CARING FOR CHILDREN WITH TYPE 1 DIABETES DURING THE SCHOOL DAY: CHALLENGES AND RECOMMENDATIONS

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Abstract:

Type 1 diabetes accounts for 5 to 10 percent of all diagnosed cases of diabetes and is the most common chronic disease of childhood, exceeded only by asthma. Because most children and adolescents spend the majority of their waking hours in a school setting, having trained school personnel on-site to assist with their daily diabetes management regimen is a high priority. However, this presents a challenge in that there is a national shortage of school nurses in the United States. This deficiency is of great public health significance because the lack of assistance in the school setting makes it more challenging for children with type 1 diabetes to achieve optimal management for their disease. The purpose of this thesis is to describe the needs of a child with diabetes, review issues that relate to their safety in the school setting, and propose a set of recommendations for schools to consider in order to provide care. Examination of whether school nurses have the appropriate knowledge in order to appropriately care for a child with type 1 diabetes will also be addressed. Finally, in light of the national school nurse shortage, this study will explore whether other school personnel can be trained to provide support to these children during the school day.

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1.0 INTRODUCTION

Type 1 diabetes accounts for 5 to 10 percent of all diagnosed cases of diabetes and is the type found most frequently in children. It is the most common chronic disease of childhood, exceeded only by asthma. Roughly one in every 400 to 600 children and adolescents has type 1 diabetes (CDC website, 2006). A recent study published in the journal *Pediatrics* found that for children who have diabetes and are under the age of 10 years, 96% have type 1 diabetes (Diabetes in Youth Study Group, 2006). For a child or adolescent diagnosed with type 1 diabetes, the disease can be a challenge to manage, especially because of the potential assistance needed outside of the home, namely in the school setting.

Children spend an average of 6-8 hours per day at school. Thus, it is imperative that all school personnel who interact with children who have type 1 diabetes be knowledgeable about and understand how to assist a child who is having acute complications related to diabetes (i.e., high or low blood glucose levels). Such school personnel include not only school nurses, but teachers, coaches, school administrators, and school bus drivers.

Type 1 diabetes develops when the body's immune system attacks and destroys the beta cells located within the pancreas. Beta cells produce insulin, a hormone that aids the body in transporting glucose, found in food, to cells throughout the body as a source of energy. When beta cells are destroyed, insulin cannot be produced and glucose remains in the blood.

Therefore, individuals with type 1 diabetes are dependent upon self-administered insulin (either by injections or an insulin pump) in order to survive.

An individual with type 1 diabetes is at increased risk of developing many serious long-term health complications, including blindness, nerve damage, cardiovascular and kidney disease. The results of the Diabetes Control and Complications Trial (DCCT) demonstrated that tight control of blood glucose aids in delaying these chronic complications (DCCT, 1993). Attempting to achieve a goal of near normoglycemia requires individuals to remain diligent with their daily diabetes management regimen, which includes testing blood glucose levels, administering insulin, managing nutrition, and adjusting therapy for physical exercise or in anticipation of special circumstances (Lorenz, 2003). However, the DCCT study also showed that as tight blood glucose control is reached, the risk of experiencing hypoglycemia, or low blood glucose, (including severe hypoglycemia) is increased (DCCT, 1993).

For a child or adolescent living with type 1 diabetes, the management of the disease may require the potential for needing assistance during a school day. The role of the school nurse is to deliver health services and provide the necessary assistance and counseling to students. However, with the national shortage of school nurses, it can potentially be an even more difficult task for children with type 1 diabetes with appropriate support services and care for their diabetes at school. It is widely known that school nurses are scarce and often given the responsibility to cover multiple schools (Price, et al., 2003). The implications of this are obvious; hence, there is a need for others to be trained to assist children with their diabetes management, especially in emergency care.

The purpose of this thesis is to describe the needs of children with type 1 diabetes, review the literature related to their diabetes management in the school setting, and propose a set of

recommendations for school administrators. In addition, results of a knowledge test from a diabetes education pilot study, conducted by the author at a recent workshop for school nurses, are presented. The purpose of the diabetes education study was to enhance the level of knowledge regarding how to manage and care for children with type 1 diabetes among school nurses and other personnel. Participants' level of knowledge was measured at baseline and post-test.

The research questions to be examined in this thesis are as follows: 1) What is known about children with type 1 diabetes? 2) What is known about children with type 1 diabetes in the school setting? 3) What do school nurses and personnel currently know about children with type 1 diabetes? 4) Where are the gaps in knowledge regarding children with type 1 diabetes? 5) What are the implications of these gaps in knowledge and how do we address them? Given the national shortage of school nurses, this study recommends that other individuals (e.g., teachers, school administrators, coaches and school bus drivers) be trained to provide immediate assistance and support in order to respond appropriately to the health needs of children with type 1 diabetes.

The remainder of this document is organized as follows: Section 2.0 presents a summary of the literature; Section 3.0 presents the results of a pre- and post-test measuring the impact of a pilot diabetes education program on the knowledge of school nurses and other school health personnel; Section 4.0 discusses the issues and lays out a set of recommendations; and Section 5.0 concludes the paper.

2.0 LITERATURE REVIEW

2.1 METHODOLOGY

As per the research questions discussed in the introduction, one of the purposes of this thesis was to review literature relevant to understanding the symptoms and complications due to type 1 diabetes, along with literature relevant to understanding the difficulties faced in caring for children with this disease in a school setting. Below, is a brief discussion of the method by which this literature review was conducted.

A list of studies regarding type 1 diabetes was originally provided by the American Diabetes Association's Safe at School Task Force. The main focus of these articles was the symptoms of the acute complications and challenges faced by children with type 1 diabetes. Other relevant studies were identified using the references of these articles. To supplement these studies, the author searched MedLine (through the PubMed database), as well as Internet-based search engines. From these searches, the majority of the information was obtained via the American Diabetes Association's website and the following journals: *Diabetes Care, Diabetes Educator, Diabetes Forecast, Journal of Pediatrics, Journal of Pediatric Psychology, Journal of School Health, and Pediatric Diabetes.* Throughout the process, certain articles and authors consistently surfaced, thereby emerging as important research studies in the area and are thus pertinent to this literature review.

As was discussed in the introduction, for children who have diabetes and are under the age of 10 years, 96% have type 1 diabetes (Diabetes in Youth Study Group, 2006). Although the prevalence of type 2 diabetes is on the rise in children and adolescents, the vast majority of this population is currently at risk for type 1 diabetes, and not type 2 diabetes. Thus, this literature will focus solely on type 1 diabetes in children.

2.2 IMPORTANT SAFETY ISSUES RE: TIGHT BLOOD GLUCOSE CONTROL FOR THE SCHOOL-AGED CHILD WITH TYPE 1 DIABETES

Diabetes is a serious disease that has both acute and chronic complications. Acute complications include hypoglycemia (low blood glucose) and hyperglycemia (high blood glucose), both experienced in attempts to balance insulin, food, and physical activity. Chronic complications including blindness, nerve damage, cardiovascular and kidney disease serve as constant threats in the daily management of the disease. For children with type 1 diabetes, the ability to monitor their blood glucose regularly, as well as balance insulin, food, and activity, is essential to help curtail these potential future health complications. Results from the Diabetes Control and Complications Trial (DCCT) show that tight control of blood glucose impedes the onset and slows the progression of long-term health complications, including diabetic retinopathy, nephropathy, and neuropathy (DCCT, 1993). In addition, this trial also demonstrated that adhering to this method of treatment increases the risk of severe hypoglycemia (DCCT, 1993). If left untreated, hypoglycemia can lead to seizures and/or a coma. Severe hypoglycemia occurs more often during childhood than adulthood, and has been linked with cognitive dysfunction and poor academic performance in children (Hershey, et al., 2004).

By contrast, hyperglycemia is a condition in which excessive amounts of glucose and insufficient insulin circulate within the blood (ADA website, Retrieved September 15, 2006). Symptoms of hyperglycemia include frequent urination, thirst, high blood glucose, and high levels of glucose in the urine (ADA website, Retrieved September 15, 2006). In order to reduce hyperglycemic symptoms, additional insulin doses may be necessary during the school day. Because of the potential daily needs, teachers and other school personnel need to be aware of the symptoms and treatment of hyperglycemia and provide support if additional insulin is required.

There are several reasons why hyperglycemia can occur in a school-aged child, including insufficient insulin doses, illness, and physical and emotional stress (e.g., exams, homework, extracurricular activities, etc.) (Siminerio and Betschart, 1995). Insulin deficiency can lead to diabetic ketoacidosis, a serious life-threatening consequence. The best way to prevent hyperglycemia is to maintain optimal diabetes control by balancing insulin, nutrition, and physical activity in response to blood glucose levels (ADA website, Retrieved September 15, 2006). Although hyperglycemia is recognized as a serious problem related to the prevention of the long-term complications of diabetes, its consequences for the child during the school day are less immediate and serious compared to hypoglycemia. Hence, the discussion in the following section focuses on hypoglycemia because of its implications and the immediate attention that it requires.

2.3 HYPOGLYCEMIA AND ITS EFFECTS ON COGNITIVE FUNCTION AND ACADEMIC PERFORMANCE FOR CHILDREN WITH TYPE 1 DIABETES

The following section discusses literature focusing on hypoglycemia and its effects on cognitive function and academic performance for children with type 1 diabetes. A summary of the studies can be found at the end of this section (Table 1).

Hypoglycemia, or low blood glucose, is one of the most common problems of type 1 diabetes and poses a major limitation in achieving near-normoglycemia (Chiarelli, et al., 1999). Hypoglycemia occurs when blood glucose levels drop and the body is unable to produce adequate energy for its activities (NDIC website, 2006). Normally, the body maintains blood glucose levels within the range. When blood glucose becomes too low, the adrenaline hormone immediately begins working to raise the body's blood glucose levels (Siminerio and Betschart, 1995). The usual symptoms of hypoglycemia are hunger, nervousness and shakiness, perspiration, dizziness or a feeling of light-headedness, confusion, and difficulty speaking. When hypoglycemia occurs, the child's blood glucose levels need to be monitored often in order to decrease the likelihood of a reoccurrence (Evert, 2005).

Hypoglycemia has varying levels of severity and can be categorized according to the symptoms the child is exhibiting (American Diabetes Association, 2005): Symptoms of mild hypoglycemia include dizziness, hunger, weakness, trouble concentrating, shakiness, tingling in extremities, sweating, fatigue, pale skin, palpitations, and occasionally headache and behavior changes such as irritability and anxiety. Symptoms may be detectable when experiencing a low with mild hypoglycemia, but children may not recognize their symptoms and need assistance. Moderate hypoglycemia is associated with drowsiness, confusion or aggressiveness. Someone else is usually needed to administer treatment at this stage. Severe hypoglycemia symptoms

include altered states of consciousness, inability to take treatment orally because of disorientation, seizures, or even a coma. Treatment at this stage requires glucagon or intravenous glucose.

There are several reasons for hypoglycemia, including missing meals or snacks, taking too much insulin, illness, and participating in unintended strenuous activities or exercise. It is necessary to treat hypoglycemia at once to prevent severe hypoglycemia. An immediate treatment for severe hypoglycemia is an injection of glucagon, a hormone that raises blood glucose.

Hypoglycemia has been associated with changes in cognitive functioning in children with type 1 diabetes, especially those who are diagnosed before the age of five (Rovet, et al., 1988; Rovet and Alvarez, 1997; Hershey, et al., 2005). Findings from studies in the past 15 years offer conflicting results. Some support a strong correlation between hypoglycemia and levels of cognitive functioning while others do not. The findings presented here are not intended to be an exhaustive review of the literature on hypoglycemia and cognitive functioning, but a summary of key and representative studies. In the studies presented, cognitive function is evaluated in several ways: attention, executive function, motor efficiency and rapid response, language, intelligence (including verbal), visuospatial processing, memory (short- and long-term), decision making, planning, and learning.

For children with a history of severe hypoglycemia, researchers have reported poor performance in verbal short-term memory (Hannonen, et al., 2003) and spatial long-term memory (Hershey, et al., 2004). Several studies noted that children with an early onset diagnosis (before the age of five years) who also experienced severe hypoglycemia scored lower on psychomotor efficiency, attention, and long-term spatial memory (Bjorgass, et al., 1997; Rovet

and Alverez, 1997; Hershey, et al., 2005). Not all studies reviewed agree with these outcomes, however. Studies conducted by Kaufman, et al. (1999), Wysocki, et al. (2003), and Strudwick, et al. (2005) found no significant group differences on overall intelligence, memory, behavioral measures, or motor speed and coordination in children with early onset type 1 diabetes (less than six years) who experienced severe hypoglycemia.

Duration of diabetes and cognitive function has also been examined. Northam, et al. (2001) found that children with type 1 diabetes, especially those diagnosed prior to the age of four years, have significantly lower verbal IQ, attention, processing speed, and executive skills (the children were tested soon after diagnosis, two years later, and again six years later). Rovet and Ehrlich (1999) found significant declines in verbal, but not visuospatial aptitude in children with type 1 diabetes who were tested at diagnosis, one year, three years and seven years later. This is especially true for those children experiencing hypoglycemic seizures.

Schoenle, et al. (2002) was the only study reviewed that showed a difference in cognitive aptitude between boys and girls diagnosed with type 1 diabetes. It was observed that among boys diagnosed by the age of six, there was a significant decrease in performance by the age of seven and a decrease in verbal intelligence between the ages of seven and 16 years. Interestingly, no observations of decreases in either of these areas are noted in boys diagnosed > six years, or for girls of any age.

It was recently reported at the 2006 American Diabetes Association conference that hypoglycemia associated with tight glucose control, does not lead to cognitive dysfunction (Jacobson, et. al., 2006). Investigators from the Joslin Diabetes Center, the University of Pittsburgh, George Washington University and the Diabetes Control and Complications Trial (DCCT)/Epidemiology of Diabetes Interventions and Complications Study (EDIC) examined as

much as 75% of the original DCCT cohort as part of a long-term follow-up study. Researchers found no change in terms of hypoglycemia versus the initial study in any of the eight cognitive domains observed (adjusting for age, sex, years of education, length of follow-up and number of cognitive tests taken). The results of this study support the safety of achieving tight glucose control to avoid long-term health complications without damaging mental abilities.

Alan Jacobson, principal health investigator for the study, however noted that acute episodes of hypoglycemia still can impair thinking and, if left untreated, even be life-threatening. This, in turn, could affect such things as concentration, which is a vital component for learning while in the scholastic environment.

Although there may be disagreement regarding the findings about the relationship between cognitive function and academic performance, it is not disputed that hypoglycemia can result in physical impairment. Avoidance of hypoglycemia, especially severe hypoglycemia, should always remain an integral part of managing type 1 diabetes.

Table 1. - Type 1 Diabetes, Cognitive Ability, and Academic Performance

Author(s)	Study Design	Results/Conclusion
Bjorgass, M.; Gimse, R.; Vik, T.; Sand, T. (1997). Cognitive function in type 1 diabetic children with and without episodes of severe hypoglycaemia. *Acta Pediatrica, 86(2): 148-153.*	Assessed the effect of diabetes and severe hypoglycemia on cognitive function in 28 children with type 1 diabetes. Each child with diabetes was compared to a healthy control child of the same age, gender, and social background. Neuropsychological assessment was blinded.	No effect on cognitive performance was found for children with late onset diabetes and severe hypoglycemia. Children with early onset diabetes and severe hypoglycemia scored lower on psychomotor efficiency and attention.
Hannonen, R.; Tupola, S.; Ahonen, T.; Riikonen, R. (2003). Neurocognitive functioning in children with type 1 diabetes with and without episodes of hypoglycemia. *Developmental Medicine and Child Neurology, 45(4): 262-268.*	Assessed the effects of diabetes and severe hypoglycemia on neurocogntive functioning of children with a standardized neuro-psychological test battery designed for the assessment of kids. 11 children with a history of severe hypoglycemia, 10 children without a history of severe hypoglycemia and 10 healthy children were assessed.	Children with a history of severe hypoglycemia showed significant differences in verbal short-term memory and phonological processing. Authors concluded that severe hypoglycemia was a risk factor for learning due to deficits in auditory-verbal functioning.
Hershey, T.; Lillie, R.; Sadler, M.; White, N. (2004). A prospective study of severe hypoglycemia and long-term spatial memory in children with type 1 diabetes. *Pediatric Diabetes, 5:63-71.*	Prospectively gathered data to determine if severe hypoglycemia was associated with decreased spatial long-term memory over time. 42 type 1 diabetes mellitus children and 25 sibling controls performed spatial delayed response (SDR) tasks with short and long delays.	Severe hypoglycemia was associated with poorer performance on spatial long-term memory tasks in type 1 diabetes mellitus children. Spatial memory was more sensitive than visual memory.

Table 1 (cont.)

Author(s)	Study Design	Results/Conclusion
Hershey, T.; Perantie, D.; Warren, S.; Zimmerman, E.; Sadler, M., White, N. (2005). Frequency and Timing of Severe Hypoglycemia Affects Spatial Memory in Children with Type 1 Diabetes. *Diabetes Care, 28(10): 2372-2377.*	103 children with type 1 diabetes mellitus and 60 nondiabetic control subjects were assessed. Each study evaluated previous severe hypoglycemia and tested short (5s) and long (60s) delay spatial memory with the spatial delayed response (SDR) task.	A history of severe hypoglycemia was associated with decreased long-term spatial memory, especially when severe hypoglycemic episodes began before 5 years of age. High frequency of early exposure to severe hypoglycemia during development negatively effected spatial long-term memory.
Jacobson, A.; Ryan, C.; Cleary, P.; Waberski, B.; Burwood, A.; Weinger, K.; Bayless, M.; Dahms, W.; Silvers, N. and Harth, J. (2006). "Effects of Intensive and Conventional Treatment of Cognitive Function Twelve Years After the Completion of the Diabetes Control and Complications Trial." Presented at the American Diabetes Association Conference on June 12, 2006. Retrieved on October 20, 2006 (please see bibliography for website).	Researchers examined 1,059 participants in the original DCCT to determine if tight glucose control had long-term negative effects on cognitive function. Some participants received intensive therapy (either via insulin pump or 3 or more daily injections) and other participants received conventional therapy (1 or 2 daily injections).	Researchers found no link between multiple hypoglycemic episodes and cognitive dysfunction. This study supports the safety in achieving tight glucose control to avoid long-term health complications without damaging mental abilities.

Table 1 (cont.)

Author(s)	Study Design	Results/Conclusion
Kaufman, F.; Epport, K.; Engilman, R.; Halvorson, M. (1999). Neurocognitive functioning in Children Diagnosed with Diabetes Before Age 10 Years. *Journal of Diabetes and Its Complications, 13: 31-38.*	Determined the scores on tests of neurocognitive functioning before age 10 and determined the association of age of diagnosis, duration of diabetes, subtle and severe hypoglycemia and history of hypoglycemic episodes with cognitive test scores.	Did not find an association between age of diagnosis and neuro-cognitive testing. Also did not find young age at diagnosis resulted in a decrease in visual spatial performance. Did not find that diabetes diagnosed before 5 years decreased scores in overall intelligence, motor speed and coordination and memory.
Northam, E. A., Anderson, P.; Jacobs, R.; Hughes, M.; Warne, G.; Werther, G. (2001). Neuropsychological Profiles of Children with Type 1 Diabetes 6 Years After Disease Onset. *Diabetes Care, 24(9): 1541-1546.*	90 children with type 1 diabetes mellitus, aged 6-17 years, were assessed soon after diagnosis, and then 2 years later. They were then re-evaluated 6 years after onset of disease and their neuropsychological profiles were compared to 84 children who were assessed during similar periods.	After 6 years, verbal IQ was significantly lower among children with diabetes and especially those with onset before age 4. Children with diabetes also scored worse on attention, processing speed, and executive skills.
Rovet, J. and Alvarez, M. (1997). Attentional functioning in children and adolescents with IDDM. *Diabetes Care, 20: 803-810.*	103 children with type 1 diabetes mellitus and 100 healthy controls were tested for intelligence and attention.	IDDM subjects differed from control subjects only in the component of attention, which was accounted for mainly by the poorer performance of children with early onset diabetes (<6 years). Within the attentional subcomponent, diabetes affected focus.

Table 1 (cont.)

Author(s)	Study Design	Results/Conclusion
Schoenle, E.; Schoenle, D.; Molinari, L.; Largo, R. (2002). Impaired intellectual development in children with Type 1 diabetes: association with HbA1c, age at diagnosis and sex. *Diabetologia, 45(1): 108-114.*	64 children with type 1 diabetes mellitus, ages 7-16, were assessed at least 4 times using the German version of the WISC-R (Wechsler Intelligence Scale for Children – Revised). A control group was used and measured as well.	A significant decrease in performance by age 7 and in verbal intelligence between age 7 and 16 was observed in boys with diabetes by age 6, but not diagnosed at an older age or in girls. Intellectual deterioration was not associated with sever hypoglycemia, but was correlated with metabolic deterioration at time of diagnosis and with high levels of HbA1c.
Strudwick, S.; Carne, C.; Gardiner, J.; Foster, J.; Davis, E.; Jones, T. (2005). Cognitive functioning in children with early onset type 1 diabetes and severe hypoglycemia. *Journal of Pediatrics, 147: 680-685.*	41 type 1 diabetes mellitus children with a history of seizures and comas were compared with 43 peers with no history of severe hypoglycemia. The object was to determine if severe hypoglycemia in young children (<6 years) with early onset type 1 diabetes was associated with abnormalities in cognitive status.	No significant differences were found on intellectual, memory or behavioral measures. No evidence that episodes of seizures or coma, including those occurring in early childhood, resulted in cognitive dysfunction.
Wysocki, T.; Harris, M.; Mauras, N.; Fox, L.; Taylor, A.; Jackson, S.; White, N. (2003). Absence of adverse effects of severe hypoglycemia on cognitive function in school aged children with diabetes over 18 months. *Diabetes Care, 26(40): 1100-1105.*	142 children, 6-15 years old, with IDDM were enrolled in a trial of intensive therapy versus usual care; cognitive tests were performed at baseline, 9 and 18 months. Episodes of severe hypoglycemia were also noted.	Severe hypoglycemia did not cause a decline in full-scale intelligence quotient (IQ), standard scores for planning, attention, simultaneous processing, or successive processing.

Source: Adapted from the following article: Taras, H. and Potts-Datema, W. (2005). Chronic Health Conditions and Student Performance at School. *Journal of School Health, 75(7): 255-266.*

2.4 PSYCHOSOCIAL ISSUES FOR SCHOOL-AGED CHILDREN AND ADOLESCENTS WITH TYPE 1 DIABETES

The following section discusses literature focusing on psychosocial issues for school-aged children and adolescents with type 1 diabetes. A summary of the studies can be found at the end of this section (Table 2).

Health is important for overall quality of life, especially for school-aged children and adolescents. Daily activities and time spent with friends become less enjoyable, or, if a child is sick enough, nonexistent. For school-aged children and adolescents with or without type 1 diabetes, the vast majority of their waking hours are spent at school. In this environment, to facilitate learning and a positive experience, every child needs to feel comfortable and safe. This especially resonates for children with a chronic disease, such as type 1 diabetes, which already has the potential to infringe on quality of life.

Children and adolescents are concerned about fitting in with their peers. Having diabetes and managing the disease properly can set a person apart in a way that may create feelings of anxiety and insecurity. Having the ability to manage stress, cope with the disease, and problem solve are skills that are equally as important to healthy development as the medical management of the disease (Boland and Grey, 1996). Several research studies have examined the psychosocial and behavioral themes that apply to children with diabetes. Jacobson, et al. (1994), Miller-Johnson, et al. (1994), and Hanson, et al. (1995) have studied the importance of adherence and compliance in relation to metabolic control, as well as the role of informal support. Grey, et al. (1998) found that youths who attended coping skills training (CST) improved their metabolic

control, as well as their quality of life. In a study conducted by Hoey, et al., (2001), results for adolescents indicated that lower HbA1c is associated with lower disease impact, fewer worries, greater satisfaction, and better perceived health. This study also revealed that girls have more worries, express less satisfaction, and report poorer health perceptions earlier than boys. This could be due to the earlier onset of puberty for girls. The results of a study performed by Grossman, et al. (1987) found a significant positive association for girls between self-efficacy for diabetes and metabolic control. This result was not found for boys.

When a child is diagnosed with type 1 diabetes, parents and family become the most influential individuals in ensuring that the daily diabetes management regimen is maintained. In a study conducted by Hauser, et al. (1985), the authors found that family attitudes toward independence, participation in social/recreational activities, and organization are strongly correlated with children's perceived proficiency and diabetic adaptation. For children old enough to manage their own diabetes, balancing independence and safety becomes difficult for a parent. Thus, one of the primary ways a parent can assist is to encourage the child to lead as normal a life as possible, while continuing to manage the diabetes (Siminerio and Betschart, 1995). The voluminous demands that are placed on children and adolescents with type 1 diabetes throughout the day include:

- Monitoring blood glucose, including the frequency and circumstances requiring testing
- Administering insulin
- Monitoring meals and snacks, including food content, amounts, and when consumed
- Being aware of symptoms of hypoglycemia and understanding treatment
- Being aware of symptoms of hyperglycemia and understanding treatment
- Testing for ketones and taking the appropriate actions if ketone levels are abnormal

Source: American Diabetes Association (2003). Care of Children with Diabetes in the School and Day Care Setting. *Diabetes Care*, 26:S131-S135, 2003.

While these demands are a daily constant for children and adolescents with type 1 diabetes, school nurses and personnel must also be cognizant of them if they are to help care for the student in managing their diabetes.

Children and adolescents spend most of their days in school or socializing with their friends (La Greca and Prinstein, 1999). In order to fit in with healthy peers, children and adolescents with diabetes may be reluctant to check their blood glucose, eat a snack, or administer insulin when they are with friends. The fear of experiencing high or low blood glucose symptoms in the presence of their peers can seriously affect one's sense of worth (Roemer, 2005). In a qualitative study performed by La Greca and colleagues (1995), the results showed that friends, more than family, provided emotional support and a sense of "feeling good" about diabetes. Helgeson, et al. (2006) discovered emotional support for adolescents may be particularly important to girls with diabetes. This study also found that it is possible that youth who have diabetes may have a stronger need for support from their friends. Thus, it is more likely that friends will be the ones to whom children turn to help cope with a difficult medical treatment (La Greca, 1990; Burroughs, et al., 1997). Yet, sometimes children with diabetes are hesitant about being forthright about their disease. Siminerio and Betschart (1995) note that a child's friends may be apprehensive because they do not understand diabetes or what it means to have the disease. They emphasize that a child's openness with their friends will help ease the fear (depending on the child's comfort with being candid).

Depression is another psychosocial issue that can affect a child or adolescent with type 1 diabetes. Depression is fast becoming prevalent among adolescents with type 1 diabetes (Massengale, 2005). Diabetes is a difficult disease for children to cope with and coupling it with

depression can make it more demanding to manage and depression can even accelerate some of the complications (Musselman, et al, 2003). Schriffin (2001) noted that adapting to diabetes and controlling the disease metabolically was negatively impacted by depression and the symptoms with which it was associated. Whittemore, et al. (2003) reported that the prevalence of depression in school-aged children without diabetes was 2% to 3%, and in adolescents and adults, it was 6% to 8%. Alternatively, for children and adolescents with type 1 diabetes, the rates of depression are two to three times that of their peers without diabetes. Kokkonen and Kokkonen (1995) found that the prevalence of symptoms related to depression in children aged eight to 12 years and adolescents with type 1 diabetes to be 12% and 18%, respectively.

School absenteeism is another issue potentially affecting the quality of life for a school-aged child or adolescent with type 1 diabetes. Compared to healthy siblings, Vetiska and colleagues (2000) found that children with diabetes miss an average of six more school days per year. Frequently missing school days can certainly affect a child's performance academically, and it can also influence psychological issues related to self-confidence and relationships with classmates. Additionally, stress related to making up missed homework can also ensue (Vessey, et al., 1996).

Because children spend so much time in school, it is important for school nurses and personnel to be aware not only of the medical aspects of managing type 1 diabetes, but also the psychosocial needs of children in keeping them safe. It is also imperative to understand that friends can aid in offering emotional support to achieve optimal metabolic control and thus improve the quality of life for children with type 1 diabetes. Such relationships should be encouraged in order to further ensure the emotional well-being of children with diabetes. Overall, children need to be able to manage their disease in a safe environment where they feel

comfortable, be it at home, with friends, or, in this case, at school. To assure all of the elements necessary for the promotion of a positive quality of life, personnel in the scholastic environment must possess the knowledge and skills necessary to assure safety, care and psychosocial support for children with diabetes.

Table 2. – Psychosocial Issues

Author(s)	Main Topic(s)	Summary
Boland, E. and Grey, M. (1996). Coping Strategies of School-Age Children With Diabetes Mellitus. *Diabetes Educator, 22: 592-597.*	43 school-age children with type 1 diabetes were studied to assess if the coping strategies they use were affiliated with their self-care management and metabolic control.	The results showed that childrlen who used cognitive coping strategies had better metabolic control than those who used emotional strategies. Higher levels of self-care were correlated with the use of cognitive strategies. Self-care was not found to be related to metabolic control. Older children relied on social supports less than younger peers.
Burroughs, T.; Harris, M.; Pontious, S.; and Santiago, J. (1997). Research on social support in adolescents with IDDM: a critical review. *Diabetes Educator, 23(4): 438-448.*	Critical literature review of 32 scientific studies that analyzed the relationship between social support and compliance/metabolic control.	Many of the studies reviewed indicated supportive, cohesive families are more likely to have children with strong compliance and metabolic control. Open communication with parents were also associated with good compliance. Recognizing adolescence is a difficult time for children & keeping this in mind when developing interventions is key.
Grey, M.; Boland, E.; Davidson, M.; Yu, C.; Sullivan-Bolyai, S. and Tamborland, W. (1998). Short-term effects of coping skills training as adjunct to intensive therapy in adolescents. *Diabetes Care, 21(6): 902-908.*	65 youths, between 13 and 20 years of age, who opted to follow an intensive insulin therapy regimen, were randomly assigned to two groups. One group taught coping skills training (CST) and the other group did not teach CST.	Researchers found those youth who went through CST had lower HbAlc, better self-efficacy and were less upset regarding coping with diabetes. CST was useful in improving quality of life as well as metabolic control.

Table 2 (cont.)

Author(s)	Main Topic(s)	Summary
Grossman, H.; Brink, S. and Hauser, S. (1987). Self-efficacy in adolescent girls and boys with insulin-dependent diabetes mellitus. *Diabetes Care, 10: 324-329.*	68 participants (34 boys and 34 girls) took part in this study to determine diabetes self-efficacy and metabolic control among boys and girls. Researchers used a self-efficacy for diabetes scale (SED) to make this determination.	The results indicated that girls had a significantly positive association between their SED scores and metabolic control. Boys did not display this association.
Hanson, C.; Deguire, M.; Schinkel, A.; Kolterman, O. (1995). Empirical validation for a family centered model of care. *Diabetes Care, 18: 1347-1356.*	By testing an empirically and theoretically based model, this study aimed to evaluate whether family relations and family life stress predicted compliance and metabolic control.	High family cohesion and low conflict related indirectly to good metabolic control through positive compliance behaviors. Family relations had an impact on compliance during the first few years of the disease. Positive family-centered environments may be useful for compliance and the promotion of ideal health.
Hauser, S.; Jacobson, A.; Wertlieb, D.; Brink, S. and Wentworth, S. (1985). The Contribution of Family Environment to Perceived Competence and Illness Adjusted in Diabetic and Acutely Ill Adolescents. *Family Relations, 34(1): The Family and Health Care: 99-108.*	Results from the first year of a four year longitudinal study analyzed insulin-dependent adolescents and their families.	The researchers found family attitudes toward independence, participation in social/ recreational activities, and organization are strongly associated with children's perceived competence and diabetic adjustment.
Helgeson, V.; Reynolds, K.; Shestak, A. and Wei, S. (2006). Brief Report: Friendships of Adolescents with and without diabetes. *Journal of Pediatric Psychology, 31(2): 194-199.*	71 adolescents (30 male and 41 female) with type 1 diabetes and 67 healthy adolescents (30 male and 37 female) participated in this study. The objective of this study was to compare friendships of adolescents with type 1 diabetes with those between healthy adolescents.	The results indicated emotional support may be especially important to girls with diabetes. It is possible that youth with diabetes had a greater need for support from their friends.

Table 2 (cont.)

Author(s)	Main Topic(s)	Summary
Hoey, H.; Aanstoot, H.; Chiarelli, F.; Daneman, D.; Danne, T.; Dorchy, H. (2001). The Hvidore Study Group. Good metabolic control is associated with better quality of life in 2,101 adolescents with type 1 diabetes. *Diabetes Care, 24: 1923-1928.*	2,101 children with type 1 diabetes participated in this study, which aimed to determine if good metabolic control or the consequences of poor metabolic control influenced quality of life.	The findings of this study suggested that lower HbA1c was associated w/reduced impact, fewer worries, greater satisfaction & a better health perception. Results also showed problems for girls, single-parent families and ethnic minorities; therefore, particular attention should be paid to these groups.
Jacobson, A.; Hauser, S.; Lavori, P.; Willett, J.; Cole, C.; Wolfsdorf, J.; Dumont, R.; Weitlieb, D. (1994). Family environment and glycemic control - a 4-year prospective study of children and adolescents with insulin-dependent diabetes mellitus. *Journal of Consulting and Clinical Psychology, 60: 104-112.*	61 children with type 1 diabetes participated in this study that assessed the psychosocial characteristics of the patients and their families.	The results displayed that children from the least openly expressive families had a larger deterioration in glycemic control.
Kokkonen, K. and Kokkonen, E. (1995). Mental Health and Social Adaptation in Young Adults with juvenile-onset diabetes. *Nordic Journal of Psychiatry, 49: 175-181.*	63 young adults with type 1 diabetes and 123 healthy control subjects participated in this study. The study's purpose was to determine whether type 1 diabetes was complicated by an increased number of mental health disorders.	It was found that depression for youth w/ type 1 diabetes was more severe than for the controls. Youth with T1DM have more problems in social development in schooling & separation from parents than did the controls. Diabetes can increase the severity of psychological symptoms, especially depression.

Table 2 (cont.)

Author(s)	Main Topic(s)	Summary
La Greca, A. (1990). Social Consequences of Pediatric Conditions: Fertile Area for Future Investigation and Intervention? *Journal of Pediatric Psychology, 15(3): 285-307.* 358	This paper examined peer relations and social functioning of children who had a chronic illness.	This review found social situations with peers may affect treatment management of a chronic illness. A disease that has physicial activity limitations, interrupts a child's daily activities or affects one's appearance will have residual effects on the child's social interactions.
La Greca, A.; Auslander, W., La Greca, P.; Spetter, D.; Fisher, E.; Santiago, J. (1995) I Get by with a Little Help from my Family and Friends: Adolescents' Support for Diabetes Care. *Journal of Pediatric Psychology, 20(4): 449-476.*	74 adolescents with type 1 diabetes participated in this study that examined and compared the support provided by family members & friends for diabetes care.	Overall, family (parents) were reported to provide more support for adolescents with type 1 diabetes than friends. Parents supported the young child more in the daily diabetes regimen tasks and friends provided more emotional support.
La Greca, A. and Prinstein, M. (1999). Peer group. In W.K. Silverman & T.H. Ollendick (Eds.), *Developmental Issues in the Clinical Treatment of Children.* Needham Heights, MA: Allyn & Bacon.	This book is an interface of clinical child psychology, development psychology, developmental psychopathology, specific child disorders and contextual issues relating to the areas aforementioned.	The specific chapter referenced in this literature review (Chapter 10 - School) addresses how school plays such a critical role in the development of the child or adolescent.
Massengale, J. (2005). Depression and the adolescent with type 1 diabetes: the covert comorbidity. *Issues in Mental Health Nursing, 26(2): 137-148.*	The purpose of this article was to raise awareness of the association between depression and diabetes in adolescents and present treatment options.	Individuals with diabetes have a greater chance of becoming clinically depressed as compared with the general population. Treatment for adolescents include: coping skills training, peer group & family intervention, cognitive behavior therapy & pharmacotherapy.

Table 2 (cont.)

Author(s)	Main Topic(s)	Summary
Miller-Johnson, S.; Emfry, R.; Marvin, R.; Clarke, W.; Lovinger, R. & Martin, M. (1994). Parent-child relationships and the management of insulin-dependent diabetes mellitus. *Journal of Consulting and Clinical Psychology, 62(3): 603-610.*	88 children and adolescents participated in this study that examined dimensions of the parent-child dynamic to determine if there were predictors of compliance to treatment and metabolic control.	This study found that as the stress of the responsibilities & demands of following a diabetes management regimen increased, disputes between the parent & child occurred. As conflict ensued, the child was at a higher risk of non-compliance & poor metabolic control.
Musselman, D.; Betan, E.; Larsen, H.; and Phillips, L. (2003). Relationship of depression to diabetes mellitus types 1 & 2: Epidemiology, biology and treatment. *Biological Psychiatry, 54: 317-329.*	This article examined the literature on the correlation between mood disorders and diabetes mellitus.	This literature review confirmed that depression was correlated with diabetes & may accelerate the onset of diabetic complications. It also noted that short-term treatment of depression in patients with diabetes improved their dysphoria & other symptoms of depression.
Roemer, J. (2005). Understanding Emotional and Psychological Considerations of Children With Diabetes: Tips for School Nurses. *School Nurse News, May: 6-8.*	This article aimed to promote the understanding of the emotional and psychological issues that children with diabetes and their parents face. By raising the awareness, school nurses and personnel can better assist these children while in a school setting.	Having to deal with diabetes on a day to day basis can be a psychological stress. From an emotional standpoint, diabetes can affect behavior, fear & anxiety, independence, depression, and feeling different. School nurses and personnel need to understand that the emotional well-being of a student with diabetes is as important to be aware of as the physical components.

Table 2 (cont.)

Author(s)	Main Topic(s)	Summary
Schiffrin, A. (2001). Psychosocial issues in pediatric diabetes. *Current Diabetes Reports, 1(1): 33-40*	The majority of patients with diabetes exhibited mild depression at the time of diagnosis. In some patients, symptoms of depression may increase with the duration of diabetes.	Family attributes can have major effects on an individual's adjustment to diabetes, as well as quality of life. Children and adolescents living in families w/conflict or who are less caring tended to have poorer metabolic control.
Siminerio, L. and Betschart, J. (1995). Guide to Raising a Child with Diabetes. Second Edition. American Diabetes Association.	This book serves as a guide to help parents and families care for children with diabetes.	This book acts as a resource for parents and families of children with diabetes. Various topics are covered such as: overview of diabetes, insulin treatment, glucose testing, hypo- & hyperglycemia, meal planning, playing sports & games & what to expect as the child grows up.
Vessey, J.; Jackson, P.; Rabin, N.; and McFadden, E. (1996). School and the child with a chronic condition. In: Jackson, P., Vessey, J. eds. Primary Care of the Child with a Chronic Condition. St. Louis, MO: Mosby Year Book, Inc.	This book represents an acknowledgement of the many components that interact with one another when caring for a child with a chronic condition.	The specific chapter referenced in this literature review (Chapter 5 - School and the Child with a Chronic Condition) addresses the legislative initiatives of special education and examines how the primary care provider can further the child's school experience.

Table 2 (cont.)

Author(s)	Main Topic(s)	Summary
Vetiska, J.; Glaab, L.; Perlman, K.; Daneman, D. (2000). School attendance of children with type 1 diabetes. *Diabetes Care, 23: 1706-1707.*	56 families recruited from the diabetes clinic at the Hospital for Sick Children in Toronto, Canada participated in this pilot study. Parents who participated were contacted via the telephone and asked to report the number of sick days their child missed as noted on their report card.	Children with type 1 diabetes were absent 6.1 more school days than their siblings. A strong correlation in absenteeism between children with diabetes & their healthy siblings indicated that family attitudes may be a component of ascertaining school attendance.
Whittemore, R.; Urban, A.; Tamborland, W.; Grey, M. (2003). Quality of Life in School-Aged Children with Type 1 Diabetes on Intensive Treatment and Their Parents. *The Diabetes Educator, 29(5): 847-854.*	The objective of this study was to analyze the child, parent and family elements associated with quality of life and metabolic control in school-aged children with diabetes following an intensive treatment regimen.	The findings of this study established that families of school-aged children were able to manage their diabetes using an intensive treatment regimen resulting in good metabolic control. No psychosocial predictors of metabolic control were discovered.

2.5 DIABETES MANAGEMENT CHALLENGES DURING THE SCHOOL DAY

The following section discusses literature focusing on the overall challenges for schools in the realm of diabetes care for children with type 1 diabetes. A summary of the studies can be found at the end of this section (Table 3).

Children rely on school nurses and school personnel to tend to their health care or medical needs while they are in a school setting. Legislation including federal laws such as Section 504 of the Rehabilitation Act of 1973, the *Individuals with Disabilities Education Act of 1991*, and the *Americans with Disabilities Act*, dictates the availability of reasonable accommodations in a school setting for children and adolescents with a disability. This, in turn, should enable the child to be able to fully participate in all school activities, resulting in minimal disruption to the child's daily schedule (ADA website, Retrieved October 3, 2006).

Ensuring the health and safety of a child with type 1 diabetes at school depends upon the knowledge that school nurses and other school personnel have regarding the care and proper management of the disease. The American Diabetes Association (2006) recommends that schools should offer the following:

- Training all adults who deliver education or care for children regarding the symptoms and treatment of hypoglycemia and hyperglycemia
- Providing immediate accessibility to the treatment of hypoglycemia by a knowledgeable adult
- Providing an area of the school where blood glucose can be checked and insulin administered and stored
- Consenting to see the school medical personnel when needed
- Consenting to eat a snack and use the restroom when needed

- Excusing absences from school for medical appointments
- Coordinating with the child's healthcare team (especially parents) in developing a specific Diabetes Medical Management Plan, an individualized medical plan that outlines the particular needs and guidelines for the child's diabetes care

Source: American Diabetes Association. (2003). Care of Children with Diabetes in the School an Day Care Setting. *Diabetes Care, 26:S131-S135*

School nurses and personnel should be educated and trained to perform blood glucose testing, insulin and glucagon administration, as well as how to recognize a medical emergency and act in an appropriate manner if one concerning diabetes arises (i.e. hypoglycemia and hyperglycemia). This also requires that a knowledgeable adult be present to perform these procedures when the child is on a field trip and/or participating in extracurricular school-related activities (American Diabetes Association Position Statement, 2006).

In addition to possessing knowledge about the necessary elements of diabetes management, school nurses and personnel also need to be trained on the use of new medical technology for diabetes management. Children and adolescents now have access to technology like digital blood glucose meters and insulin delivery systems, such as pumps (continuous subcutaneous insulin infusion – CSII) and pens (insulin delivery system that carries insulin in a self-contained cartridge). Unfortunately, many school nurses and personnel may not be skilled in using these innovative technologies. (Siminerio and Koerbel, 2000).

In the event that a child with type 1 diabetes experiences hypoglycemia, it can usually be treated effectively and with ease. If hypoglycemia is not recognized, and consequently leads to a severe hypoglycemic state, a glucagon injection may become necessary. Glucagon administration is the treatment of choice for those hypoglycemic episodes leading to a loss of consciousness. Unfortunately, there is paucity of information regarding glucagon administration in the literature. The few available publications noted that family members were unaware of

how to use glucagon (Harris, et al., 2001). Frank and Daneman (1998) noted that it is unreasonable to expect school personnel to respond to severe hypoglycemia with glucagon; rather, they think an ambulance should be called. However, a recent decision by the New York State Education Department and the Department of Health permits licensed registered nurses in the school setting to train unlicensed individuals in glucagon administration for emergency situations (New York State Nurses Association website, 2006). In addition, California and Vermont have similar measures that have been passed or are under consideration. These decisions set an encouraging precedent that may inspire other states to heed the American Diabetes Association's declaration that administering glucagon to a student with diabetes who is experiencing hypoglycemia will not harm the individual.

In a recent study by Lewis, et al. (2003), 9% (6 of 65) of schools that were surveyed did not have a policy concerning diabetes management, and nearly 17% of the schools did not have staff trained in diabetes management. Of those same 65 schools that were polled, 80% responded that they have children with diabetes in attendance. Greenhalgh (1997) surveyed teachers and found 61% did not have adequate knowledge regarding diabetes. Nabors, et al. (2005) found that in a survey of nurses (n=38), 95% of elementary and 89% of middle and high school nurses agree that teachers and other school personnel need to improve their knowledge about diabetes. In a recent study published in the *Journal of School Health,* the results of a survey measuring the knowledge of school personnel indicated that school counselors possess only a basic level of diabetes knowledge, which is inadequate to give appropriate assistance to children with type 1 diabetes (Wagner and James, 2006). This pilot study also found that compared to school counselors with no formal diabetes training, those colleagues who have had

some past diabetes training possess more knowledge regarding diabetes and its management in children.

Staffing issues for school nurses is one of the major challenges facing schools today (Schwab and Gelfman, 2001). School nurses are charged with planning and implementing school health programs, delivering health services to students, conducting health education classes, providing necessary counseling to students, and advocating on behalf of children and adolescents for their health rights (Schwab and Gelfman, 2001). However, diminishing school budgets often mean health services and school nurses are considered unnecessary in contributing to the overall mission of the school (Price, et al., 2003). Personnel costs (including salaries and fringe benefits) are one of the biggest expenses for any organization's overall budget, and schools are no exception. There has been a trend for school systems to control costs by hiring as few school nurses as the law allows (Schwab and Gelfman, 2001). As a result, some institutions may not have a nurse in the school building on a daily basis (Nabors, et al., 2003). This presents a major concern considering that 10-30% of all children in the United States will encounter an ailment lasting three months or longer, which constitutes having a chronic illness (Grey and Sullivan-Bolyai, 1999).

Given the shortage of school nurses, who, in the school setting, could be available to assist in safeguarding the health of children with diabetes during their daily regimen and in an emergency situation? The American Diabetes Association has identified other school personnel (non-healthcare staff) who, in the absence of a school nurse, could be educated and prepared to administer diabetes management responsibilities (ADA Comments on Draft ANA Position Statement, 2006). In a survey conducted by Nabors, et al. (2005), school nurses reported that school staff need to have a better understanding of what to do if blood glucose levels become too

high or too low. Many of these same school nurses also noted that all adults (e.g., bus drivers, teachers, parent volunteers) should possess some education regarding the daily management of diabetes. In a study conducted by Brener, et al. (2001), 92% of states, 94% of school districts and 97% of schools allowed school faculty and staff to administer prescription drugs to students, as long as it was approved by the parent and documented.

On July 1, 1999, the state of Virginia took an unprecedented step toward protecting the health of children with diabetes in school settings by passing Senate Bill 88 School System. This law mandates that all Virginia public schools that enroll students with diabetes have employees trained by a licensed medical professional in the administration of insulin and glucagon. More specifically, this law requires that schools with faculty and administrative staff of ten or more possess at least two full-time trained employees and smaller schools must maintain at least one full-time trained employee (American Diabetes Association website, Retrieved September 15, 2006). More recently, because of the initiative taken by a school secretary in Alaska, the national Parent Teacher Association (PTA) approved the resolution, "Recognition and Care of School-Age Children with Diabetes". This resolution advises that all school personnel receive routine training on diabetes, and that a minimum of two staff members per school be trained in diabetes care, emergency protocols, and how to identify and treat symptoms of hypoglycemia and hyperglycemia as is legally allowed by each state (*Diabetes Forecast*, November 2006).

One of the major advantages of training school personnel, especially teachers, on the daily management and emergency regimen of diabetes care is that they are ideally situated to recognize children who are having difficulty with their emotional and academic progress (Greenhalgh, 1997). Even full-time school nurses are not necessarily in the classrooms, on the field trips, or present at extracurricular activities to assist the child if necessary.

Table 3. - School Issues

Author(s)	Main Topic(s)	Summary
American Diabetes Association (2006). ADA Comments on Draft ANA Position Statement: "School Nurses: Providing Safe Health Supervision and Care for Children in the School Setting".	Comments pertained to the American Nurse Association (ANA) draft position statement regarding its impact on children with type 1 diabetes if implemented.	The ADA agreed with some of the ANA position statement, such as the need for more school nurses in the U.S. However, during this shortage, the ANA did not provide a solution of how to keep students with medical needs safe. The ADA recommended training other school personnel to assist all students in need.
American Diabetes Association website. (2006). School Legislative Action. Retrieved October 3, 2006 from: http://www.diabetes.org/advocacy-and-legalresources/state-legislation/schooldiscrimination/jsp.	Rehabilitation Act of 1973 (Section 504); Americans with Disabilities Act (ADA); and Individuals with Disabilities in Education Act (IDEA).	Review of federal laws that protect students with diabetes, including, Section 504; ADA; and IDEA. These laws dictate availability of reasonable accommodations in a school setting for children with a disability. This then, enables the child to participate in all school-related activities with minimal disruption to their daily life.
American Diabetes Association. (2006). Position statement: Diabetes Care in the School and Day Care Setting. *Diabetes Care, 29 (Suppl 1): S49-S55).*	Diabetes and the law; diabetes care in the schools; general guidelines for the care of the child in the school and day care setting including a diabetes medical management plan, responsibilities of various care providers (including parents & school personnel), and expectations of student.	The ADA provided information re: how to keep children with type 1 diabetes safe during the school day that included proper planning, education and training for personnel, and participation on behalf of the children with T1DM & parents to ensure a safe learning environment.

Table 3 (cont.)

Author(s)	Main Topic(s)	Summary
Brener, N.; Burstein, G.; DuShaw, M.; Vernon, M.; Wheeler, L.; Robinson, J. (2001). Health Services: Results from the School Health Policies and Programs Study 2000. *Journal of School Health, 71(7): 294-304.*	Described the findings of the School Health Policies and Programs Study (SHPPS) about state- and district-level policies and practices pertaining to various school health services, including, but not limited to, staffing, special needs students and medication administration.	Study found most districts use school nurses to provide health services to students at school, but some districts contracted with off-site agencies. About one-third of the schools polled used health aides either solely or in addition to school nurses. The National Assoc. of School Nurses and American School Health Assoc. provided guidance, but there is no consensus about the best model to provide school health services.
Diabetes Forecast. (2006). Another Victory For Kids. *November: 97-98.*	The absence of a school nurse left a secretary from Alaska feeling frustrated because she was not trained on how to respond to a student's low blood glucose level.	A school secretary from Alaska was instrumental in developing a diabetes school care proposal to be considered by her state's Parent Teacher Assoc. (PTA). The proposal entitled, "Recognition and Care of School-Age Children with Diabetes" was approved in Alaska in early 2006, and nationally in July.
Frank, M. and Daneman, D. (1998). Hurry! Get the glucagon! *Diabetes Forecast, 51(1): 44-46.*	An article addressed questions regarding glucagon.	This article attempted to answer questions about glucagon such as: who may need glucagon (those at risk for severe hypoglycemia), when it should be used (when the individual with diabetes is not able to ingest sugar via the mouth), and who should learn to us it (key members of households – not necessarily school personnel).

Table 3 (cont.)

Author(s)	Main Topic(s)	Summary
Greenhalgh, S. (1997). Improving school teachers' knowledge of diabetes. *Professional Nurse, 13(3): 150-156.*	This study was conducted to address concerns on behalf of parents about the supposed lack of knowledge about diabetes among school teachers. The objective was to evaluate school teachers' knowledge on this subject.	It was found that the majority of teachers did not know enough about diabetes, but are suitably placed to identify students having difficulties emotionally & academically. Therefore, appropriate care & knowledge was important for the child to succeed in school.
Grey, M. and Sullivan-Bolyai, S. (1999). Key issues in chronic illness research: Lessons from the study of children with diabetes. *Journal of Pediatric Nursing, 14(6): 351-*358	Study aimed to discuss the differences in child and adult chronic illness research, analyzed the key issues in research pertaining to chronic illness and determined implications for expanding nursing science for the care of children with chronic illnesses.	Adult and children chronic illness is very different; therefore, the same methods can not be used to study these unique populations. Developmental and social issues need to be considered when examining childhood chronic illness.
Harris, G.; Diment, A.; Sulway, M. and Wilkinson, M. (2001). Glucagon administration - underevaluated and under-taught. *Practical Diabetes International, 18(1): 22-25.*	136 parents and health professionals participated in a timed, simulated glucagon administration experiment. Researchers then compared the results to determine statistical difference.	A statistical difference was found between parents & health professionals. Parents are not accurate in administering recommended dosages. The authors advised that 'hands on' training sessions for glucagon administration need to be conducted for parents of children w/diabetes on a regular basis.

Table 3 (cont.)

Author(s)	Main Topic(s)	Summary
Horovitz, B. and McCoy, K. (2005). "Nurse Shortage Puts School Kids at Risk". *USA Today*, December 15th.	Some schools have one nurse, often of part-time status, shuttling between buildings while others have no nurse at all. Therefore, many children, especially those with chronic conditions, must rely on teachers or other school personnel to assist.	Shrinking school district budgets struggle to locate funds in which to pay for a school nurse. School nurses' salaries are roughly $20,000 less than the median salary for a hospital nurse. Nursing shortages can result in deadly mistakes made by the nurse. More complex student health issues make it very important for a school nurse to be on staff.
Lewis, D.; Powers, P.; Goodenough, M.; Poth, M. (2003). Inadequacy of In-School Support for Diabetic Children. *Diabetes Technology & Therapeutics, 5(1): 45-56.*	The aim of the study was to determine the obstacles to optimal control of diabetes in the school setting. The results would then be used to identify interventions to improve support for children while attending school.	There was inconsistent diabetes education programs across school districts; therefore, creating diabetes awareness interventions needs to be a priority for all schools. Also revealed was the lack of communication between parents and school personnel concerning the care of their child.
Nabors, L.; Lehmkuhl, H.; Christos, N.; Andreone, T. (2003). Children with Diabetes: Perceptions of Supports for Self-Management at School. *Journal of School Health, 73(6): 216-221.*	Study explored children's and adolescents' views of support and assistance for diabetes management while in a school setting.	Children revealed they need support with educating staff, supply availability, teacher flexibility, aid with hypoglycemic episodes, reminders to follow regimen & emotional support. Education sessions re: diabetes need to be held consistently for school personnel.

Table 3 (cont.)

Author(s)	Main Topic(s)	Summary
Nabors, L.; Troillett, A.; Nash, T.; Masiulis, B. (2005). School Nurse Perceptions of Barriers and Supports for Children With Diabetes. *Journal of School Health, 75(4): 119-124.*	Researchers surveyed 43 school nurses regarding their perceptions of the trials and specifications of children with type 1 diabetes in the school setting.	Some barriers noted that make it difficult for children to manage their diabetes in school are testing blood glucose levels or eating a snack when needed. Improving education for school staff & coordination among parents, children, medical team and school staff was key.
New York State Nurses Association. (2006). New Directive on Training Unlicensed Personnel in Glucagon Administration. Retrieved October 6, 2006 from http://www.nysa.org/programs/nai/practice/alerts/glucagon/htm	This editorial described a decision recently provided by the New York State Education Department (SED) and the Department of Health (DOH) regarding glucagon administration in the school setting.	The decision made by the SED & DOH permitted licensed registered nurses in the school setting to train unlicensed personnel in the administration of glucagon for emergency situations.
Price, J.; Dake, J.; Murnan, J.; Telljohann, S. (2003). Elementary School Secretaries' Experiences and Perceptions of Administering Prescription Medication. *Journal of School Health, 73(10): 373-379.*	Random sample of elementary school secretaries from across the U.S. was done to assess their perceptions and experiences with administering prescription medication to students.	School secretaries noted medication administration is one of the most common responsibilities passed on to them in the absence of a school nurse (most w/out the appropriate training). To avoid medication errors and the risk of liability, training for secretaries, and other non-medical school personnel, needs to occur frequently to ensure the safety and health of the students.

Table 3 (cont.)

Author(s)	Main Topic(s)	Summary
Schwab, N. and Gelfman, M. (2001). Legal Issues In School Health Services. A Resource for School Administrators, School Attorneys and School Nurses. Sunrise River Press. Minnesota.	Legal resource for education and health professionals involved with school health services.	This book focuses on the demands of health services needed for students (ages 3-21 years) in public schools. These demands can lead to legal and ethical dilemmas for which this book aims to act as a guide.
Siminerio, L. and Koerbel, G. (2000). A diabetes education program for school personnel. *Practical Diabetes International, 17: 174-177.*	This project aimed to determine the knowledge levels, along with the needs of school personnel, regarding type 1 diabetes.	The results of this project indicated that school personnel need to have education programs that focus on symptoms of hyperglycemia, actions of glucagon and the responsibilities that are outlined in the American Disabilities Act. Also noted was the need for other school personnel to be trained, e.g. coaches, substitute teachers and school aides.
Wagner, J. and James, A. (2006) A pilot study of school counselors' preparedness to serve students with diabetes: relationship to self-reported diabetes training. (Research Papers) *Journal of*	The objective of this pilot study was to examine the knowledge, attitudes and awareness of 132 school counselors regarding students with diabetes.	The pilot study found that school counselors show only a basic level of knowledge re: diabetes & its management in children - an inadequate amount to be able to provide aid to children with diabetes. The study also found those counselors who received some diabetes training showed more knowledge re: diabetes than did their colleagues who had received no training.

3.0 DIABETES EDUCATION PROGRAM AND PILOT STUDY

3.1 PILOT STUDY

Overview of Program

Rates of diabetes, asthma, and obesity are exceedingly high in Fayette County; a rural area located about 70 miles south of Pittsburgh, Pennsylvania. In 2004, Pennsylvania was one of three states to be awarded a federal grant (through the Centers for Disease Control and Prevention) to partake in a national program entitled "Steps to a Healthier US." Due to the elevated rates of diabetes, asthma, and obesity, the Pennsylvania Department of Health selected Fayette County as one of three counties in Pennsylvania to participate in this national program. As a result of the federal grant and high prevalence rates discussed above, a number of intervention programs have been initiated in Fayette County.

In the fall of 2005, Carole Perry of the Steps to a Healthier Pennsylvania in Fayette County surveyed school nurses, Registered Nurses (RN), Licensed Practical Nurses (LPN), paraprofessional RNs, and school nurse assistants regarding the health issues plaguing students that were of greatest concern. Results from this survey revealed a strong need for more education on the subject of diabetes and thus, a pilot diabetes education program was developed.

The training took place on August 15, 2006, in a lecture-based format, and was conducted by Ms. Marilyn Clougherty, RN, MSN, CDE, Diabetes Program Coordinator, and Ms. Terri McGee, MS, RD, LDN, CDE, of Children's Hospital of Pittsburgh, Pennsylvania. Following the presentation, there was a hands-on component that lasted one hour, for

participants to operate various insulin pumps. At the beginning and end of the training, a 15-item pre- and post-test was administered in order to measure participants' knowledge regarding type 1 and type 2 diabetes.

Objectives

The overall goal of the diabetes education program was to increase the knowledge of school nurses, RNs, LPNs, paraprofessional RNs and school nurse assistants regarding the medical, psychosocial, and policy issues related to type 1 and type 2 diabetes. The specific objectives of the workshop were to: 1.) present current trends in diabetes management for children with type 1 and type 2 diabetes, 2.) describe the needs of children with diabetes, 3.) discuss problems encountered during the school day, 4.) review nutritional management and 5.) explain the importance of the Section 504 Plan of the Rehabilitation Act of 1973 for students with diabetes. Section 504 ensures that students with a disability have the same access to education as do other children.

3.2 METHODOLOGY

Study Design

The intervention was designed as an educational workshop offered at one point in time. A pre- and post-test was administered with no control group. An evaluation was also administered at the end of the educational workshop.

Measures

Knowledge Test. The pre- and post-test utilized in this study was taken from a knowledge test developed by Linda Siminerio and Glory Koerbel in 2000 and then updated by Marilyn Clougherty in 2006. These tests were based on ADA content areas. The first 13 questions of the pre- and post-test were multiple choice and participants were instructed to circle only one answer (there was only one correct answer for each question). The remaining two questions were open-ended and directed the participant to list issues that school nurses should be aware of regarding children with diabetes in a school setting and the components of a medical plan of care for these children (see Appendix A for the pre- and post-test questions). Demographic information, including occupation (title), county of employment (Fayette vs. non-Fayette), level of education and years employed as a school nurse, was also collected.

Participant Evaluation. The evaluation form was developed by Carole Perry and Amy Cook in 2006. This evaluation was based on the objectives identified by Marilyn Clougherty and Terri McGee of Children's Hospital in Pittsburgh, Pennsylvania. At the close of the educational program, the participants were directed to complete the evaluation form that was intended to measure the effectiveness and applicability of the diabetes education program.

Study Sample/Participants

Participants were initially identified by relevant occupation in the Fayette County school system. Additional participants self-selected into the program through "word-of-mouth" information obtained from Fayette County school nurses and other school health professionals. The participants included nurses who defined themselves as official school nurses, nurses who did not self-identify as school nurses, and others, e.g., faculty, aides and assistants.

Analysis

Knowledge Test. The pre- and post-test data were coded and entered into a database. Correct answers were coded as "1" and incorrect responses were "0". Data were then analyzed using SPSS® statistical analysis software (SPSS, version 14.0). As discussed in the knowledge test section, only the first 13 questions were applied to this scoring system (the remaining two questions were open-ended, and thus, no correct answer existed). The mean score presented in the results section was based on the average questions answered correctly in this group of questions. For the two open-ended questions, the qualitative data were categorized into prominent themes and calculated by the number of times each theme was noted. Occupation was aggregated into three groups: School Nurse (School Nurse and Certified School Nurse); Nurse (Nurse, Paraprofessional RN, and CRNP); and Other (School Nurse Assistant, Faculty, and LPN).

Participant Evaluation. The 16-item evaluation was broken down into two subgroups. The first 12 questions were in the form of a Likert scale ranging from "strongly agree" to "strongly disagree." The remaining four questions were open-ended inquiries. The Likert scale questions were then computed by summing the number of responses provided by the participants. The four open-ended questions were analyzed by summing up answers categorized into prominent themes.

Institutional Review Board

An application for the diabetes education intervention was submitted to the University of Pittsburgh's Institutional Review Board (IRB). The IRB determined that the intervention did not meet the regulatory definition of human subject research; therefore no further review was necessary.

3.3 RESULTS

Knowledge Test

A total of 32 pre-tests and 28 post-tests were completed and submitted, resulting in a return rate of 87%. Nurses and school nurses completed the majority of pre- and post-tests. As for education, the majority of participants had a bachelor's degree (50% for pre-tests and 46.4% for the post-tests).

Table 4 presents t-test statistics comparing mean scores from the pre- and post-tests for three groups: the overall sample, the school nurses, and non-school nurses (which includes anyone not identifying themselves as a school nurse). The results indicate that the overall sample, as well as the non-school nurse sub-group, displayed statistically significant improvement in knowledge scores. Note: A perfect score consists of answering all 13 questions correctly; all significance testing is based on a 95% confidence interval.

Table 4. – T-Test Statistics for Various Groupings: Pre- and Post-Test

	Pre-Test		**Post-Test**		
Group	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**	**p-value**
Overall	9.9	1.4	11.0	1.2	0.0003
School Nurses	10.2	0.9	11.1	1.4	0.0732
Non-School Nurses	9.6	1.7	10.9	1.1	0.0089

If we compare by occupation, the school nurse's mean score was 6% higher at baseline than non-school nurses. However, if we compare post-test scores by occupation, the school nurses only scored 2% higher, which also represents an insignificant difference. Finally, if we compare the differences in improvement from pre-test and post-test by occupation, we find that the school nurses improved by 9% and the non-school nurses improved by 14%.

Table 5 presents a breakdown of the percent of correct answers at the pre- and post-test for each of the 13 multiple-choice questions, and the change in test scores from the pre- to the post-test. Table 6 provides statistics similar to those in Table 5, but aggregated by question theme, and disaggregated by occupational groupings.

Table 5. – Question-by-Question Percent Answered Correctly: Pre- and Post-Test

Question	Pre-Test	Post-Test	Δ	p-value	Confidence Interval
Question 1	100%	100%	0%	-------	(0%, 0%)
Question 2	88%	100%	+12%	0.0540	(0%, 25%)
Question 3	16%	7%	-9%	0.3154	(-25%, 8%)
Question 4	78%	79%	+1%	0.9673	(-21%, 22%)
Question 5	97%	96%	-1%	0.9250	(-10%, 9%)
Question 6	97%	100%	+3%	0.3540	(-4%, 10%)
Question 7	94%	100%	+6%	0.1844	(-3%, 15%)
Question 8	78%	79%	+1%	0.9673	(-21%, 22%)
Question 9	56%	64%	+8%	0.5342	(-18%, 34%)
Question 10	97%	100%	+3%	0.3540	(-4%, 10%)
Question 11	72%	89%	+17%	0.0956	(-3%, 38%)
Question 12	34%	82%	+48%	0.0001	(25%, 71%)
Question 13	84%	100%	+16%	0.0290	(2%, 30%)

Table 6. - Percent Answered Correctly: Pre- and Post-Test – Aggregated by Question Theme and Broken Down by Occupational Grouping

	School Nurse			Nurse			Other		
Theme	**Pre**	**Post**	**Δ**	**Pre**	**Post**	**Δ**	**Pre**	**Post**	**Δ**
ADA	87%	100%	+13%	85%	100%	+15%	100%	100%	0%
High/Low Blood Glucose	73%	73%	0%	73%	70%	-3%	63%	67%	+4%
Insulin Pump	49%	79%	+30%	46%	88%	+42%	42%	89%	+47%
School-Related Issues	82%	88%	+6%	79%	88%	+9%	92%	89%	-3%
Glucose Essential	100%	100%	0%	100%	100%	0%	100%	100%	0%
Glucagon	87%	91%	+4%	77%	71%	-6%	50%	67%	+17%

*ADA – Question 2; High/Low Blood Glucose – Questions 3-6; Insulin Pump – Questions 11-13; School-Related Issues – Questions 7, 9, and 10; Glucose Essential – Question 1; and Glucagon – Question 8.

The only significant finding had to do with the questions regarding the insulin pump. At the pre-test only, 42-49% answered correctly. But after the educational session, 79-89% of participants answered correctly.

On both the pre- and post-test, participants were asked to cite three components of a medical plan of care for children with diabetes in school settings. At both points in time, the majority of the participants listed the following as elements of a plan: “action taken if low or high blood glucose”, “activity and eating schedules”, and “administration of insulin and maintenance of pump”. In addition, participants noted need for “blood glucose testing” and “parent/faculty/medical staff participation.”

Participant Evaluation

Twenty-eight participants completed and submitted evaluation forms (see Appendix B for a list of evaluation questions). Overall, the attendees found the information outlining diabetes management for children with type 1 and type 2 diabetes to be valuable and felt confident in identifying the problems encountered by students with diabetes. The attendees felt the hands-on training with the insulin pumps were especially helpful. Some of the areas where the attendees felt they could use more skill development were exchange lists and carbohydrate counting; handling diabetic equipment (i.e. insulin pumps); and identifying the differences between type 1 and type 2 diabetes and the importance of the section 504 Plan.

Some of the strengths of the program cited by participants were the 'hands-on' training with insulin pumps, knowledgeable presenters, and information provided regarding type 1 and type 2 diabetes. One of the main weaknesses identified was that not enough time was allotted for presenters to fully discuss all of the information provided, especially regarding nutrition. In general, the participants reported that the session was important, and requested that additional programs of this nature be offered.

3.4 DISCUSSION

Knowledge Test

The results of the pre- and post-test have some interesting implications. First, the diabetes education program appeared to have a significant impact on improving the knowledge of school nurses and non-school nurses. Second, both groups scored comparably on the pre-test and post-test. The comparable improvement in scores in both occupational groups suggests that regardless of school personnel role (school nurse versus other), each participant improved the level of their diabetes knowledge. We can take away from this analysis that the diabetes education program supplemented information to an already knowledgeable group, and everyone involved appeared to gain comparable knowledge.

All school personnel, regardless of occupation, appeared to improve their understanding of the American Disabilities Act, that it includes children with diabetes, that glucose is essential for the brain to function, and that there is a variety of school-related issues that pertain to a child with diabetes. The biggest difficulty faced by all participants was in understanding the use of the insulin pump. Of all the topics covered during the session, it appeared that information about insulin pumps was by far the most positively affected. This result is very encouraging because many of the participants were most interested, as well as concerned about, their knowledge of this device.

When asked to list the areas of concern regarding children with diabetes in the school setting, the four most frequently listed items were “child responsibility”; “hypoglycemia”; “hyperglycemia” and “snack/meal choices”. Ability to monitor blood glucose and other school personnel to be trained and educated were also noted. These points indicate that future educational sessions should continue or begin to include this subject matter, as well as possibly

extend the invitation to this type of a session to other school personnel. These responses also revealed the participants' awareness of what information is needed to be documented in the diabetes medical plan of care in order to maintain a safe and healthy school environment for the child.

Although the diabetes education program significantly improved the knowledge of school nurses and non-school nurses, limitations of the study should be noted. First, the size of the population of school nurses, nurses, and other (e.g., teachers, aides and assistants) is small. Therefore, more educational sessions of this nature need to be conducted in several school districts and states. Second, the sample population is made up almost exclusively of health professionals. Having participants from a more diverse occupational background would be helpful in determining how well, for example, other school professionals would perform. Third, a coding system was not utilized to link each pre-test with its corresponding post-test. Thus, since four individuals only completed a pre-test, and some individuals that did complete both pre- and post-test changed occupation status, future studies need to determine a methodology by which pre-tests and post-tests can be linked, while still maintaining confidentiality of the participants. Finally, three- and six-month follow-ups need to be planned to measure how well the information was retained since the education program took place in August of 2006. Additionally, including a behavioral component in these follow-ups would be useful in ascertaining if the knowledge learned has been translated into practice. These three- and six-month follow-ups will also assist in determining if these types of training sessions need to be offered multiple times during the school year.

Participant Evaluation

Overall, the attendees found the information outlining diabetes management for children with type 1 and type 2 diabetes to be valuable and felt confident in identifying the problems encountered by students with diabetes. Some of the areas where the participants reported that they could use more information were ‘exchange lists’ and ‘carbohydrate counting’, handling diabetic equipment (i.e., insulin pumps), identifying the differences between type 1 and type 2 diabetes, and the importance of the section 504 Plan.

4.0 DISCUSSION AND RECOMMENDATIONS

Children spend many of their weekday hours in school, and for those with diabetes, they require trained school personnel to be available in the event that assistance is needed. Unfortunately, as noted in the literature review, there is a shortage of school nurses. Thus, to protect said children, school officials need to supplement school nurses with other school personnel who are trained not only to assist in the care of children with type 1 diabetes, but also to recognize the symptoms of the most frequent acute complications, hypoglycemia and hyperglycemia. School is an environment for learning, both emotionally and intellectually. If children cannot fully concentrate on the lesson plan, or focus on a project, they risk losing out on vital mental stimulation. An unsupportive educational environment has the potential to produce students who are scholastically disadvantaged.

By passing laws such as Section 504 of the Rehabilitation Act of 1973, the *Individuals with Disabilities Education Act of 1991*, and the *Americans with Disabilities Act*, the federal government created the structure to provide children who have a disability with opportunities that they previously did not enjoy. However, the federal government did not provide guidelines for policy implementation regarding diabetes management in the school setting or for education and training sessions regarding the various disabilities students may possess. Furthermore, in a time when there is a national shortage of school nurses, the Department of Education does not

emphasize the federal recommendation regarding the ratio of nurses to students (1:750) (U.S. Department of Health and Human Services, 2000: *Healthy People 2010*).

Ultimately, it is of utmost importance that all school personnel are properly trained in diabetes management and emergency care. This is especially true for anyone who is in constant contact with the students, namely teachers, coaches, and bus drivers. Unlike school nurses, who do not have daily interaction with the students, non-healthcare school personnel may be in the position to limit the potency of hypoglycemia and/or hyperglycemia because they are consistently interacting with the children, and can see when a child is not paying attention, or seems to lack energy. In many respects, the non-healthcare school personnel are a child's first line of defense, and it is potentially more important that these adults be able to recognize dangerous situations before they escalate. If nothing else, a teacher or coach should know who has type 1 diabetes, and should be able to identify symptoms as a means of preventing interruption of the scholastic experience. This will provide the student with a more enjoyable and less stressful environment in which to learn, because they will not feel alone in managing this disease.

Through the pilot study, the pre- and post-test results presented evidence that since healthcare professionals profited from the educational session, there is no reason why non-healthcare professionals could not as well. The session provided a low-cost, time-efficient opportunity to offer important knowledge regarding type 1 diabetes and its care. Schools could require all personnel to attend these sessions, and thereby take the first step towards providing children with the safe learning environment to which they are entitled.

Based on a review of the literature and the pilot study, the following recommendations are offered for consideration:

Immediate Consideration

- All school personnel, including school nurses, should receive training from a qualified health care professional (e.g., physician, registered nurse or certified diabetes educator) in the daily management and emergency care for children with type 1 diabetes (specifically, glucagon administration). All new trends and medical equipment must be reviewed consistently. Additionally, knowledge about the emotional well-being and developmental issues need to be discussed and emphasized as the psychosocial components are so important to keeping children and adolescents safe and healthy while in school.
- Diabetes education sessions should be held once a year and required as a part of the performance review process for all school employees including school nurses, teachers, coaches, and administrators. The sessions should include diabetes management content as well as new trends and new medical equipment. A hands-on component for medical apparatus should be included to familiarize school personnel with how to operate each device.
- As part of the education and training sessions for school personnel and nurses, school resources from the American Diabetes Association (www.diabetes.org) and the National Diabetes Education Program (http://ndep.nih.gov) websites should be referenced. In addition to helpful information regarding management of diabetes for students, both organizations recommend school personnel utilize

the guide entitled, *Helping the Student with Diabetes Succeed: A Guide for School Personnel.*

- As discussed previously, only a limited amount of literature exists in support of glucagon usage. Thus, these studies are insufficient to provide any consensus as to the safety of glucagon administration. Because of this deficiency in the literature, further research on this topic is needed to verify the ease and safety of administering glucagon by properly trained individuals.

Long-Term Consideration

- The federal government should mandate that all states adopt a law similar to that passed by state of Virginia (Senate Bill 88 School System), thus prohibiting individual school districts from deciding how to keep children with type 1 diabetes safe and healthy.
- In light of the national school nurse shortage, nursing salaries should be reconsidered so that the overall compensation package is more attractive to lure individuals into the field. This is especially important as school district budgets are shrinking due to the demands of, for example, the government's "No Child Left Behind" law, which ties federal funding for schools to students' improved standardized test scores, and not health.

5.0 CONCLUSION

Dealing with diabetes is not an intermittent responsibility. School-aged children and adolescents must be diligent about taking care of their disease in order to reduce the advancement of long-term health complications. To assist children in maintaining a healthy lifestyle, school nurses and personnel need to be able to provide the appropriate care, which consists of possessing the proper knowledge and training in the daily management of type 1 diabetes, as well as how to respond in an emergency situation.

The literature review highlights the importance of tight blood glucose control to prevent long-term health complications that accompany type 1 diabetes. It also highlights the challenges for children with type 1 diabetes to achieve good glycemic control in a school setting. Such demands include the daily regimen of diabetes management, psychosocial issues (e.g., “fitting in” with others and symptoms of depression), and the shrinking pool of school nurses, the very individuals who are trained to assist children with their daily diabetes management routine.

This review also points to the lack of consensus in research findings regarding the effects of hypoglycemia (specifically severe hypoglycemia) on cognitive functioning and academic performance. The conflicting results of studies indicate further research is necessary to determine the impact that severe hypoglycemia has on neurocognitive functioning in children with type 1 diabetes.

Also highlighted are the issues of the national school nurse shortage and the dilemma of keeping children with type 1 diabetes safe and healthy while in school. The literature and the recommendations suggest that teachers, coaches, and school administrators are the most logical individuals to step in, and with proper training, assist children in their efforts to manage their disease. The federal laws that have been implemented to provide opportunities for children with disabilities need to be strengthened with provisions that will assure that all school personnel are educated and trained in proper diabetes management and actions to take in the event of an emergency. Leaving the policy-making decision up to individual school districts has not been a successful method to ensure the safety and health of children with type 1 diabetes.

Finally, the diabetes education pilot study provides useful information in several areas. First, the educational session provided valuable information regarding the symptoms of acute complications and care of diabetes, as is reflected in the significant improvement on overall pilot study test scores, as well as for the specific questions regarding insulin pumps, one of the main concerns for this educational session. Second, and more important, because the educational session was useful for school nurses and other school healthcare personnel, it does not seem unwarranted to extrapolate this benefit to other school personnel. Thus, because this project acknowledges the need for additional diabetes supervision and care in the school setting, future education sessions should include other school personnel. This represents a potentially cost-effective, efficient method by which to begin to address the current deficiency in providing a safe and supportive scholastic environment to children with type 1 diabetes.

APPENDIX A

QUESTIONS FROM THE PRE- AND POST-TEST FORM[1]

MULTIPLE CHOICE:

Question 1: Glucose is essential for the brain to function.

a) true
b) false
c) not sure

Question 2: The American Disabilities Act:

a) includes children with diabetes
b) is not relevant to children with diabetes
c) should not include children with diabetes
d) not sure

Question 3: A major concern for the school child with diabetes is the likelihood of developing:

a) high blood glucose problems
b) infections
c) low blood glucose problems
d) both a and c
e) not sure

[1] Pre- and Post-test questions originally used in: Siminerio, L. and Koerbel, G. (2000). A diabetes education program for school personnel. *Practical Diabetes International, 17: 174-177.* Questions were then revised by: Marilyn Clougherty, RN, MSN, CDE (May 2006).

Question 4: A sign of high glucose in a child with diabetes may be:

a) feeling shaky
b) having to go to the bathroom frequently
c) irritability
d) not sure

Question 5: Low blood glucose requires:

a) parental attention and a call to the parents immediately
b) immediate attention by school personnel
c) no action since this is not an immediate concern
d) not sure

Question 6: A general rule for treatment of low blood glucose is:

a) call the child's physician
b) give some form of glucose as quickly as possible
c) make sure the child is given more insulin
d) not sure

Question 7: Children with diabetes need to miss more school days:

a) true
b) false
c) not sure

Question 8: Glucagon is:

a) a hormone that lowers blood glucose levels
b) a medication that mimics insulin
c) a hormone that raises blood glucose levels
d) not sure

Question 9: Schools can ask parents to waive liability:

a) true
b) false
c) not sure

Question 10: Children with diabetes should be reprimanded if seen eating a candy bar:

a) true
b) false
c) not sure

Question 11: For children with diabetes using insulin pump therapy, the basal insulin is the amount of insulin:

a) given when a meal is eaten
b) given if you disconnect for gym class
c) the body requires when no food is eaten
d) not sure

Question 12: If a child disconnects their pump for sports activities, when should the blood glucose first be checked?

a) after one hour
b) after two hours
c) it's not necessary to test as long as the child is feeling okay
d) before their next meal
e) not sure

Question 13: The student using an insulin pump should check the urine for ketones:

a) after a low blood glucose reaction
b) before taking insulin at lunch
c) when blood glucose is over 240 mg/dl
d) after gym class
e) not sure

Answers: 1-a; 2-a; 3-c; 4-b; 5-b; 6-b; 7-b; 8-c; 9-b; 10-b; 11-c; 12-a; and 13-c;

Open-Ended Format:

Question 14: List four areas of concern, in your personal experience, regarding children with diabetes in the school setting.

Question 15: Cite three components of a medical plan of care for children with diabetes in school.

APPENDIX B

QUESTIONS FROM THE EVALUATION FORM

Question 1: The content regarding diabetes management for children with type 1 diabetes provided information that was valuable to me.

Strongly Agree ___ Agree ___ Disagree ___ Strongly Disagree ___

Question 2: As a result of this educational session, I am confident in my ability to identify the risk factors for type 2 diabetes in children.

Question 3: The content regarding interventions for the prevention of type 2 diabetes in children provided information that was valuable to me.

Question 4: The content regarding exchange lists & carbohydrate counting to control blood glucose levels by food portions provided information that was valuable to me.

Question 5: As a result of this educational session, I feel more comfortable handling diabetic equipment (i.e. insulin pumps).

Question 6: As a result of this educational session, I feel confident that I can identify the differences between type 1 and type 2 diabetes.

Question 7: As a result of this educational session, I understand the importance of the Section 504 Plan for students with diabetes.

Question 8: As a result of this educational session, I feel confident I am able to identify the main problems encountered for students with diabetes.

Question 9: The presenters were knowledgeable in their subject area.

Question 10: The presenters employed effective teaching techniques.

Question 11: The Penn State Fayette, Eberly Campus Facilities were:

Excellent ___ Appropriate ___ Adequate ___ Poor ___

Question 12: The presenters were knowledgeable in their subject area.

More than Needed ___ Just Right ___ Less than Needed ___

Open-Ended Format:

Question 13: What were the STRENGHS of the educational session?

Question 14: What were the WEAKNESSES of the Conference?

Question 15: List learning experiences, resources, activities, or programs that are needed:

Question 16: Additional Comments:

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