC], 2014; American Diabetes Association, 2013).

Management of Diabetes

The medical management of diabetes among youth is multifaceted. Management of type 1 diabetes involves insulin administration, blood glucose monitoring, physical activity, and nutrition management (Kaufman et al., 2009). Management of type 2 diabetes may require blood glucose lowering medications, blood glucose monitoring, physical activity, and nutrition management (Kaufman et al., 2009). As type 1 diabetes (and possibly type 2 diabetes) requires routine blood glucose monitoring, the American Diabetes Association recommends a hemoglobin A1C goal for youth 6 to 12 years of age less than 8% and youth 13 to 19 years of age less than 7.5% (Spiegel, Evert, & Shea, 2009). With the management of diabetes being

complex, approximately 30% of youth report difficulties in following their medical regimen (Nabors, Troillett, Nash, & Masiulis, 2005).

Diabetes in Schools

As diabetes affects 1 in every 400 youth (American Diabetes Association, n.d.a), it is likely education professionals will encounter students with diabetes. Federal and state regulations require schools to provide care for all students, including students with diabetes. Therefore, as students spend a significant portion of their day in school, school personnel must be knowledgeable of the disease and its management to be able to assist and support youth.

Schools in receipt of federal funding must act in accordance with Section 504 of the Rehabilitation Act of 1973. This act requires schools to conduct an individual assessment of a student with diabetes and document the provisions the school will provide for the student (U.S. Department of Education, 2013). Also as a provision of this act, the student does not have to take or pass a test for eligibility (JDFR, n.d.).

The Americans with Disability Act of 1990 prohibits schools, except those operated by religious entity, from discrimination (ADA.gov, n.d.; JDRF, n.d.). This act is designed to ensure equality for individuals with disability. Therefore, students with diabetes are given “an equal opportunity to participate at school and cannot be excluded from any equal access academic programs or school-sponsored extracurricular activities (i.e., field trips)” (JDRF, n.d., p.63). In 2009, new amendments to this act guarantees students who use medication, such as insulin, will remain covered under the act (JDRF, n.d.).

Moreover, the Individuals with Disabilities Education Act offer protection to youth whose disability impairs their academic performance (JDRF, n.d.). School districts are required

to determine eligibility. If eligible, an Individualized Education Program is developed and specialized services are provided to the student by a trained school personnel (JDRF, n.d.).

Along with federal regulations, some states provide policies on who is responsible for providing diabetes management in the school system. In 2012, the Georgia House Bill 879 was implemented. This law requires Georgia school districts, including elementary and secondary schools, to have a written Diabetes Medical Management Plan completed by the student's physician and signed by both physician and parent, before any school diabetes management is provided. In addition, the law requires schools to train at least two onsite non-nursing personnel on diabetes management. The training must be provided by a school nurse or a healthcare professional with expertise in diabetes (Georgia General Assembly, n.d.; Georgia Department of Education, 2012). By law, the training should include:

> "(1) Recognition and treatment of hypoglycemia and hyperglycemia; (2) understanding the appropriate actions to take when blood glucose levels are outside of the target ranges indicated by a student's diabetes medical management plan; (3) understanding physician instructions concerning diabetes medications dosage, frequency, and the manner of administration; (4) performance of finger-stick blood glucose checking, ketone checking, and recording the results; (5) administration of insulin and glucagon, an injectable used to raise blood glucose levels immediately for severe hypoglycemia, and the recording of results; (6) performance of basic insulin pump functions; (7) recognizing complications that require emergency assistance; (8) recommended schedules and food intake for meals and snacks, the effect of physical activity upon blood glucose levels, and actions to be implemented in the case of schedule disruptions; and (9) the requirements of O.C.G.A. §

20-2-779 and State Board of Education Rule 160-4-8-.18 *Diabetes Medical Management Plans"* (Georgia Department of Education, 2012, p. 3).

Though these federal and state regulations are in place, research has shown that schools are unaware of the regulations and students are not receiving adequate diabetes management (Schwartz et al., 2010). Furthermore, schools with emergency plans specific to youth with diabetes practiced the plan only periodically or never during a school year (Olympia, Wan, & Avner, 2005).

Diabetes Management in Schools

School Nurses

In an academic setting, the school nurse primarily provides the necessary care for diabetes management (Schwartz et al., 2010). However, some school districts have a shortage of trained nurses. According to the National Association of School Health Nurses, 45% of public schools have a nurse present all day, while 30% work part time in one or more schools (National Association of School Nurses, 2007). While Healthy People 2020 recommends a nurse-to-student ratio of 1 nurse for every 750 students (HealthyPeople.gov, 2013), in 2012, the state of Georgia nurse-to-student ratio was 1 for every 2,300, ranking the state 46th in the nation (Turner, 2012). Research has shown schools nurses with fewer schools are able to provide appropriate diabetes care (Engelke et al., 2011). A shortage of school nurses can increase the risk of health complications among students with diabetes. In the absence of a nurse, effective diabetes care remains necessary and is imperative for the health and safety of the student.

Diabetes Knowledge

As students with diabetes spend one-third of their day in a school setting, school personnel can assist in diabetes management and treatment (Hayes-Bohn et al., 2004). To assist

students, school personnel must have an understanding of diabetes including, signs and symptoms, and effective treatment (American Diabetes Association, 2013a). Thus, knowledgeable school personnel can assist students in daily disease management and recognize and respond to emergent situations, such as hypoglycemia and hyperglycemia.

School Personnel Knowledge

Studies have revealed that school personnel lack knowledge on diabetes, diabetes treatment, and diabetes management (Amillategui et al., 2009; Amillategui et al., 2007; Ayan et al., 2012; Boden et al., 2008; Bradbury & Smith, 1983; Gormanous et al., 2002; Pinelli et al., 2011; Schwartz et al., 2010; Tannous et al., 2012; Wagner & James, 2006). Gormanous and colleagues (2002) conducted a study among elementary school teachers. A total of 722 teachers were surveyed to determine diabetes knowledge. It was found that majority of the teachers could not recognize symptoms of low blood glucose (Gormanous et al., 2002). Furthermore, Amillategui et al. (2009) found that 10% of teachers lacked knowledge of the use of glucagon for treating hypoglycemia.

These findings may justify the reasons of parents' perception that teachers have limited knowledge of the symptoms and treatment of diabetes. Amillategui et al. (2007) found that 34% of parents of students with diabetes believe teachers could recognize symptoms of hypoglycemia. The same study also reported 27% of teachers are unable to differentiate type 1 and type 2 diabetes.

A youth engaging in physical activity is an important component in managing diabetes (Kaufman et al., 2009). Aycan et al. (2012) conducted a study to assess knowledge of diabetes among 1054 school personnel. Of the participants 47.6% had a moderate level of knowledge, 32.4% had less knowledge, and 3.7% had no knowledge about diabetes. Specifically, Aycan et

al. (2012) found that school personnel would not allow children with diabetes to participate in physical activities.

Diabetes Education

In regards to diabetes education, research has shown that schools with a shortage of nurses do not require school personnel to provide medical care (Amillategui et al., 2007). In addition, school personnel working with diabetic students were not provided in-service training and education (Gormanous et al., 2002; Wagner & James, 2006). In a study conducted by Wagner and James (2006), 87% of school personnel reported not receiving diabetes management training; although, 40% worked directly with students diagnosed with diabetes.

Common sources of diabetes information to school personnel are children, parents, and media (Bradbury & Smith, 1983; Gormanous et al., 2002; Pinelli et al., 2011; Tannous et al., 2012) as opposed to a healthcare professional, such as a school nurse or certified diabetes educator. Insufficient knowledge of diabetes may cause apprehension among school personnel to manage students with diabetes or respond to a diabetic emergency. This was supported by studies that reported school personnel with training reported fear and limited knowledge to provide diabetes management (Wagner & James, 2006; Schwartz et al., 2010).

Interventions

Recommendations

Optimal diabetes care in the school setting is crucial for the health and safety of the student. The American Diabetes Association's position statement recommends that a school work with parents and the student's healthcare providers to develop a Diabetes Medical Management Plan. The plan should address specific needs of the student, including instructions for blood glucose monitoring, meals and snack, insulin administration and/or other diabetic

medications, symptoms and treatment of hypoglycemia and hyperglycemia, and physical activity (American Diabetes Association, 2013a). In addition, the American Diabetes Association recommends a school to provide training on diabetes for all personnel to recognize and treat hypoglycemia and hyperglycemia and provide a location for students to monitor blood glucose levels (American Diabetes Association, 2013a).

Moreover, the National Diabetes Education Program's *Helping the Child with Diabetes Succeed: A Guide for School Personnel* provides actions for personnel to ensure effective diabetes management for students. This program recommends providing diabetes training on all personnel, assembling a school health team, and developing a health care plan (i.e., Diabetes Medical Management Plan) and education plan (i.e., Section 504 of the Rehabilitation Act of 1973) (Silverstein et al., 2009). The program also suggests collaboration among the student's parent and healthcare professional in developing a healthcare and education plan (Silverstein et al., 2009).

Additional recommendations for improving diabetes care in school include increasing the number of full-time school nurses (Amillategui et al., 2007). Nabors et al. (2005) and Amillategui et al. (2007) recommend improving communication among school personnel, parents, and diabetic students. Moreover, Hayes-Bohn, Neumark-Sztainer, & Patterson (2004) recommend schools to improve food choices to aid in nutrition management and assess school regulations for students to achieve effective diabetes management.

Diabetes Training

Multiple studies have shown the importance of training school personnel on diabetes (Amillategui et al., 2007; Mandali & Gordon, 2009; Schwartz et al., 2010; Wagner & James, 2006). Wagner and James's (2006) study found that training school personnel on diabetes

improves the overall management of the disease in a student. Mandali and Gordon (2009) concluded that diabetes training for school personnel permit the necessary assistance for managing hypoglycemia and hyperglycemia.

Radjenoviv and Wallace (2001) developed and evaluated a computer-based training system on type 1 diabetes for elementary school personnel. The computer-based system consisted of links to diabetes information, audio explaining low blood sugar, and videos demonstrating insulin injections and nutrition management. Radjenoviv and Wallace (2001) found that personnel completing a computer training module enhanced their knowledge on diabetes. Furthermore, the computer-based system enabled personnel to access diabetes modules at their convenience; ultimately, retaining knowledge and increasing confidence to respond to a diabetic emergency (Radjenoviv & Wallace, 2001).

Bachman and Hsueh (2008) examined an online continuing education program to educate school nurses on managing diabetes. The online program included an overview of diabetes management in the school setting, managing students with insulin pumps, and the school nurse role in managing children with diabetes. It was found that an online continuing education with current practices on diabetes care and insulin pumps increases a school nurse ability to manage a student with diabetes.

In a study evaluating a diabetes education program used to train school personnel, Smith et al. (2012) found a significant improvement in posttest knowledge assessment. The program consisted of a 60-minute and 180-minute session, including an overview of diabetes and demonstrations on administering insulin injections. In addition to acquiring knowledge, there was a significant increase in school personnel's confidence to provide care for a diabetic student

(Smith et al., 2012). The results of these studies support training and educating school personnel on diabetes are essential for diabetes management in school.

Theory

A theory is "a set of interrelated concepts, definitions, and propositions that presents a systemic view of events by establishing a relationship among variables to explain or predict events or situations" (Glanz, Rimer, & Lewis, 2002, p.25). Theories aid in segmenting audiences and determining desired outcomes. Furthermore, theories are utilized as roadmaps to guide in to development, implementation, and evaluation of intervention theories (Glanz, Rimer, & Lewis, 2002).

Fisher (2006) utilized the Bandura's Theory of Self-Efficacy to investigate school nurses' perceived self-efficacy in providing diabetes care for children. The findings from the study revealed self-efficacy was significantly higher among school nurses performing and participating in diabetes education and care, working with children with type 1 diabetes, and participating in blood glucose monitoring (Fisher, 2006). It was concluded that school nurses with experience in providing direct care for children with diabetes enhances self-efficacy.

In a study conducted by Naar-King et al. (2006), the Social Ecological Model was employed to understand the multiple factors that contribute to illness management of type 1 diabetes in youth. Factors assessed in the study included individual, family, and extrafamilial (medical providers). Of the 96 participants, the researchers found that each factor correlates with illness management. It was determined that health beliefs and problem-solving ability at the individual level and social support for caregivers at the family level are important in understanding the health outcomes in youth.

Summary

Diabetes is a common chronic illness in children. The literature review revealed that school personnel have inadequate knowledge of diabetes. The lack of understanding and recognizing symptoms of diabetes can delay effective treatment of hypoglycemia and hyperglycemia. As more children are diagnosed with diabetes in the United States and the incidence of diabetes in children is not reportable in Georgia, more research needs to be conducted to examine both diabetes knowledge and skills in public school personnel. Findings from this study could strengthen support of diabetes management in schools through innovative and effective interventions and policies.

CHAPTER 3

METHODS

This chapter describes the research design, population, sample and sampling procedures, and methodology of data collection and analysis. The purpose of the study was to assess elementary school personnel's knowledge about diabetes and perceived self-competence in performing diabetes management skills to response to a diabetic emergency. The following research questions guided the study:

Research Questions

1. What is the current level of diabetes knowledge among school personnel?
2. What is the level of school personnel's perceived self-competence in performing diabetes management skills as required by Georgia's House Bill 879?
3. Are there significant differences in diabetes knowledge among school personnel?
4. Are there significant differences between perceived skill competence in diabetes management among school personnel?

Research Design

The study utilized a quantitative methods design. Quantitative methods design collects numerical data and analyzes it using statistical procedures (Creswell, 2009). The type of quantitative methods design employed for this study was a cross-sectional survey design (see Figure 1). This design enabled the researcher to collect data at a specific point in time and generalize from the sample to the population (McKenzie, Neiger, & Thackeray, 2013; Creswell, 2009). Additionally, employing a cross-sectional survey is cost effective, reduces response bias, and enables the researcher to collect data from a vast number of respondents (McKenzie, Neiger, & Thackeray, 2013). The rationale for selecting this design was to collect quantitative data to

explain elementary school personnel's diabetes knowledge and perceived self-competence in performing diabetes management skills to respond to a diabetic emergency in Georgia public schools. At present, there are no studies that have assessed both diabetes knowledge and diabetes management skills among school personnel since Georgia HB 879 was passed in 2012.

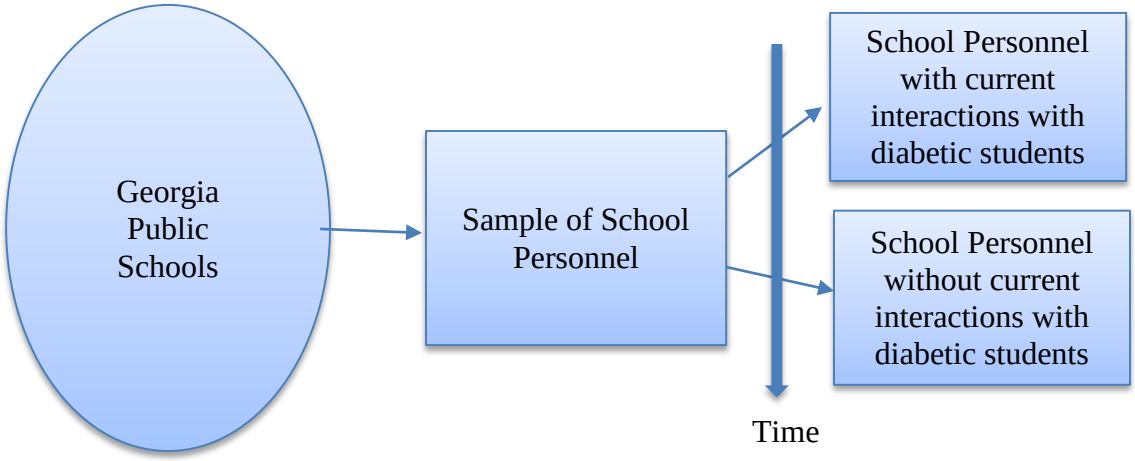

Figure 1. Cross-sectional Research Design

Population

The study's population consisted of elementary school personnel from five counties in Georgia. For the purpose of maintaining confidentiality and anonymity, the counties and associated school districts that participated in the study will be identified alphabetically (but not correspondingly to the first initial of their county name). Two counties, A and E, are located in Georgia's Southeast Public Health District (Southeast Health District, 2012). According to the Georgia Department of Public Health (n.d.), the Southeast Public Health District has significantly higher diabetes prevalence than the state of Georgia (9.7%) at 10.7% (28,540 adults). In 2013, the total populations in County A was 71,214 (U.S. Census Bureau, 2014) and County E was 30,077 (U.S. Census Bureau, 2014a). Of these populations, 20.5% were 18 years

of age and younger in County A (U.S. Census Bureau, 2014) and 24.7% in County E (U.S. Census Bureau, 2014a). In 2011, 10.6% (5,538 adults) and 12.4% (2,743 adults) of county A and E residents' respectively were diagnosed with diabetes (Centers for Disease Control and Prevention [CDC], n.d.).

County A school system has nine public elementary schools and County E school system has five. Limited data exists on the number of youth 18 years of age and younger diagnosed with diabetes in these Georgia counties. A telephone conversation with the lead school nurse and school health coordinator for the counties, confirmed twenty-eight students in the County A school system and twelve students in the County E school system having a diagnosis of diabetes (type 1 and type 2).

The other three counties in the study (B, C, and D) are situated in Georgia's Coastal Public Health District (Coastal Health District, 2014). This health district has a diabetes prevalence of 9.4% (38,491 adults) compared to the state (9.7%) (Georgia Department of Public Health, n.d.). In 2013, the total populations in counties B, C, and D were 51,476; 54,456; and 81,508, respectively (U.S. Census Bureau, 2014 b,c,d). Of these populations, 25.7% (County B), 27.1% (County C), and 23.4% (County D) were 18 years of age and younger (U.S. Census Bureau, 2014 b,c,d). In 2011, 10.9% of County B, 10.4% of County C, and 10.0% of County D adults were living with the diagnosis with diabetes (Centers for Disease Control and Prevention [CDC], n.d.). The number of public elementary schools in these counties includes B (9), C (8), and D (10). Similar to counties A and E, a telephone discussion with the lead county school nurses, confirmed 34 students in B, 18 students in C, and 21 students in D Counties' school systems had both type 1 and type 2 diabetes during the time of the study.

These five Georgia Counties were selected for this study because three formal trainings on *Diabetes Care in School Settings* was provided to the school systems' nurses and non-nursing personnel by a Certified Diabetes Educator and Family Nurse Practitioner in the summer and fall of 2012 to comply with Georgia's House Bill 879 training guidelines. The trainer adapted educational resources from the American Diabetes Association's *Safe at School*, a thirteen-module curriculum on diabetes care tasks in school. Also, the trainer conducted direct observations on personnel performing specific diabetes care tasks. Moreover, the school system in these counties comprised of five or more public elementary schools with enrollment of pre-kindergarten to fifth graders diagnosed with diabetes.

Sample and Sampling Procedures

The sample in this study included non-nursing (i.e., teachers, paraprofessionals, physical education coaches, counselors, and school nutrition staff) and "trained diabetes" (i.e., nurses) school personnel who were employed at a public elementary school from A, B, C, D, and E counties' school systems. The total number of public elementary schools within the five counties was forty-one. A nonprobability sampling design, convenience sampling, was employed to access the non-nursing and "diabetes trained" school personnel.

Each elementary school had approximately eighty school personnel. To calculate the sample of school personnel needed for the questionnaire, Dillman's sample formula was performed ($N_s = (N_p)(p)(1 - p) / (Np - 1)(B/C)^2 + (p)(1 - p)$) (Dillman, 2007). Setting the parameters at a 95% confidence interval, 0.05 sampling error, and 0.5 margin error, the sample size needed was 1641.

Recruitment of Participants

In September and October of 2014, the researcher contacted each county school systems' superintendent or assistant superintendent by email to explain the purpose, significance, benefit, and methodology of the study. In addition to email communications, research proposal applications were completed to adhere to the school systems' research policies. Once formal approval of the study was received, an introductory email that included a meeting request was sent to each principal. If a principal did not respond to the initial email, a follow-up email was sent. Face-to-face meetings were scheduled with the principals, lead county school nurses, or school health coordinators in February 2015 to describe the study in detail and identify dates during the months of March, April, and May of 2015 to administer the questionnaire. Of the 41 identified schools, 28 participated in the study.

The questionnaire was administered to study participants using two methods: (1) Qualtrics, an on-line survey software; and (2) paper-and-pencil. A cover letter served the dual purpose of explaining the study and acting as an informed consent form. The consent form included the identification of the researcher, benefits of participating, notation of risks, rights to withdraw, and confidentiality (Creswell, 2009) (see Appendix A). The consent form was passive and placed before the online questionnaire, whereas participants who chose to participate utilizing the paper-and-pencil questionnaire, signed the consent form and provided a copy for their records. There was no penalty for participants who chose not to participate. Participants who completed the questionnaire and provided their name and email address were able to enter into a drawing to receive compensation in the amount of $25.00. Five randomly selected participants received a $25.00 Wal-Mart gift card for participating in the study.

Instrumentation

Diabetes Knowledge Questionnaire

A diabetes knowledge questionnaire for school personnel in Georgia has not been developed to assess current level of diabetes knowledge and skills related to effective diabetes management. After a lengthy search, a questionnaire assessing diabetes knowledge and skill competence regarding diabetes management was created. The questionnaire was designed utilizing Georgia's House Bill 879 training guidelines to care for students with diabetes and the American Diabetes Association's (ADA) *Diabetes Care Tasks at School: What Key Personnel Need to Know* training curriculum. The training guidelines of House Bill 879 (Georgia General Assembly, n.d.) comprise of nine essential components for school personnel to provide diabetes management and the ADA training curriculum consists of thirteen PowerPoints with corresponding videos for health professionals to use to train school nurses and other school personnel (American Diabetes Association, n.d.).

Validity and Reliability

Validity is the accuracy of a measurement instrument (Litwin, 2003). Common types of validity include content and face validity. Content validity is how appropriate the items are measuring the concepts and constructs, whereas, face validity is a review of the items to determine if measures what it needs to measure (Bernard, 2013; Fink, 2003).

For this study, content validity of the original questionnaire was reviewed by a panel of experts for review of content, specificity, and accuracy of question items. The panel of experts was three faculty members in nutrition from the School of Health & Kinesiology at Georgia Southern University. The questionnaire was also reviewed by a local Certified Diabetes Educator and Pedorthist that specializes in the management of diabetes foot care.

Face validity was used during the pilot study to assess whether the instrument measured diabetes knowledge and skills. The researcher revised the instrument based on participants' feedback.

To assess reliability of the questionnaire, Cronbach's alpha was calculated to determine the internal consistency reliability. The diabetes management skills alpha was of 0.957. A Cronbach's alpha of 0.80 or higher indicates a good reliability (Bernard, 2013).

Pilot Test

After initial instrument development, the researcher conducted a pilot study with thirty elementary school personnel from a local elementary school that was not included in the population. Since the questionnaire was developed, a pilot study was vital in assessing the practical application of the instrument (Litwin, 2003). For each participant, the researcher recorded the amount of time to complete the questionnaire and asked the following questions: (1) Do you understand the questions? (2) What questions were confusing? (3) What would you change about a question or format? (4) Do you think the questionnaire asked the appropriate questions? and (5) What did you think about the questionnaire? The questionnaire was revised based on the information gained from the participants.

The final questionnaire included an introduction identifying the researcher, purpose of the study, anonymity, voluntary participation, and expected time to complete questionnaire. The instrument consisted of five sections including demographics (11 items), diabetes education (3 items), diabetes basics (9 items), diabetes management (10 items), and diabetes skills (19 items); a total of fifty-two questions. The questionnaire comprised of dichotomous and multiple choice questions and a five-point Likert-type scale, ranging from 0 – Not Sure to 4 – Highly Competent (See Appendix C).

Data Collection Procedures

Data were collected using the fifty-two item self-administered questionnaire. The questionnaire was administered as an online survey through Qualtrics and paper-and-pencil method. Twenty-five principals were sent an introduction email inviting personnel to participate in the study. The introduction email included identification of the researcher, benefits of participating, confidentiality, time required to complete questionnaire, compensation for participating, closing date to submit completed questionnaire, and anonymous survey link. The principals distributed the email to their respective personnel's email accounts. One week prior to the closing date of the questionnaire, the researcher followed-up with the principals and thanked them for distributing the questionnaire. Also, the researcher provided the principals with a reminder email to share with their personnel. The reminder email thanked those who completed the survey and reiterated the benefits of participating, anonymous survey link, and closing date for those who had not completed the questionnaire. A total of seven hundred on-line surveys were submitted.

Three public elementary schools received paper questionnaires and consent forms. The researcher hand-delivered the self-administered questionnaires and consent forms in a collection box to the principals on a designated date. Comparable to the online survey, participants had two weeks to complete the questionnaire. The principals discussed the purpose of the study and distributed both questionnaire and consent form during their faculty/staff meeting. The researcher followed-up with the principals to thank them for their participation and ask if additional questionnaires were needed. On the final day to submit questionnaires, the researcher collected the signed consent forms and completed questionnaires from the schools' front office. A total of 162 paper questionnaires were collected.

Data Analysis

The dependent variables of this study included diabetes knowledge and perceived self-competence in diabetes management skills. School personnel's gender, age, level of education, role in school, and diabetes training are the independent variables. Questionnaire data was entered into IBM Statistical Package for Social Science (SPSS) 23 and recoded into new variables for data analysis. Descriptive statistics were calculated for each of the questionnaire items. The descriptive statistics included frequency, percentage, mean, and standard deviation.

A principal component analysis was performed for the five-point Likert-type scale for perceived self-competence in performing diabetes management skills to determine the variables with the highest correlations. Next, one-way analysis of variance utilizing post hoc comparisons was conducted to determine the difference between school personnel's role in school on diabetes knowledge and perceived self-competence in performing diabetes management skills to respond to a diabetic emergency.

Ethical Considerations

An approval of this study was obtained from Georgia Southern University Institutional Review Board (see Appendix B). Informed consent form was provided to participants before the paper-and-pencil questionnaire was administered. For the online questionnaire, passive consent was obtained. Participants were informed of the purpose of the study and use of data. Also, participants were informed participation was voluntary and had the rights to withdraw from the study at any time without retribution. After completing the questionnaire, participants could provide their name and email address for a monetary drawing, nonetheless, responses and identity remained confidential. The researcher secured all data, including paper-and-pencil questionnaires and written consent forms in both a password protected file cabinet and computer.

Summary

This chapter discussed the quantitative methods design employed for the study. Chapter 4 will present the results of the findings. Subsequently, chapter 5 will provide discussion of results, strengths and limitations of the study, public health implications, and recommendations for future research.

CHAPTER 4

RESULTS

The purpose of this quantitative study was to assess knowledge about diabetes and perceived self-competence in performing diabetes management skills in response to a diabetic emergency. A convenience sample of school personnel from 28 public elementary schools located within five Georgia counties was surveyed. The research questions that guided the study were analyzed using descriptive statistics, one-way analysis of variance (ANOVA), and principal component analysis. This chapter presents the results by research questions.

Description of the Sample

A total of 862 questionnaires were collected from elementary school personnel from 28 different schools from five counties in Georgia. Fifty-three questionnaires were excluded due to incompleteness (less than 30% of the questionnaire completed), resulting in a sample size of 809 and a response rate of 94%.

The questionnaire contained eleven demographic questions. These questions included items on gender, age in years, education level, county of employment, role in school, years in current role, number of students diagnosed with diabetes in classroom, interactions with a student with diabetes, observations of a student experiencing a diabetic emergency, and whether they provided care for a student experiencing a diabetic emergency. The majority of the school personnel were female (97%, n = 782), while 3% (n = 24), were male. Three respondents did not reveal their gender. For the purpose of data analysis, the first age range of 18 - 24 was collapsed with 25 - 34 age range due to few respondents in the 18 - 24 year old category. Twenty-one percent of respondents were aged 18 – 34; 27% were aged 35 – 44; 37% of respondents' current age in years was 45 - 54; and 15% were aged 55 or older. One respondent did not specify their age. Level of education ranged from less than high school through doctorate degree. Due to the

small number of respondents in some of the education categories, the response items were collapsed from eight to five. A little over one-third of the respondents (35%) had completed a master's degree; fewer than 15% had completed some college but no degree or associate degree; and less than 10% had completed less than a high school, high school diploma, or general education development (GED). Two respondents did not respond to the education level question. More than half (59%) of the respondents identified their current role in school as a teacher. Eighteen percent identified themselves as paraprofessional, and the remaining 18% identified as school nurse or other. School nurse respondents accounted for only 3% of the respondent sample. The category other did not have a specific role assigned; however, respondents could specify their role. Roles identified in the other category included: administrator, media specialist, speech pathologist, and therapist. One respondent did not specify their role.

Respondents were asked about the length of time in their current role. Over a quarter of the respondents (28%) reported being in their current role for 0 – 4 years and 8% reported 25 or more years. Four respondents did not indicate the number of years in current role. Respondents were asked to identify whether they had a student diagnosed with diabetes in their classroom or had previous interactions with a student with diabetes. The "role" categories with the highest percentages of a student with diabetes in their class or previous interactions were highest for classroom teachers, health and physical education coaches, and paraprofessionals. Ten percent of teachers, less than one-tenths (8%) of paraprofessionals, and more than half (60%) of health and physical education coaches reported "yes" to currently having a student diagnosed with diabetes in their classroom. As for recent interactions with a student with diabetes, 22% of teachers, 28% of paraprofessionals, and 70% of health and physical education coaches reported "yes." The

majority of respondents (77%) reported never observing or providing care (84%) for a student experiencing a diabetic emergency. For this study, a diabetic emergency is operationalized to include hypoglycemia, hyperglycemia, or diabetic ketoacidosis. As discussed in chapter 3, school districts that participated in the study were identified alphabetically to maintain confidentiality and anonymity. The demographic variables of the study are presented in tables 4.1 and 4.2.

Table 4.1
Descriptive Statistics of the Total Sample of School Personnel

Variable		Frequency (n)	Percentage (%)
Gender			
	Female	782	96.7
	Male	24	3.0
Age in years			
	18-34	170	21.0
	35-44	222	27.4
	45-54	296	36.6
	55 or older	120	14.8
Education			
	Less than high school, high school diploma, or GED	62	7.7
	Some college but no degree or associate degree	115	14.2
	Bachelor's degree	191	23.6
	Master's degree	282	34.9
	Specialist degree or doctorate degree	157	19.4

Table 4.2

Descriptive Statistics of the Total Sample of School Personnel (Continued)

Variable		Frequency (n)	Percentage (%)
County of Employment			
	A	94	11.6
	B	156	19.3
	C	238	29.4
	D	163	20.1
	E	158	19.5
Role			
	Teacher	474	58.6
	Paraprofessional	149	18.4
	Physical Education Coach	10	1.2
	Counselor	15	1.9
	School Nutrition Staff	12	1.5
	School Nurse	25	3.1
	Other	123	15.2
Years in Role			
	0 – 4	225	27.8
	5 – 9	162	20.0
	10 – 14	133	16.4
	15 – 19	117	14.5
	20 – 24	100	12.4
	25 or More	68	8.4

n = 809

Research Question 1

What is the current level of diabetes knowledge among school personnel?

To assess diabetes knowledge among school personnel, respondents answered a total of 19 questions (9 single response and 10 multiple responses) that pertained to the causes and symptoms of diabetes, definitions of hypoglycemia and hyperglycemia, and the management and treatment of diabetes for school-aged children. For the single response questions in which 4 or 5 choices were available, there was only one correct answer. Responses were recoded as "0" for incorrect and "1" for correct.

To measure school personnel's knowledge about diabetes, a composite score was created for the nine single response questions, by adding the total number of correct responses and computing the mean. The mean for the single response questions was .58 (*SD* = .24). For the multiple response questions, the responses were recoded with the correct answer choices as a "1" and incorrect choices as "0". A composite score was derived by adding the number of correct responses and computing the mean. Therefore, it was possible to have a mean score between 0 - 4. For example, question 15 asked "Which of the following are common symptoms of both Type 1 and Type 2 diabetes?" if all four responses were answered, the least possible score was 0 and the maximum possible score was 4. A "do not know" response was not scored for the multiple response questions. The mean for the multiple response questions was 2.34 (*SD* = .81).

School personnel correctly identified the common symptoms of both Type 1 and Type 2 diabetes, *M* = 2.94 (*SD* = 1.11). However, only 38% of respondents identified hunger as a common symptom. For blood glucose management, a balanced nutrition is essential. A little over three-fourths (77%) of the respondents identified carbohydrate as a nutrient that has the greatest effect on a diabetic's blood glucose, *M* = .79 (*SD* = .41). Seventy-nine percent of respondents

correctly defined hypoglycemia as blood glucose being low and respondents correctly identified the cause of hypoglycemia, *M* = 70 (*SD* = .46). Additionally, the majority of the respondents correctly identified symptoms of hypoglycemia, *M* = 2.90 (*SD* = 1.02). These symptoms included trembling, excessive sweating, and confusion. Regarding the treatment of hypoglycemia, the mean for glucagon being used to treat a diabetic experiencing a hypoglycemic emergency was .32 (*SD* = .47), whereas, the mean for providing a half cup of fruit juice as a quick acting glucose source was .74 (SD = .44), indicating respondents were more knowledgeable on a glucose source than the use of glucagon when a diabetic is exhibiting signs of hypoglycemia. Frequencies and percentages of responses to the diabetes knowledge questions are presented in Appendix D.

For hyperglycemia, respondents correctly defined the variable as blood glucose being high, *M* = .75 (*SD* = .43). Despite respondents correctly defining hyperglycemia, the mean to check blood glucose as a response for a diabetic exhibiting signs of hyperglycemia was only .41 (*SD* = .49). For the causes of hyperglycemia, the mean score was 1.44 (*SD* = 1.02) indicating that respondents were familiar with almost 2 out of the three causes of hyperglycemia. Twenty-eight percent and 38% of respondents correctly selected strenuous physical activity and illness respectively as causes of hyperglycemia. However, the mean for physical activity having an effect on Type 1 diabetes was *M* = .06 (*SD* = .23), indicating that although school personnel correctly identified physical activity as a cause for hyperglycemia, they were not as knowledgeable about its effect on diabetes management. Physical activity is a vital component for diabetes management. In addition to physical activity being an important component for diabetes management, respondents correctly identified nutrition, medication, and blood glucose monitoring as preventive actions for hypoglycemia and hyperglycemia, *M* = 3.15 (*SD* = 1.40).

Regarding diabetic ketoacidosis (described as excess ketones in the urine), not quite half of the respondents correctly identified the causes, *M* = 1.67 (*SD* = 1.04) and symptoms *M* = 1.41 (*SD* = 1.58). A student diagnosed with diabetes and attending school will have a diabetes medical management plan (DMMP) that is created by the student's medical team and parent/guardian (American Diabetes Association, 2015). School personnel correctly identified two out of the four items that are included in a student's DMMP, *M* = 2.55 (*SD* = 1.76). Table 4.3 summarizes the mean of correctly identified diabetes knowledge items by school personnel.

Table 4.3

Overall Mean of Diabetes Knowledge among School Personnel

Item	Mean	Standard Deviation (SD)	Range	
			Minimum	Maximum
Single Responses				
Definition of hypoglycemia	.79	.408	0	1
Cause of hypoglycemia	.70	.457	0	1
Definition of hyperglycemia	.75	.434	0	1
Physical activity on type1	.06	.230	0	1
Nutrients	.79	.406	0	1
Glucagon	.32	.466	0	1
Glucose source	.74	.437	0	1
Response for hypoglycemia	.61	.489	0	1
Response of hyperglycemia	.41	.493	0	1
Multiple Responses				
Symptoms of diabetes	2.94	1.11	0	4
Symptoms of hypoglycemia	2.90	1.02	0	4
Causes of hyperglycemia	1.44	1.02	0	3
Symptoms of hyperglycemia	2.77	1.45	0	4
Cause of diabetic ketoacidosis	1.67	1.04	0	4
Symptoms of diabetic ketoacidosis	1.41	1.58	0	4
Diabetes medical management plan	2.55	1.76	0	4
Part of diabetes management	3.15	1.40	0	4
Monitor blood glucose	2.67	1.51	0	5
Response for hypoglycemia (2)	2.14	.62	1	3

Research Question 2

What is the level of school personnel's perceived self-competence in performing diabetes management skills as required by Georgia's House Bill 879?

Georgia's House Bill (HB) 879 requires school districts to train non-nursing personnel on diabetes management and treatment. Respondents were asked about awareness of HB 879. Twenty-eight percent of respondents reported having some knowledge of the bill, while 72% reported no knowledge. Of these respondents, 68% reported receiving training on diabetes and its management and treatment through their current school of employment (see Table 4.4).

Table 4.4
Cross tabulation of Georgia HB 879 and Diabetes Training among Survey Respondents

Georgia House Bill 879	Training		
	Yes n (%)	No n (%)	Total n (%)
Yes	134 (59.3)	92 (40.7)	226 (100%)
No	54 (9.4%)	522 (90.6%)	576 (100%)
Total	188 (23.4%)	614 (76.6)	802 (100%)

Note: Reported % values are within Georgia HB 879

The level of perceived self-competence among school personnel in performing diabetes management skills was based upon a 5-point rating scale, with responses from Not Sure to Highly Competent. The responses were coded as 0 - 4 with the directionality indicating greater competence. About 36% of the respondents reported that they were "somewhat competent" in recognizing symptoms of hypoglycemia, however, 45% of respondents reported "not competent" in providing treatment for hypoglycemia. A little over one-third (36%) and 11% of respondents respectively reported being "not competent" in recognizing symptoms of hyperglycemia and providing treatment for hyperglycemia. Additionally, respondents reported they were "not

competent" in performing a finger-stick to check a student's blood glucose (37%), communicating the results of blood glucose to parent/guardian or healthcare professional (40%), or recording the results of blood glucose on a proper document (40%). In assessing urine for ketones, 67% of respondents reported they were "not component," while 10% of respondents reported being "somewhat competent." For insulin administration, less than ten percent (9%) of respondents were "highly competent" in preparing insulin doses. However, 64% and 42% of the sample of respondents respectively reported being "not competent" with administering insulin to a student through the subcutaneous (beneath the skin) route and recording the time, dose, and site of insulin administration on a proper document. The majority of the respondents were "not competent" with preparing (69%), administrating (66%), and recording (44%) glucagon for a student experiencing hypoglycemia. Furthermore, 22% of respondents reported that they were "competent" in disposing insulin needles in an appropriate container, whereas, 33% of respondents reported being "not competent." More than half of the respondents were "not competent" in identifying signs that an insulin pump site needed to be changed, delivering bolus with an insulin pump, and disconnecting an insulin pump. The frequencies and percentages for school personnel's perceived competence for each of the nineteen diabetes management skills are presented in Appendix E.

Research Question 3

Are there significant differences in diabetes knowledge among school personnel?

It would be expected that differences in diabetes knowledge would exist between school personnel based on their level of education and type of education. For example, the school nurse would be educated on chronic disease management, whereas the classroom teacher would not. Furthermore, the health and physical education coaches would also have some knowledge of

chronic disease identification. Furthermore, based on the passage of HB 879, it was expected that those school personnel who received training, would have a higher level of knowledge about the causes, symptoms, and management of diabetes than those who did not receive training, or were not a nurse or health and physical education coach.

A one-way ANOVA was conducted to determine differences in diabetes knowledge among school personnel. There was a significant difference between school personnel's role on diabetes knowledge, $F(6, 801) = 9.52$, $p = 0.000$ (see Table 4.5). With unequal group sizes of school personnel, (e.g., teachers comprised the highest proportion of school personnel, while the health and physical education coaches was the lowest proportion), the researcher used the harmonic means sample size of 22.805. The post hoc comparisons utilizing the Tukey HSD test determined that the mean score of school nurses, $M = .85$ ($SD = .06$) was significantly different from the school counselors ($M = .73$, $SD = .16$), other ($M = .60$, $SD = .22$), health and physical education coach ($M = .59$, $SD = .15$), teacher ($M = .58$, $SD = .19$), paraprofessional ($M = .57$, $SD = .20$), and school nutrition staff ($M = .47$, $SD = .24$). This result is not surprising because based on their nursing training, understanding how to recognize and respond to diabetic emergencies is expected. There was no significant differences between school counselor and school nurse ($p = .563$).

Table 4.5

One-Way Analysis of Variance of School Role by Diabetes Knowledge

Source	df	SS	MS	F	p
Between groups	6	2.188	.365	9.518	.000
Within groups	801	30.692	.038		
Total	807	32.880			

Research Question 4

Are there significant differences between perceived skill competence in diabetes management among school personnel?

A principal component analysis using varimax and oblimin rotations was performed to determine the variability of the 19 diabetes management skill items. The items yielded three components (factors) with eignevalues greater than 1. The three factors accounted for 76% of the variance explained (see Table 4.6). As presented in Table 4.7, all items had primary factor loadings at .50 or above. Eight items loaded onto factor one and were related to the communication of diabetes management results. Seven items loaded onto factor two. This factor was associated with insulin care and administration. For factor three, four items loaded and were related to recognizing and providing treatment for hypoglycemia and hyperglycemia. Internal consistency for each of the scales was examined using Cronbach's alpha, a value between 0 and 1. The alphas for each scale was .90 or higher (see Table 4.7), indicating a reliable scale. Moreover, composite scores were obtained for each of the three factors by computing the mean.

Table 4.6

Eigenvalues and Percentage of Variance Associated with Each Component (Factor)

Component	Eignevalue	Percentage of explained variance	Cumulative percentage of explained variance
1	**10.969**	**57.730**	**57.730**
2	**1.955**	**10.290**	**68.020**
3	**1.439**	**7.574**	**75.595**
4	.937	4.932	80.527
5	.599	3.154	83.681
6	.524	2.756	86.437
7	.469	2.470	88.907
8	.354	1.864	90.771
9	.318	1.675	92.446
10	.278	1.465	93.911
11	.236	1.245	95.156
12	.210	1.106	96.262
13	.192	1.012	97.274
14	.162	.854	98.128
15	.113	.597	98.726
16	.082	.430	99.156
17	.062	.326	99.482
18	.060	.314	99.796
19	.039	.204	100.000

Table 4.7

Item Loadings of Principal Component Analysis for Diabetes Management Skills

Items	1	2	3	Crohnbach's Alpha
Record blood glucose results on proper document	**.877**	.206	.254	
Record time dose, and site of administrating insulin on proper document	**.845**	.304		
Record time, dose, and site of administrating glucagon on proper document	**.808**	.323		
Record ketone results on proper document	**.774**	.228	.167	
Communicate blood glucose results to parent/guardian or healthcare professional	**.773**	.299	.281	
Dispose needles in appropriate containers	**.677**	.251	.236	
Perform a finger-stick to check blood glucose	**.668**	.240	.403	
Check urine for ketones	**.540**	.307	.414	
				.946
Disconnect the insulin pump	.286	**.846**	.187	
Identify signs that insulin pump site need to changed	.308	**.818**	.209	
Deliver bolus with insulin pump	.188	**.814**	.256	
Prepare glucagon using diluting solution	.297	**.725**	.269	
Administration of glucagon	.383	**.707**	.352	
Administration of insulin through subcutaneous route	.398	**.662**	.412	
Prepare correct insulin dose	.522	**.620**	.292	
				.949
Recognize symptoms of hyperglycemia	.163	.280	**.851**	
Provide treatment for hypoglycemia	.262	.235	**.847**	
Recognize symptoms of hypoglycemia	.178	.249	**.846**	
Provide treatment for hyperglycemia	.253	.290	**.820**	
				.933

Comparable to diabetes knowledge, it would be expected that significant differences exist between perceived self-competence in diabetes management skills and school personnel. A one-way ANOVA was used to assess perceived self-competence in performing diabetes management skills among school personnel. Regarding skills that pertain to communicating results of diabetes management (factor one), there was significant differences among the school personnel $F(6, 775) = 17.89$, $p = .000$. As expected, school nurses showed the highest competency in performing those skills ($M = 3.71$, $SD = .47$) and other ($M = 1.87$, $SD = 1.08$), paraprofessional ($M = 1.80$, $SD = 1.01$), teacher ($M = 1.75$, $SD = .91$), counselor ($M = 1.73$, $SD = .63$), school nutrition staff ($M = 1.60$, $SD = .81$) and health and physical education coaches ($M = 1.38$, $SD = .43$) were the least competent in communicating results of diabetes management. The post-hoc Scheffè tests showed that school nurses differed significantly from each of the other six identified roles. Thus, the role of personnel predicts 12% of the variability in perceived self-competence in communicating results of diabetes management.

For skills in performing insulin care and administration (factor 2), there was significant differences among the personnel, $F(6, 775) = 38.91$, $p = .000$. Of the roles, school nurses were more competent, $M = 3.71$, (SD = .47). The differences between teacher, paraprofessional, health and physical education coach, counselor, school nutrition staff, and other was not statistically significant. However, personnel role predicted 23% of the variability in their competence in performing insulin care and administration. Furthermore, the skills in recognizing and providing treatment for hypoglycemia and hyperglycemia (factor 3), was statistical significant $F(6, 775) = 23.36$, $p = .000$. The post hoc Scheffè tests revealed school nurse ($M = 3.61$, SD = .48) is significantly different among the six identified school roles. While school nurses are, on average,

more competent in performing diabetes management skills, there is a variation in school personnel role with each diabetes management skill.

CHAPTER 5

SUMMARY, DISCUSSION, AND CONCLUSIONS

Diabetes is a chronic disease in children that requires extensive medical management (Kaufman et al., 2009). As the majority of children with diabetes continue to attend school, personnel play an essential role in helping them with effective diabetes management (Bohn et al., 2004; Silverstein et al., 2009). The purpose of this quantitative study was to assess elementary school personnel's knowledge about diabetes and perceived self-competence in performing diabetes management skills in response to a diabetic emergency. Respondents were from a sample of personnel from five Georgia public school systems. Additionally, this study examined whether diabetes knowledge and diabetes management skills differed among various school personnel. This chapter provides a summary of the study, discussion of the results, strengths and limitations of the study, implications for public health, and suggestions for future research.

Summary of the Study

A questionnaire was developed and validated by the researcher to examine and answer the study's research questions. The questionnaire was administered electronically, utilizing Qualtrics, and paper-and-pencil. The analyses of the quantitative data were performed using SPSS (v. 23). The statistical procedures included frequencies and measures of central tendency, principal component analysis, and one-way ANOVA. Findings from the study revealed school personnel had limited knowledge of diabetes and did not believe they were competent in performing diabetes management skills as required by Georgia HB 879.

Discussion of the Results

The state of Georgia passed HB 879 to ensure students diagnosed with diabetes continue to receive optimal diabetes management while in an academic environment. The five school

systems that participated in this study had received formal diabetes education training following the passage of HB 879. Notably, while each school system indicated receiving training, only 68% of the respondents reported ever receiving training on diabetes management and treatment. Not surprisingly, the majority of respondents did not score high on the diabetes knowledge portion of the questionnaire.

Diabetes Knowledge

School personnel demonstrated a knowledge deficit in understanding what diabetes is, symptoms of a diabetic emergency, and effective treatment for a diabetic emergency. Respondents were asked to identify the common symptoms of both type 1 and type 2 diabetes. Findings from the study revealed respondents were not strong in their knowledge of basic symptoms of type 1 and type 2 diabetes (e.g., hunger). Being able to recognize basic symptoms of both type 1 and type 2 diabetes is critical to anyone working with school-aged populations. Amillategui and colleagues (2007) reported that teachers were unable to distinguish the difference between type 1 and type 2 diabetes. In the same study, researchers found that parents of diabetic children felt that it was imperative for school personnel, specifically teachers, to be aware of the symptoms of type 1 diabetes and treatment options. Although 68% of teachers received training for diabetes, if they did not have opportunities for refresher courses or there was a gap of two or more years between their training and taking the questionnaire, knowledge not used is often forgotten.

A high proportion of respondents knew the definition of hypoglycemia and hyperglycemia. However, they did not have a true understanding of the appropriate treatment and management for a student experiencing a hypoglycemic episode. For example, respondents were unaware that glucagon was used to treat hypoglycemia by immediately raising blood

glucose levels. Similarly, Amillategui et al. (2009) found that 10% of teachers lacked sufficient knowledge on the use of glucagon. As for hyperglycemia, a little over one-third of respondents were not aware of the importance of checking a student's blood glucose before the administration of insulin for a student exhibiting signs of hyperglycemia. The results of the blood glucose test could assist personnel on the appropriate plan of action for assisting a diabetic student. Physical activity plays a critical role in managing diabetes, specifically for hyperglycemia (Kaufman et al., 2009). The study's finding indicated that most of the respondents were not aware of the effect physical activity has on regulating blood glucose. In a prior study, it was reported that a quarter of the teachers believed children with diabetes should not be allowed to attend health and physical education classes (Ayan et al., 2012). This is not consistent with the American Diabetes Association guidelines. The American Diabetes Association's *Safe at School* encourages participation in physical activities for students with diabetes (American Diabetes Association, n.d.). Research has reported engaging in physical activity can lower blood glucose levels (Spiegel et al., 2009; Kaufman et al., 2009).

Knowledge about diabetic ketoacidosis (DKA) was another deficiency of the school personnel's diabetes knowledge. Almost half of respondents were not able to correctly identify the causes and symptoms of DKA. This is very alarming since DKA is a life-threatening condition as well as the primary reason for children with diabetes to be hospitalized (Kaufman et al., 2009; American Diabetes Association, n.d.). Knowledge of symptoms, triggers and treatment of DKA may help school personnel to be able to accurately monitor students' blood glucose levels. Children attending Georgia public schools with a diagnosis of diabetes from the study sample are at increased risk that if they experience a hypoglycemia or hyperglycemia emergency, school personnel will be unable to assist. Previous research suggests personnel

assisting with diabetic emergencies requires “professional judgment and coordination” (Engelke et al., 2011, p. 357), and that training could improve the understanding of diabetes (Pinelli et al., 2011; Boden et al., 2012) and recognition of symptoms.

Diabetes Management Skills

School personnel’s lack of diabetes knowledge also reflected their perceived self-competence in performing diabetes management skills. Although respondents were able to correctly define hypoglycemia and hyperglycemia, they did not perceive themselves as competent in symptom recognition or to provide treatment. This was evident in how respondents responded to the questions that related to the use of glucagon and actions for a diabetic exhibiting signs of hyperglycemia. The study findings were similar with previous literature showing school personnel being inadequately prepared to assist a student with hypoglycemia (Schwartz et al., 2010). Contrary to the current study, Amillategui et al. (2009) study found that teachers would be able to recognize a student experiencing hypoglycemia during a physical activity.

Blood glucose monitoring is an integral component of diabetes management. Researchers suggest blood glucose monitoring be performed before meals and snacks; before, during, and after physical activity; and for hypoglycemia and hyperglycemia symptoms (Kaufman et al., 2009). Once a blood glucose test is performed, it is recommended that the results are recorded. If the results display glucose numbers that are not within the student’s target range as documented on their Diabetes Medical Management Plan, immediate action may be required (American Diabetes Association, n.d.). In the current study, findings indicated respondents are not competent in performing a student’s blood glucose test, recording the results of the test, or communicating the results to the school’s onsite health care provider or student’s parent or

guardian. Based on a student's age, the student may need assistance from school personnel to check, monitor, and record blood glucose (Silverstein et al., 2009; Kaufman et al., 2009). School personnel's confidence in performing blood glucose monitoring could help students achieve optimal diabetes management and correctly identify hypoglycemia and hyperglycemia.

The use of insulin injections and insulin pumps are treatment strategies for students with diabetes. While in a school setting, it is imperative for students to receive accurate insulin dose in a timely manner to avoid disastrous consequences. The results of the study showed that nearly half of the respondents are not competent in their ability in preparing insulin, administering insulin, and assisting with an insulin pump. Interestingly, 9% of respondents are "highly competent" in preparing the correct amount of insulin dose for a diabetic student. The researcher believes this skill was achieved by the school nurses due to education attainment and level of medical training. The researcher's theory correlates with Pinelli et al. (2016) finding of the rarity of non-nursing personnel to perform the administration of insulin with an injection or insulin pump.

Diabetes Knowledge among Personnel Role

Knowledge of diabetes has been reported as an indicator for school personnel to assist students with the management of diabetes (Mandali & Gordon, 2009). In the current study, there were statistically significant differences between diabetes knowledge and role of personnel. School nurses scored significantly higher on knowledge questions than health and physical education coaches, teachers, paraprofessionals, and school nutrition staff, but not for school counselors, implying counselors have some knowledge of diabetes. This result was consistent with Wagner and James (2006) findings that reported school counselors had basic level of diabetes knowledge, however, it was inadequate to manage a student's diabetes. Researches

suggests counselors can assist students with diabetes by being trained on how to identify symptoms that affect academic performance and being abreast of mental health risks (e.g., depression and anxiety) that are associated with diabetes (Wagner & James, 2006). Although it was not surprising for school nurses to be more statistically significant, the results indicate non-nursing personnel demonstrates an understanding of diabetes; a finding that contradicts previous studies (Aycan et al., 2012; Hayes-Bohn et al., 2004; Gormanous & Pope, 2002).

Diabetes Management Skills among Personnel Role

Comparable to diabetes knowledge, a statistically significant difference existed between perceived self-competence in diabetes management skills and the role of school personnel. School personnel who knew more also were more competent in their ability to perform skills related to effective diabetes management. School personnel who identified as school nurses scored at statistically significant levels in communicating the results of diabetes management. These skills of communication included: (1) recording blood glucose results on proper document; (2) recording time, dose, and site of administering insulin on proper document; (3) recording time, dose, and site of administering glucagon on proper document; (4) recording ketone results on proper document; (5) disposing needles in appropriate containers; (6) performing a finger-stick to check blood glucose; and (7) checking urine for ketones. The roles of paraprofessional, counselor, health and physical education coach, school nutrition staff, teacher, and other were not statistically different from each other at the $p < 0.05$ level. Although school nurses differed significantly between the identified school roles, the amount of variability shared by all personnel with perceived competence in communicating results of diabetes management was only 12%. Moreover, there remained a statistically significant difference among school personnel and the skills in performing insulin care and administration and

recognizing and providing treatment for hypoglycemia and hyperglycemia. Of the study's identified roles, school nurses scored at statistically significant levels. Yet, results displayed a 23% variation in school role with insulin care and administration.

These variations could be an indication of school nurses being the only health care professional in a school environment. Thus, nurses have become the cornerstone resource in providing care for children with chronic illnesses such as diabetes during school hours. With nurses being trained in managing diabetes, it can be determined that they can quickly recognize symptoms of hypoglycemia and hyperglycemia and provide effective treatment. Another possible explanation of the variance is that school nurses are the primary contact between a student's parent or guardian and health care provider when reviewing or developing a student's diabetes medical management plan (Schwartz et al., 2010). Additionally, with federal laws ensuring students with diabetes can continue medical care while in school; non-nursing personnel must receive diabetes education training (Hellems & Clarke, 2007; Georgia Department of Education, 2012). The training received may have aided non-nursing personnel in their ability to perform effective diabetes management skills. Furthermore, whether or not personnel has had a diabetic student in their classroom or has observed a student experiencing a diabetic emergency could also account for variations of perceived self-competence in performing diabetes management skills and school personnel.

Strengths and Limitations

The study presents both strengths and limitations. A major strength of the study is the sample size (n = 809). The study's sample size was much larger compared to prior literature assessing diabetes knowledge and management in a school setting. Conducting a pilot study with an elementary school that was not included in the population was an additional strength. The

pilot study enabled the researcher to assess readability and understanding of the questionnaire and modify based on the information gained from participants. Furthermore, the researcher established rapport with the principals by conducting face-to-face meetings to discuss the study in detail and sending thank you emails for their participation.

In addition to the study's strengths, there are several limitations. One limitation is the small number of students diagnosed with diabetes (type 1 and type 2) within the five Georgia counties' school systems. The number of diabetic students ranged from 18 to 34. It is plausible that diabetes was not considered a health priority among the personnel who participated in the study. Furthermore, the prevalence of diabetes is unknown for youth 18 years of age and younger residing in Georgia. To obtain the number of diabetic students, the researcher had to communicate with the counties' lead school nurses or health coordinators.

Another limitation is the employment of a cross-sectional design. Cross-sectional designs collects data at a particular point in time (Creswell, 2009), which limited the ability for the researcher to gain an in-depth understanding of the causality of school personnel's knowledge about diabetes and perceived-competence in performing diabetes management skills. Incorporating a qualitative component, such as direct observations, key informant interviews, or focus groups would have provided a more robust study. Due to the feasibility of convenience sampling, there was an over-representation of gender and role in school. Ninety-seven percent of the sample was female and 3% were male. Also, half of the respondents identified their current role as a teacher. This could be due to the fact that teaching is a more female dominated occupation and the principals from the participating schools administering the questionnaire to accessible personnel (e.g. computer and internet access and attendance in staff meeting). As a result, generalizations could not be interpreted for the entire population.

Public Health Implications and Recommendations

The current study demonstrates that elementary school personnel lacked knowledge of diabetes and self-competency to perform a diabetes management skill. However, school nurses were more knowledgeable of diabetes and executing diabetes management. Thus, school nurses are paramount in promoting optimal health for children with chronic illnesses.

School nurses should establish partnerships with local public health departments to assess the study findings. By assessing the findings collaboratively, a diabetes education curriculum could be developed and taught by the school nurses and public health practitioners twice during a school year. To ensure successful and effective outcomes, the curriculum should be evaluated utilizing the Centers for Disease Control and Prevention's six-step evaluation framework. This framework includes: (1) engaging stakeholders; (2) describing the curriculum; (3) focusing the evaluation; (4) gathering data; (5) justifying conclusions; and (6) disseminating and sharing lessons learned (Centers for Disease Control and Prevention, 1999). Additionally, the curriculum could enhance non-nursing personnel self-efficacy to manage students diagnosed with diabetes and respond efficiently when a student is experiencing a diabetic emergency.

Several federal and state laws have been passed to support and protect the rights of children diagnosed with diabetes (American Diabetes Association, 2013a; Georgia General Assembly, n.d.). However, these laws are not properly evaluated to ensure school systems have the capacity to employ the law successfully. The findings from the study will assist with school systems employing innovative trainings on diabetes and its management Furthermore, to the researcher's knowledge, the state of Georgia does not have a database system of the prevalence of diabetes among youth per county. An established database system would empower diabetes

advocates and influence policy (e.g. environment and institutional) change at the federal, state, and county level.

Future Research

Diabetes is a chronic illness that is affecting our children and cannot be disregarded. As stated in chapter 1, nearly 86,000 children between the ages of zero and fourteen are estimated to develop the disease annually (International Diabetes Federation, 2015). As evidenced in the study, school personnel do not have a comprehensive understanding of diabetes. As a result, school personnel have a knowledge deficient in regards to diabetes and are not competent in their ability to provide optimal diabetes management to comply with Georgia HB 879. Despite the passage of HB 879 and the American Diabetes Association developing recommendations on how a school environment can assist students with diabetes, the understanding of diabetes and its management among school personnel appears to be a low priority. Therefore, future research is warranted for diabetic children to attain a desirable quality of life while in an academic setting.

For future research, the researcher presents the following recommendations:

- Investigate a broader sample of school personnel from Georgia school districts to include both elementary and secondary schools. A broader sample will yield a more representative sample of school personnel.
- Employ a longitudinal design of a diabetes education training program to determine the impact of diabetes knowledge and outcome of diabetes management.
- Conduct a qualitative method such as key informant interviews or focus groups to understand the causality of diabetes knowledge and perceived self-competence in diabetes management.

- Conduct a comparison study of the level of knowledge among school personnel employed in an urban versus rural setting.
- Engage community members, school officials and personnel, public health practitioners, diabetic children, and parents of diabetic children through community-based participatory research to develop interventions that will achieve effective diabetes management in school settings.
- Redesign survey instrument, including the format of questions and evaluate the psychometrics to ensure validity and reliability.

Conclusions

In a school setting, school nurses play a significant role in providing care for students diagnosed with diabetes (Guttu et al., 2004). Unfortunately, a nurse is not always accessible for diabetic students. In the absence of a nurse, non-nursing personnel could assist with diabetes management and treatment. Although extensive research has been conducted on diabetes management in an academic setting, there are no studies to the researcher's knowledge that have assessed both diabetes knowledge and skills among school personnel since the Georgia HB 879 was enacted. This quantitative study aimed to fill the gap in research on diabetes knowledge deficit and ability to perform diabetes management in response to a diabetic emergency among various school roles. The results of the study demonstrated that despite state mandates for training, many school personnel are not well trained nor are skills for assessing a diabetic student reinforced over time. Training in recognition of symptoms of diabetes, diabetes-related conditions, and diabetes management skills need to occur in on-going rotation in schools. Incompetence of diabetes can delay early recognition of symptoms and treatment of a diabetic emergency. With an increase in diagnosis of type 2 diabetes in youth expected to increase over

the next few years due to obesity; school systems need to be ready to address this potential emergency. Furthermore, public health education needs to extend to school systems to increase knowledge about diabetes and its related conditions and competence in diabetes management to enhance a safe school environment.

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APPENDIX A

School Personnel Informed Consent

JIANN-PING HSU COLLEGE OF PUBLIC HEALTH

DEPARTMENT OF COMMUNITY HEALTH BEHAVIOR & EDUCATION

SCHOOL PERSONNEL INFORMED CONSENT

1. My name is Alesha Wright and I am a public health doctoral student at Georgia Southern University Jiann-Ping Hsu College of Public Health. I am doing this research as part of the requirements for the Doctorate in Public Health, Community Health Behavior and Education, under the guidance of Joanne Chopak-Foss, Ph.D. and committee members Ashley Walker, Ph.D. and Gulzar Shah, Ph.D.

2. Purpose of the Study:
   The purpose of this study is to assess elementary school personnel's knowledge about diabetes and perceived self-competence in skills to respond to a diabetic emergency.

3. Procedures to be followed:
   Participation in this research will include completion of a questionnaire administered to elementary school personnel from five counties' school systems in Georgia. At each of the participating schools, school personnel will receive a copy of the informed consent form, and questionnaire to complete.

   Participants will submit signed consent form and completed questionnaire in a designated area in school.

4. Discomforts and Risks:
   The risk of physical and psychological harm is minimal. Participation in this study will not require activities that are above and beyond normal classroom instruction, medical care, and daily duties, as the focus is on diabetes knowledge and skills. Some participants may experience minor discomfort answering questions about diabetes knowledge and skills in performing diabetes management.

5. Benefits:
   a. The benefits to participants include improved knowledge about diabetes and additional training for assisting students with the disease.
   b. The benefits to society include ensuring academic success for students with diabetes by providing a safe environment, appropriate medical care, and equal educational opportunities as students without a chronic disease. Results of the study will be shared with each participating school system to determine if follow-up training for school personnel on diabetes management is needed.

6. Duration/Time required from the participant:
   The questionnaire will take approximately ten minutes to complete.

7. Statement of Confidentiality:
   Responses will be kept confidential. Only the researchers will have access to the information related to the study. All data, including questionnaire data will be stored on the principal investigator's password protected computer for a period of seven years and then destroyed.

Deidentified or coded data from this study may be placed in a publically available repository for study validation and further research. The names of specific school districts and individuals will not be identified in the data set or any reports or publications using information obtained from this study, and confidentiality as a participant in this study will remain secure. Subsequent uses of records and data will be subject to standard data use policies which protect the anonymity of individuals and institutions.

8. Right to Ask Questions:
   You have the right to ask questions and have those questions answered. If you have questions about this study, please contact Alesha Wright, whose contact information is located at the end of the informed consent. For questions concerning your rights as a research participant, contact Georgia Southern University Office of Research Services and Sponsored Programs at 912-478-0843.

9. Compensation:
   If you participate in the study and complete the questionnaire you can enter into a drawing to receive compensation in the amount of $25.00. Compensation will be awarded in May 2015.

10. Voluntary Participation:
    Participating in this study is voluntary. If you choose to withdraw your participation you can do so by not completing the questionnaire and not returning the questionnaire. You do not have to answer any questions you do not want to answer.

11. Penalty:
    There is no penalty for deciding not to participate in the study; you may decide at any time you do not want to participate further. There is no penalty or retribution for withdrawing from this study.

12. You must be 18 years of age or older to consent to participate in this research study. If you consent to participate in this research study and to the terms above, please sign your name and indicate the date below.

You will be given a copy of this consent form to keep for your records. This project has been reviewed and approved by the GSU Institutional Review Board under tracking number H15200.

Title of Project:
Assessing the Knowledge and Skills of School Personnel to Respond to Diabetic Emergencies in Georgia Public Schools

Principal Investigator:
(Alesha Wright)
P.O. Box 8015 Statesboro, GA 30460

Other Investigator(s):
Dr. Joanne Chopak-Foss
P.O. Box 8015 Statesboro, GA 30460

Dr. Ashley Walker
P.O. Box 8015 Statesboro, GA 30460

Dr. Gulzar Shah

P.O. Box 8015 Statesboro, GA 30460

Faculty Advisor:
Dr. Joanne Chopak-Foss
P.O. Box 8015 Statesboro, GA 30460

_____ _____
Participant Signature Date

I, the undersigned, verify that the above informed consent procedure has been followed.

_____ _____
Investigator Signature Date

APPENDIX B

Institutional Review Approval Form

Georgia Southern University
Office of Research Services & Sponsored Programs

Institutional Review Board (IRB)

Phone: 912-478-0843
Fax: 912-478-0719
IRB@GeorgiaSouthern.edu
Veazey Hall 2021
P.O. Box 8005
Statesboro, GA 30460

To:	Alesha Wright Dr. Joanne Chopak-Foss
cc:	Charles E. Patterson Vice President for Research and Dean of the Graduate College
From:	Office of Research Services and Sponsored Programs Administrative Support Office for Research Oversight Committees (IACUC/IBC/IRB)
Approval Date:	12/17/14
Subject:	Status of Application for Approval to Utilize Human Subjects in Research

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After a review of your proposed research project numbered **H15200** and titled **"Assessing the Knowledge and Skills of School Personnel to Respond to Diabetic Emergencies in Georgia Public Schools,"** it appears that your research involves activities that do not require full approval by the Institutional Review Board (IRB) according to federal guidelines.

According to the Code of Federal Regulations Title 45 Part 46, your research protocol is determined to be exempt from full review under the following exemption category(s):

B2 Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (I) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (II) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Therefore, as authorized in the Federal Policy for the Protection of Human Subjects, I am pleased to notify you that your research, as submitted, is exempt from IRB approval. No further action or IRB oversight is required, as long as the project remains the same. If you alter the project, it is your responsibility to notify the IRB and acquire a new determination of exemption. Because this project was determined to be exempt from further IRB oversight, this project does not require an expiration date.

Sincerely,

Eleanor Haynes
Compliance Officer

APPENDIX C

Diabetes Knowledge Questionnaire

Diabetes Knowledge Questionnaire (DKQ)

My name is Alesha Wright and I am a doctoral student at Georgia Southern University Jiann-Ping Hsu College of Public Health. You are invited to participate in a research study that is assessing elementary school personnel's knowledge of diabetes and skills related to effective diabetes management. The time needed to complete the questionnaire is approximately 10 minutes. Please DO NOT write your name or any other identifying information anywhere on the questionnaire. Responses will be kept confidential and will not be seen by other school personnel. Your participation is voluntary. Since you are part of a small sample, your participation will be extremely helpful for this study as the results from the study will assist the school district in providing follow-up training for assisting students with diabetes. Thank you for your help in this important health issue.

Section I: Demographics
This set of questions is related to your demographics. **Please check only one answer for each question.**

1. What is your gender?
   _____Female _____Male

2. What is your current age?
   _____18 - 24 years old
   _____25 – 34 years old
   _____35 – 44 years old
   _____45 – 54 years old
   _____55 years or older

3. What is your highest level of education that you completed?
   _____Less than High School
   _____High School Diploma or GED
   _____Some College but no Degree
   _____Associate Degree
   _____Bachelor's Degree
   _____Master's Degree
   _____Specialist Degree
   _____Doctorate Degree

4. What is your county of employment? _____

5. What is your current role?
   _____Teacher (please specify position) _____
   _____Paraprofessional
   _____Physical Education Coach
   _____Counselor
   _____School Nurse
   _____School Nutrition Staff
   _____Other (please specify) _____

6. How long have you been in your current role?
   _____0 – 4 years
   _____5 – 9 years
   _____10 – 14 years
   _____15 – 19 years
   _____20 – 24 years
   _____25 years or more

7. If your current role is a teacher, paraprofessional, or physical education coach, do you have a student with diabetes in your class?
   _____Yes _____No _____Not Sure _____Not Applicable

8. If your current role is a teacher, paraprofessional, or physical education coach, do you have interactions with a student with diabetes?
   _____Yes _____No _____Not Sure _____Not Applicable

9. If your current role is a counselor, school nurse, school nutrition staff, or other, do you have interactions with a student with diabetes?
   _____Yes _____No _____Not Sure _____Not Applicable

10. Have you observed a student experiencing a diabetic emergency (i.e., Hypoglycemia or Hyperglycemia)?
    _____Yes _____No

11. Have you provided care for a student experiencing a diabetic emergency (i.e., Hypoglycemia or Hyperglycemia)?
    _____Yes _____No

Section II: Diabetes Education
This set of questions relates to diabetes education in school. **Please check only one answer for each question.**

12. Are you familiar with Georgia House Bill 879? *A bill that requires Georgia school districts to train non-nursing personnel on diabetes management and treatment.*
    _____Yes _____No

13. Have you attended training on diabetes and diabetes management through the school you are currently employed? **(If NO, GO TO QUESTION 15.)**
    _____Yes _____No

14. If yes, how long ago was the training?
    _____1 – 3 months
    _____4 – 6 months
    _____7 – 9 months
    _____10 – 12 months
    _____Other (please specify)_____

Section III: Diabetes Basics
This next set of questions relates to causes and symptoms of diabetes. **Please circle only one answer for each question, unless instructed to select all that apply.**

15. Which of the following are common symptoms of both **Type 1** and **Type 2** diabetes? **SELECT ALL THAT APPLY.**
    a. Frequent urination
    b. Thirst
    c. Fatigue (weak, tired feeling)
    d. Hunger
    e. Do not know

16. What is the definition of **Hypoglycemia**?
    a. Blood glucose is low
    b. Blood glucose is normal
    c. Blood glucose is high
    d. Do not know

17. What is the cause of **Hypoglycemia**?
    a. Too much insulin
    b. Not enough exercise
    c. Too much food intake
    d. Do not know

18. What are symptoms of **Hypoglycemia**? **SELECT ALL THAT APPLY.**
    a. Trembling
    b. Excessive sweating
    c. Loss of appetite
    d. Confusion
    e. Do not know

19. What is the definition of **Hyperglycemia**?
    a. Blood glucose is low
    b. Blood glucose is normal
    c. Blood glucose is high
    d. Do not know

20. Which of the following causes **Hyperglycemia**? **SELECT ALL THAT APPLY.**
    a. Skipping or forgetting insulin
    b. Strenuous physical activity
    c. Illness
    d. Do not know

21. What are symptoms of **Hyperglycemia**? **SELECT ALL THAT APPLY.**
    a. Increased thirst
    b. Fatigue (weak, tired feeling)
    c. Blurred vision
    d. Headaches
    e. Do not know

22. Which of the following is the cause of **Diabetic Ketoacidosis** in Type 1 diabetes? **SELECT ALL THAT APPLY.**
    a. Too little insulin
    b. Severe infection or illness
    c. Dehydration
    d. Too much insulin
    e. Do not know

23. What are symptoms of **Diabetic Ketoacidosis** in Type 1 diabetes? **SELECT ALL THAT APPLY.**
    a. Vomiting
    b. Blurred vision
    c. Rapid, deep breathing
    d. Excessive thirst and frequent urination
    e. Do not know

Section IV: Diabetes Management
This set of questions relates to the management and treatment of diabetes for school-aged children. **Please circle only one answer for each question, unless instructed to select all that apply.**

24. A **Diabetes Medical Management Plan (DMMP)** is a school-based individualized diabetes care plan. What information is included in the DMMP? **SELECT ALL THAT APPLY.**
    a. Insulin administration
    b. Meal and snack schedule
    c. Blood glucose monitoring
    d. Physical activity
    e. Do not know

25. To prevent **Hypoglycemia** and **Hyperglycemia**, which of the following are part of diabetes management? **SELECT ALL THAT APPLY.**
    a. Nutrition
    b. Physical activity
    c. Medication
    d. Blood glucose monitoring
    e. Do not know

26. Based on your knowledge, when should a diabetic monitor blood glucose? **SELECT ALL THAT APPLY.**
    a. Before meals and snacks
    b. After meals and snacks
    c. Before physical activity
    d. After physical activity
    e. During physical activity
    f. Do not know

27. Based on your knowledge, what effect can physical activity have on a diabetic with Type 1 diabetes?
    a. Have no effect on blood glucose
    b. Lower blood glucose
    c. Raise blood glucose
    d. Do not know

28. Based on your knowledge, which of the following nutrients has the greatest effect on a diabetic's blood glucose?
    a. Carbohydrates
    b. Fat
    c. Protein
    d. Do not know

29. Based on your knowledge, when is glucagon used to treat a diabetic?
    a. Hyperglycemia
    b. Hypoglycemia
    c. High blood glucose
    d. Do not know

30. Based on your knowledge, what is a quick acting glucose source for a diabetic showing signs of **Hypoglycemia**?
    a. ½ cup of fruit juice
    b. ½ cup of diet soda
    c. 4 small soft candies
    d. Do not know

31. Based on your knowledge, what would be the appropriate response for a diabetic who exhibits signs and symptoms of **Hypoglycemia**?
    a. Check blood glucose
    b. Send student to nurse's office alone
    c. Call 9-1-1 or local emergency number
    d. Do not know

32. Based on your knowledge, what would be the appropriate responses for a diabetic who is unconscious in the classroom from **Hypoglycemia**? **SELECT ALL THAT APPLY.**
    a. Leave student to find help
    b. Call 9-1-1 or local emergency number
    c. Administer glucagon
    d. Do not know

33. Based on your knowledge, what would be the appropriate response for a diabetic who is exhibiting signs of **Hyperglycemia**?
    a. Check blood glucose
    b. Send student to the office
    c. Give 4 small hard candies
    d. Administer insulin
    e. Do not know

Section V: Diabetes Skills
This next set of questions is related to perceived competence (*ability*) in performing selected diabetes management skills. For each skill, please indicate your level of competency. **Please check only one.**

Skill	Not Competent	Somewhat Competent	Competent	Highly Competent	Not Sure
34. Recognize symptoms of hypoglycemia.					
35. Provide treatment for hypoglycemia.					
36. Recognize symptoms of hyperglycemia.					
37. Provide treatment for hyperglycemia.					
38. Perform a finger-stick to check blood glucose.					
39. Communicate blood glucose results to parent/guardian or healthcare professional.					
40. Record blood glucose results on proper document.					
41. Check urine for ketones.					
42. Record ketone results on proper document.					
43. Prepare correct insulin dose.					
44. Administration of insulin through subcutaneous (*beneath the skin*) route.					
45. Record time, dose, and site of administrating insulin on proper document.					
46. Prepare glucagon using diluting solution.					
47. Administration of glucagon.					
48. Record time, dose, and site of administrating glucagon on proper document.					
49. Dispose needles in appropriate containers.					
50. Identify signs that insulin pump site need to be changed.					
51. Deliver bolus with insulin pump.					
52. Disconnect the insulin pump.					

THANK YOU FOR COMPLETING THE QUESTIONNAIRE!

If you would like to participate in a $25.00 Wal-Mart gift card drawing, please provide your name and email address.

Name_____ Email_____

APPENDIX D

Frequencies and Percentages of Diabetes Knowledge Questions Responses

Knowledge of definition, symptoms and causes of diabetes, hypoglycemia, and hyperglycemia among school personnel

Variables		Frequency (n)	Percentage (%)	Missing
Symptoms of diabetes				4
	Frequent urination	673	83.2	
	Thirst	711	87.9	
	Fatigue	680	84.1	
	Hunger	303	37.5	
	Do not know	54	6.7	
Definition of hypoglycemia				3
	Blood glucose is low	636	78.6	
	Blood glucose is normal	1	1	
	Blood glucose is high	121	15.0	
	Do not know	48	5.9	
Cause of hypoglycemia				12
	Too much insulin	561	69.3	
	Not enough exercise	14	1.7	
	Too much food intake	51	6.3	
	Do not know	171	21.1	
Symptoms of hypoglycemia				2
	Trembling	610	75.4	
	Sweating	549	67.9	
	Loss of appetite	245	30.3	
	Confusion	627	77.5	
	Do not know	112	13.8	

Definition of hyperglycemia				7
	Blood glucose is low	128	15.8	
	Blood glucose is normal			
	Blood glucose is high	601	74.3	
	Do not know	73	9.0	
Causes of hyperglycemia				8
	Skipping/forgetting insulin	618	76.4	
	Strenuous physical activity	229	28.3	
	Illness	307	37.9	
	Do not know	168	20.8	
Symptoms of hyperglycemia				5
	Thirst	570	70.5	
	Fatigue	534	66.0	
	Blurred vision	599	74.0	
	Headaches	530	65.5	
	Do not know	125	15.5	
Cause of diabetic ketoacidosis				4
	Too little insulin	280	34.6	
	Illness	169	20.9	
	Dehydration	217	26.8	
	Too much insulin	123	15.2	
	Do not know	397	49.1	
Symptoms of diabetic ketoacidosis				5
	Vomiting	234	28.9	

	Blurred vision	301	37.2	
	Rapid breathing	255	31.5	
	Thirst and urination	340	42.0	
	Do not know	400	49.4	
Diabetes Medical Management Plan				15
	Insulin administrati0n	528	65.3	
	Meal/Snack schedule	540	66.7	
	Glucose monitoring	539	66.6	
	Physical activity	417	51.5	
	Do not know	240	29.7	
Part of diabetes management				16
	Nutrition	672	83.1	
	Physical activity	573	70.8	
	Medication	597	73.8	
	Glucose monitoring	656	81.1	
	Do not know	95	11.7	
Monitor blood glucose				18
	Before meals	608	75.2	
	After meals	414	51.2	
	Before physical activity	335	41.4	
	After physical activity	345	42.6	
	During physical activity	91	11.2	
	Do not know	112	13.8	
Physical activity on type 1				26
	Lower blood glucose	445	55.0	

	Have no effect on blood glucose	22	2.7	
	Raise blood glucose	44	5.4	
	Do not know	272	33.6	
Nutrients				24
	Carbohydrates	622	76.9	
	Fat	25	3.1	
	Protein	27	3.3	
	Do not know	111	13.7	
Glucagon				26
	Hyperglycemia	61	7.5	
	Hypoglycemia	250	30.9	
	High blood glucose	70	8.7	
	Do not know	402	49.7	
Glucose source				35
	½ cup of fruit juice	576	71.2	
	½ cup of diet soda	7	.9	
	4 small soft candies	80	9.9	
	Do not know	111	13.7	
Response of hypoglycemia				45
	Check blood glucose	463	57.2	
	Send student to nurse’s office alone	56	6.9	
	Call 911	94	11.6	
	Do not know	151	18.7	
Response for hypoglycemia				

	Leave student to find help			
	Call 911	646	79.9	
	Administer glucagon	260	32.1	
	Do not know	112	13.8	
Response of hyperglycemia				48
	Check blood glucose	315	38.9	
	Send student to the office	44	5.4	
	Give 4 small hard candies	49	6.1	
	Administer insulin	116	14.3	
	Do not know	237	29.3	

APPENDIX E

Frequencies and Percentages of Diabetes Skills Questions Responses

Skills Competence in Performing Diabetes Management

Skills	Frequency (n) and Percentage (%)					Missing	Mean
	Not Sure	Not Competent	Somewhat Competent	Competent	Highly Competent		
Recognize symptoms of hypoglycemia	65 (8.0)	270 (33.4)	**287 (35.5)**	117 (14.5)	44 (5.4)	26	1.75
Provide treatment for hypoglycemia		**363 (44.9)**	210 (26.0)	95 (11.7)	46 (5.7)	95	1.75
Recognize symptoms of hyperglycemia	69 (8.5)	**293 (36.2)**	283 (35.0)	90 (11.1)	45 (5.6)	29	1.68
Provide treatment for hyperglycemia	13 (1.6)	**91 (11.2)**	35 (4.3)	5 (0.6)	10 (1.2)	655	1.40
Perform a finger-stick to check blood glucose	43 (5.3)	**297 (36.7)**	165 (20.4)	136 (16.8)	138 (17.1)	30	2.04
Communicate blood glucose results to parent/guardian or healthcare professional	53 (6.6)	**327 (40.4)**	134 (16.6)	143 (17.7)	123 (15.2)	29	1.94
Record blood glucose results on proper document	50 (6.2)	**324 (40.0)**	143 (17.7)	135 (16.7)	126 (15.6)	31	1.95
Check urine for ketones	62 (7.7)	**540 (66.7)**	78 (9.6)	42 (5.2)	57 (7.0)	30	1.35
Record ketone results on proper document	64 (7.9)	**465 (57.5)**	96 (11.9)	80 (9.9)	77 (9.5)	27	1.54
Prepare correct insulin dose	60 (7.4)	**490 (60.6)**	98 (12.1)	62 (7.7)	69 (8.5)	30	1.47
Administration of insulin through subcutaneous route	61 (7.5)	**516 (63.8)**	85 (10.5)	56 (6.9)	64 (7.9)	27	1.42
Record time, dose, and site of administrating insulin on proper document	51 (6.3)	**337 (41.7)**	153 (18.9)	130 (16.1)	111 (13.7)	27	1.89
Prepare glucagon using diluting solution	73 (9.0)	**556 (68.7)**	66 (8.2)	43 (5.3)	41 (5.1)	30	1.26
Administration of glucagon	69 (8.5)	**531 (65.6)**	74 (9.1)	58 (7.2)	45 (5.6)	32	1.33
Record time, dose, and site of administrating glucagon on proper document	58 (7.2)	**355 (43.9)**	152 (18.8)	128 (15.8)	88 (10.9)	28	1.79
Dispose needles in appropriate containers	48 (5.9)	**263 (32.5)**	142 (17.6)	175 (21.6)	150 (18.5)	31	2.15
Identify signs that insulin pump site need to changed	69 (8.5)	**551 (68.1)**	81 (10.0)	39 (4.8)	41 (5.1)	28	1.27
Deliver bolus with insulin pump	69 (8.5)	**597 (73.8)**	49 (6.1)	29 (3.6)	36 (4.4)	29	1.19
Disconnect the insulin pump	67 (8.3)	**575 (71.1)**	64 (7.9)	36 (4.4)	35 (4.3)	32	1.22