



5-2009

Diabetes Management with Insulin Pump Therapy and its Compliance in Adolescents

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DIABETES MANAGEMENT WITH INSULIN PUMP THERAPY
AND IT'S COMPLIANCE IN ADOLESCENTS

by

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Bachelor of Science in Nursing, Minot State University, 2002

An Independent Project

Submitted to the Graduate Faculty

of the

University of North Dakota

in partial fulfillment of the requirements

for the degree of

Master of Science

Grand Forks, North Dakota

May
2009

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ACKNOWLEDGEMENTS

I would like to thank the faculty in the College of Nursing at the University of North Dakota who have helped and supported me during my graduate education adventures. Special thanks to Dr. Seal who has been my advisor and to Dr. Julie Anderson for her support and guidance.

Also, I want to thank all my classmates. I learned so much from all of you and have gained strength and confidence from your support and friendship.

I would especially like to thank my family and friends for their continued love and support during this time for without them it would have been impossible. Special thanks to my husband, Tracey, who has never complained about lost evenings and weekends due to my studying. Another very special thanks to my son, Gaige, I hope you always know you come first. I also want to thank my parents because they have always stepped up to help if I am feeling overwhelmed by making supper, cleaning my house, or watching Gaige for the evening. It does not go unnoticed, thank you.

To My Son, Gaige Scott Reep

May you always understand the importance of life long education
and most importantly know how much I love you.

Abstract

Glycemic control is difficult to achieve for the adolescent with type 1 diabetes mellitus (T1DM). Intensive insulin therapy through continuous subcutaneous insulin infusion (CSII) with an insulin pump can give the adolescent better glycemic control and a more flexible schedule and lifestyle. The purpose of this project was to determine if insulin pump therapy among adolescents increases their compliance of their medical regimen and to increase awareness of diabetic educators of insulin pump therapy and it's appropriateness among adolescent patients.

An intensive literature review was conducted to determine the current evidence on insulin pump therapy in adolescents and their compliance. There were nine areas of focus in this literature review: treatment difficulties of adolescents with T1DM, diabetes care, nutritional concerns, intensive insulin therapy, adolescents who will benefit from CSII, advantages of CSII, family involvement, keys to success with CSII, and concerns of CSII. At the culmination of the project, local diabetic educators will be given a presentation about insulin pump therapy in adolescents and its effects on compliance.

CHAPTER I

INTRODUCTION

Diabetes mellitus rates as the 5th leading cause of death due to disease in the United States, most of these deaths are related to complications and conditions secondary to diabetes associated with poor glycemic control (Faulkner & Quinn, 2008). An adolescent with diabetes on average has a 1% higher HgbA1c compared to an adult with diabetes and this poor glycemic control leads to adverse effects (Faulkner & Quinn, 2008). Type 1 diabetes mellitus has an estimated prevalence of 87-140 cases per 100,000 children in Germany, which has a similar prevalence worldwide, and it is increasing approximately 3% per year (Kapellen, Heidtmann, Bachmann, Ziegler, Graber, & Holl, 2007). More attention is needed in diabetes control and glucose management in adolescents to prevent long-term complications.

Adolescents with diabetes often have low compliance rates of their diabetic regimens because of the difficulty to control and manage their diabetes. Intensive insulin regimens, with multiple daily injections, create a strict schedule of meals, activity, and insulin with a rollercoaster of blood glucose levels. This kind of a strict schedule can be hard for adolescents to maintain with their daily activities of school, extracurricular activities, sports, hanging out with friends, and varying meals and snacks. Adolescents often times forget or choose to ignore their diabetes and the care it demands, which can lead to serious consequences. They don't want to check their blood sugars, eat, or give themselves their insulin; they want to be able to do and eat as their peers. Using an insulin pump is one way in which adolescents can manage their diabetes. Insulin pumps allow for schedule changes and can give adolescents more freedom and choices in their daily lives compared to what they may have with intensive insulin regimens of multiple daily injections.

Clinical Problem

The treatment of diabetes mellitus type I is difficult in children and adolescents. Combination of severe insulin deficiency and the physical and psychosocial changes that accompany normal growth and development present unique challenges to pediatric healthcare professionals. The transition to adolescents for children with T1DM is commonly associated with decreased adherence to diabetes management tasks leading to worse metabolic control (Svoren, Volkening, Butler, Moreland, Anderson, & Laffel, 2007).

The goal for HbA1c set by the American Diabetes Association is <8% for children aged 6-12 years and <7.5% for adolescents aged 13-19 years. Previous studies have shown that children and adolescents with type 1 diabetes showed an average HbA1c levels ranging from 8.07 – 9.07% (Johns, Faulker, & Quinn, 2008).

There is an immediate need for better diabetes management in the adolescent population. Physicians and other health care providers often times do not believe that insulin pumps are appropriate for adolescent patients therefore limiting them to multiple daily injections to manage their diabetes. Health care providers need to be made aware of the appropriateness of insulin pump use in their adolescent patients. The decision on how to manage diabetes in an adolescent patient needs to be made with the patient, their family and their health care provider to devise a treatment regimen that is effective in controlling blood glucose levels.

Purpose of the Project

The purpose of this project was to review current literature to see if insulin pump therapy among adolescents increases their compliance of their medical regimen and to increase awareness of diabetic educators of insulin pump therapy and it's appropriateness among adolescent patients. Characteristics of adolescents indicating appropriate use of insulin pump

therapy, advantages and concerns of insulin pumps, family involvement, and keys to success with insulin pump therapy will be addressed in the following paper. Evidence to support insulin pump therapy in adolescents will be presented to diabetic educators in an effort to educate them on the information regarding insulin pump therapy in adolescent patients to be used in their practice.

Conceptual/Theoretical Framework

The theory utilized in this independent project was the Self-Care Deficit Nursing theory founded by Dorothea Orem, a Grand Nursing Theorist. This theory focuses on the person as an agent (McEwen & Wills, 2007). Orem's theory encompasses three theories including theories of self-care, self-care deficit, and nursing systems. The three theories relate to each other in that the nursing system is the outer encompassing theory, which contains the self-care deficit theory and the self-care theory is a component of the self-care deficit theory (McEwen & Wills, 2007). Central to Orem's theory is that people function and maintain life, health, and well-being by caring for themselves (Fan, 2008).

Self-neglect is defined as the failure to engage in self-care acts which adequately regulate functioning supply levels of food, take actions to prevent, alleviate, cure or control conditions which affect life, health and well-being (Lauder, 2001). Self-care behaviors include adherence to medication, diet, and exercise. Persons who are self-neglecting do not provide optimum levels of self-care and have a self-care deficit (Lauder, 2001).

Orem also discusses self-care requisites which are factors that are necessary for health and well-being (Lauder, 2001). Self-care requisites can be universal, developmental or a health deviation (Lauder, 2001). The health deviation self-care requisites include seeking medical attention and following a prescribed treatment regimen (Lauder, 2001). Self-care requisites are

formulated and expressed knowledge of actions to perform that are known to be necessary in regulating an aspect of human functioning and development (Tomey & Alligood, 2002). A formulated self-care requisite explains the factor to be controlled to keep an aspect of human functioning and development within norms compatible with life, and the extent of the action required (Tomey & Alligood, 2002). Formulated and expressed self-care requisites are the reason self-care is completed (Tomey & Alligood, 2002).

Self-care agency, according to Orem, is the power and capability to engage in self-care (Lauder, 2001). Self-care agency is an acquired ability which is influenced by internal and external variables (Lauder, 2001). Internal variables include such things as cognitive functioning and knowledge. External variables involve education and the ability to work (Lauder, 2001).

One's self-care ability can be limited because of factors that are out of control of the individual. Orem suggests that a person's behavior is rational and open to choice except in situations where the individual's ability to reason is constrained (Lauder, 2001). This idea was developed when Orem was discussing an individual's self-evaluation of care measures, not knowing what to do or how to do it, and the presence of disease may limit what the individual can do for themselves by way of self-care actions (Lauder, 2001). Therefore, Orem's Self-care theory proposes that to care for one's self is a rational act, and that humans are rational beings inherently predisposed to engage in self-care (Lauder, 2001). People who do not engage in appropriate self-care then are not rational (Lauder, 2001).

Orem also talks about the influence families can have on the care of an individual. Families can be both supportive or a barrier to efficient and effective self-care. Although, nurses can care for families it is important to remember that according to Orem, the basic unit of care

needs to remain the individual (Lauder, 2001). Orem's theory focuses on the purpose of nursing as helping people meet their self-care needs (Hood & Leddy, 2003).

Orem's theory relates that humans engage in continuous communication and interchange among themselves and their environments to remain alive and to function (McEwen & Wills, 2007). Mature humans experience privations through caring of self and others involving making life-sustaining and function-regulating actions (McEwen & Wills, 2007). Self-care is learned as a person matures and is affected by ones cultural beliefs, habits, and customs of their family and society (Hood & Leddy, 2003).

Orem's Self-care deficit nursing theory is appropriate for this project because its focus is on self-care and the individual. Adolescents are often thought of as having a self-care deficit and unable to care or make decisions for themselves. Orem's theory can be used in nursing practice to teach adolescents self-care activities to manage their diabetes. Self-care must be learned and purposely performed continuously to be effective in regulating the requirements of the individual (Tomey & Alligood, 2002). If adolescents are given the right tools or, self-care agency, to care for themselves and to make decisions the responsibility shifts from the care givers to the adolescent and diabetes management compliance rates may improve.

Definitions

Adolescence- a period of transition between childhood and adulthood, a time of profound biologic, intellectual, psychosocial, and economic change; involves three distinct sub phases: early adolescents (ages 11-14), middle adolescents (ages 15-17), and late adolescents (ages 18-20) (Hockenberry, 2008, pg. 812)

Multiple daily injections (MDI)- multiple injections throughout the day with a once or twice daily dose of long-acting insulin to stimulate the basal insulin secretion and injections of rapid-acting insulin before each meal (Hockenberry, 2008, 1711)

Insulin pump- electromechanical device designed to deliver fixed amounts of regular or lispro insulin continuously, and the ability to administer pre-meal boluses (Hockenberry, 2008, pg. 1711)

Glycosylated hemoglobin (HgbA1C)- satisfactory method for assessing the control of the diabetic patient; reflects average blood glucose levels over the previous 2-3 months (Hockenberry, 2008, pg. 1712)

Type 1 diabetes mellitus (T1DM)- a chronic disorder of metabolism characterized by a partial or complete deficiency of the hormone insulin; abrupt onset usually under the age of 20, peak incidence between ages 10 and 15 years (Hockenberry, 2008, pg. 1705)

CHAPTER II

REVIEW OF LITERATURE

An intensive review of literature was completed to determine the current information on insulin pump usage among adolescents and compliance with their medical regimen. The following paper will discuss adolescents with diabetes mellitus and the different treatment options. There are 9 areas of focus in this review: treatment difficulties of adolescents with T1DM, diabetes care, nutritional concerns, intensive insulin therapy, adolescents who will benefit from CSII, advantages of CSII, family involvement, keys to success with CSII, and concerns of CSII.

Treatment Difficulties of Adolescents with T1DM

Type 1 diabetes mellitus (T1DM) is an autoimmune disease where the immune system destroys the insulin-producing cells of the pancreas which help control blood glucose levels therefore requiring daily insulin injections (National Diabetes Education Program, 2008). Onset for T1DM is usually acute, it can occur at any age but is most common in children and young adults (National Diabetes Education Program, 2008). There is no cure for T1DM and no known ways to prevent the onset. Risk factors for T1DM include both genetic and environmental factors (National Diabetes Education Program, 2008). T1DM accounts for 5-10% of all diagnosed cases of diabetes and is the leading cause of diabetes in all children (National Diabetes Education Program, 2008). In the United States 186,300 young people less than 20 years old had diabetes in 2007 this is 0.2% of all people this age (National Diabetes Education Program, 2008). The Diabetes in Youth study states approximately 15,000 youth are diagnosed with T1DM annually (National Diabetes Education Program, 2008).

Treatment of T1DM in children and adolescents is difficult. The developmental changes that occur as school-age children with T1DM grow into adolescence necessitate frequent reevaluation of their therapeutic needs (Faulkner & Chang, 2007). The combination of severe insulin deficiency and the physical and psychosocial changes that accompany normal growth and development present unique challenges to pediatric healthcare professionals (Svoren, Volkening, Butler, Moreland, Anderson, & Laffel, 2007). The transition to adolescents for children with T1DM is commonly associated with decreased adherence to diabetes management tasks leading to worse metabolic control (Svoren, Volkening, Butler, Moreland, Anderson, & Laffel, 2007).

Additional barriers for adolescents making diabetes treatment difficult include a growing sense of self-consciousness, increased risk of cognitive and behavioral difficulties, negative attitudes, and increasing age which means increasing weight, height, growth and pubertal development. Children and adolescents may feel embarrassment at having to care for their diabetes in public and these feelings can be exaggerated in teens with an increasing sense of self-consciousness (Brunton, 2008). Children with diabetes also are at an increased risk of cognitive and behavioral issues related to fluctuations in blood glucose levels (Knight, Northam, Donath, Gardner, Harkin, Taplin, Joy, Cameron, & Ambler, 2009). In a study of mothers' perceptions of their children with diabetes between the ages of 6-18 it was noted that although older children had higher levels of self-care they also had more negative attitudes about their diabetes which can indicate that older children are going to be less receptive to education (Amillategui, Mora, Calle, & Giralt, 2008). As a child ages their bodies change and so do their insulin requirements. Children over the age of 12 have the highest insulin requirements and highest insulin peaks (Szypowska, Lipka, Blazik, Golicka, Groele, & Pankowska, 2009). A child's insulin dose

increases with their age (Szypowska, Lipka, Blazik, Golicka, Groele, & Pankowska, 2009) therefore requiring many adjustments to their medical regimen during their adolescent years.

HgbA1c levels increase in association with increasing age and duration of diabetes. The influence of age on HgbA1c levels in youth with T1DM can be attributed to the physiological insulin resistance of puberty (Springer, Dziura, Steffen, Ahern, Vincent, & Weinzimer, 2006). Achieving tight glycemic control in T1DM is a priority, especially early in the course of the disease before micro vascular complications become established (Springer, Dziura, Tamborlane, Steffen, Ahern, Vincent, & Weinzimer, 2006). In type 1 diabetes glycemic control is affected by many factors, including insulin administration, activity levels, stress, diet, and hormones (Patton, Dolan, & Powers, 2007).

Diabetes Care

A diagnosis of diabetes means major changes in one's life. Caring for diabetes is complex involving all aspects of a person's life. Areas of diabetes care include insulin, nutritional management, physical activity, blood glucose testing and learning how to avoid hypoglycemia (National Diabetes Education Program, 2008). Insulin can be administered by pen, syringe or pump. CSII is considered the best way to administer insulin to achieve strict metabolic control and minimize the risk of complications (Szypowska, Lipka, Blazik, Golicka, Groele, & Pankowska, 2009). Dietary changes can be hard to make and maintain on a daily basis. The ADA recommends matching the insulin dose with the grams of carbohydrate consumed (Rovner & Nansel, 2009). Children with diabetes should follow the same recommendations in the 2005 Dietary Guidelines for Americans and consume a diet high in fruits, vegetables, whole-grains, and low fat milk products avoiding unhealthy low nutrient foods (Rovner & Nansel, 2009). Also, it is important for children with diabetes to maintain active

lifestyles. The National Diabetes Education Program (2008) recommends 60 minutes of physical activity everyday. The child with diabetes needs to check their blood sugar before engaging in physical activity and if blood sugar levels are low must delay the activity until the low blood glucose has been treated (National Diabetes Education Program, 2008). Checking blood glucose levels several times a day helps to care for diabetes in all areas. The blood glucose levels indicate the amount of insulin given, foods that are consumed, and whether or not to exercise. Diabetics should keep a log of blood sugars and insulin given, to review with their health care provider, to develop a plan that best cares for them and their diabetes.

Significant opportunities for improving blood glucose levels in youth remain. Current recommendations mandate that youth with T1DM should be treated with intensive therapy to normalize glycemic control as early as possible (Svoren, Volkening, Butler, Moreland, Anderson, & Laffel, 2007). Optimal control of glucose levels requires a balance of dietary practices, exercise behaviors, and insulin dose adjustments for youth who are growing and developing (Faulkner & Chang, 2007).

Patients with more frequent clinic visits demonstrate improved glycemic control (Svoren, Volkening, Butler, Moreland, Anderson, & Laffel, 2007). It is unclear if increased exposure to care is a true indicator of improved glycemic control, or if increased exposure to care is better viewed as a marker of implementation of intensive diabetes management, which is a true indicator of improved glycemic outcomes (Svoren, Volkening, Butler, Moreland, Anderson, & Laffel, 2007).

Nutritional Concerns

A big part of diabetes care is nutrition. Dietary regimens for adolescents with type 1 diabetes can be complex. The American Diabetes Association (ADA) recommends not just a

low sugar and carbohydrate diet but also one with a variety of healthy foods and individualized health plans incorporating food preferences, culture, physical activity, family eating patterns and schedules (Rovner & Nansel, 2009).

Research investigating the dietary adherence of children and adolescents with T1DM has found rates of dietary adherence ranging from 21% to 56% based on self-reported adherence ratings (Patton, Dolan, & Powers, 2007). According to Rovner and Nansel (2009) 17.9% of older children with diabetes met the fruit recommendations and 15.2% met the vegetable recommendations. Calcium recommendations are met by only 54% of older children with diabetes and fiber intake is also below the recommended amount (Rovner & Nansel, 2009). Dietary restrictions are seen as problematic for diabetic children and adolescents, they relate they have to eat when they are not hungry and can't eat the foods that they want (Herrman, 2006). Overall, adolescents have fewer adherences to their diet than school age children (Patton, Dolan, & Powers, 2007).

Intensive insulin therapy allows children and adolescents to be less restrictive in their diets, which also allows them to eat unhealthy foods and refined sugars as long as they are include in their daily carbohydrate allowance (Rovner & Nansel, 2009). Many children and adolescents believe that "free" foods such as cheese and bacon which are high in fat and cholesterol are good food choices because they do not have carbohydrates (Rovner & Nansel, 2009). With intensive insulin therapy it is important to encourage healthy foods related to the increased risk of dyslipidemia and cardiovascular disease with diabetes (Rovner & Nansel, 2009).

Intensive Insulin Therapy

Intensive insulin therapy is used for many adolescents with diabetes. The most common method for delivering insulin to people with diabetes is multiple daily injections, in which combinations of short and long-acting insulins are used (Sullivan-Bolyai, Knafl, Tamborlane, & Grey, 2004). Another type of intensive therapy is insulin pump therapy. The insulin pump, or continuous subcutaneous insulin infusion (CSII), uses only rapid-acting insulin, therefore providing a closer approximation of normal plasma insulin (Sullivan-Bolyai, Knafl, Tamborlane, & Grey, 2004).

The Diabetes Control and Complications Trial (DCCT) highlighted the importance of intensive therapy in achieving near-normoglycemia and long-term health in Type 1 diabetes (Johansson, Adamson, Lins, Wreding, 2005). Continuous subcutaneous insulin infusion uses rapid acting insulin for continuous delivery from a pump via an infusion set consisting of catheter tubing and a needle or soft cannula. In addition, bolus doses of insulin, programmed by the user, are delivered at mealtimes, and the patient may use extra boluses to correct high blood glucose levels (Johansson, Adamson, Lins, & Wredling, 2005). Also included in intensive therapy is essential diabetes care, such as self-monitoring of blood glucose (Svoren, Volkening, Butler, Moreland, Anderson, & Laffel, 2007). An increase in frequency of self blood glucose checks is related to lower HbA1c levels (Svoren, Volkening, Butler, Moreland, Anderson, & Laffel, 2007). Insulin pump therapy or CSII has been shown to effectively lower HgbA1c levels therefore reducing the risk and severity of long-term complications in most children, and it also reduces the occurrences of severe nocturnal hypoglycemia and recurrent DKA (Wilson, 2008).

Insulin pump therapy has become increasingly popular for the treatment of type 1 diabetes in pediatric patients (Eugster, Francis, Lawson-Wilkins Drug & Therapeutics Committee, 2006).

In comparing multiple daily injections to CSII, CSII improves HgbA1c levels, gives greater flexibility in timing of meals and snacks, reduces the risk of severe hypoglycemia and enhances patients' ability to control their own diabetes (Johansson, Adamson, Lins, & Wredling, 2005). CSII has been found to be an effective, alternative mode of consistently administering insulin to adolescents by lowering levels of HgbA1c and reducing hypoglycemic episodes over time (Sullivan-Bolyai, Knafl, Tamborlane, & Grey, 2004).

Insulin pumps or CSII have better insulin pharmacokinetics, less variability in insulin absorption, and decreased risk of hypoglycemia. Bode, Tamborlane, and Davidson (2002) relate a 15%-20% decrease in severe hypoglycemia with CSII because of the improved pharmacokinetic delivery of insulin. Insulin absorption of modified insulin's vary from 19%-55% in the same individual which results in variable glucose levels, but with short acting insulin's that are used in CSII the absorption varies by less than 3% daily (Bode, Tamborlane, & Davidson, 2002). Insulin pumps also offer patients a greater flexibility in lifestyle (Bode, Tamborlane, & Davidson, 2002). All children with diabetes, regardless of age, should be considered to be potentially eligible candidates for insulin pump therapy.

In a study done by Bode, Tamborlane and Davidson (2002) 50 adolescents who have used CSII for a mean of 3.53 years, have observed a significant decline in the average hgbA1c level, from 9.6 before initiation of pump therapy to 8.3 after initiation of pump therapy. In the same study 25 teenagers who selected CSII had lower hgbA1c levels and a 50% reduction in the risk for severe hypoglycemia. Teenagers who use CSII report that they can cope with their diabetes much easier (Bode, Tamborlane, & Davidson, 2002).

Adolescents Who Will Benefit From CSII

Type 1 diabetes in children and young people is difficult to control and manage despite regime concordance and frequent clinic attendance (Wilson, 2008). Consequences of poor control results in frequent DKA requiring hospitalization, and periodic hypoglycemia (Wilson, 2008). A driving force in insulin pump use is a pursuit for better glucose control and easier management of diabetes (Sullivan-Bolyai, Knafl, Tamborlane, & Grey, 2004). Lack of insulin due to missing injections is one of the most common reasons for a high HgbA1c, and those missing the most insulin were at the highest risk for DKA (Hanas & Ludvigsson, 2006). Hypoglycemia is also a fear of adolescents and their families with type 1 diabetes and may pose a barrier to improved glycemic control (Phillip, Battelino, Rodriguez, Danne, & Kaufman, 2007).

The National Institute for Health and Clinical Excellence (NICE) states the recommendations about insulin pump therapy for type 1 diabetes are also valid for children and adolescents (Wilson, 2008). Pump therapy is beneficial for those who are able to achieve target HgbA1c but only at the expense of frequent hypoglycemia which has an adverse effect, and those who have made significant efforts to optimize control but have a high HgbA1c due to marked fluctuation in blood glucose and for whom a further reduction in levels will result in unacceptable hypoglycemia (Wilson, 2008).

The best candidates for CSII are patients who are practicing diabetes self-management meaning they are monitoring blood glucose levels often, recording blood glucose and insulin values in a log book, visiting a medical team on a regular basis, and counting carbohydrates (Bode, Tamborlane, & Davidson, 2002). Potential indications for CSII in teenagers with type 1 diabetes include: control has deteriorated; insulin dose omissions are common; control of

morning glucose is troublesome; severe hypoglycemic events are recurrent and the presence of eating disorders (Campbell, 2008).

Candidates for CSII should be experienced in the use of multiple daily injections (MDI), perform daily blood glucose monitoring and be psychologically stable (Johansson, Adamson Lins, & Wredling, 2005). According to the Swedish national reference group for CSII, suitable candidates are patients with poor glycemic control, labile glucose control, history of early morning pronounced hyperglycemia, history of severe hypoglycemic events and patient preference for a high flexibility of lifestyle in conjunction with strict glycemic control (Johansson, Adamson Lins, & Wredling, 2005). A German group in 2003 defined six different indications for pediatric treatment goals of CSII: dawn phenomenon, reduction of severe hypoglycemia, improvement of hyperglycemia, more flexibility, failure of injection therapy and pregnancy. The German working group also suggested CSII might be used to improve motivation of pediatric patients (Kapellen, Heidtmann, Bachmann, Ziegler, Graber, & Holl, 2007). CSII can also be beneficial in children and adolescents with T1DM who are competitive athletes or who have a needle phobia (Phillip, Battelino, Rodriguez, Danne, & Kaufman, 2007).

NICE now recommends CSII as a treatment option for children aged 12 years and older with type 1 diabetes in whom MDI insulin therapy causes disabling hypoglycemia and the target HbA1c level remains high, and CSII is recommend for those under 12 years old when the use of MDI is impractical or inappropriate (Campbell, 2008).

Advantages of CSII

The benefits of insulin pump therapy are endless. Insulin pump therapy in children has shown significant reduction in risk of severe hypoglycemia despite improvements in HgbA1c (Svoren, Volkening, Butler, Moreland, Anderson, & Laffel, 2007). With fewer variables to deal

with such as only one type of insulin and carbohydrate intake as the determining factor for how much insulin to administer, or manipulate, treating high or low blood glucose levels is easier (Sullivan-Bolyai, Knafl, Tamborlane, & Grey, 2004).

Children on CSII are reported to be in “better moods” and have increased school concentration. Children can eat when and what they want to, they can “sleep in”, participate in sleepovers and social events without the rigid schedule (Sullivan-Bolyai, Knafl, Tamborlane, & Grey, 2004). CSII is more of a convenient way of insulin administration with programmable basal rates delivered automatically and also CSII only requires an injection every 2-3 days when the subcutaneous cannula needs replacing (Campbell, 2008). Using an insulin pump can improve a child’s quality of life by increasing their lifestyle flexibility (Mednick, Cogen, & Streisand, 2004).

Insulin pumps can reduce the frequency and severity of hypoglycemia (Hanas & Ludvigsson, 2006). There is a decreased variability in insulin absorption, decreased risk of nocturnal hypoglycemia and improved control of the dawn phenomenon with the use of variable basal rates, greater freedom in timing of meals and snacks and decreased risk of activity induced hypoglycemia (Bode, Tamborlane, & Davidson, 2002). There is a reduction in DKA rates in adolescents who use CSII which is achieved through patient education on how to treat high blood glucose levels. Also, CSII stimulates the function of the islets cells more closely than MDI (Bode, Tamborlane, & Davidson, 2002).

Family Involvement

It is important to examine parental well-being in relation to a child’s diabetes management regimen as it has a direct impact on the child’s quality of life (Eugster, Francis,

Lawson-Wilkins Drug & Therapeutics Committee, 2006). The decision to implement CSII in a young patient should be between the child's physician and parents not a third-party payer.

Every effort needs to be made to ensure that parents have realistic expectations of what CSII can and cannot do (Eugster, Francis, Lawson-Wilkins Drug & Therapeutics Committee, 2006). It has been shown that the higher a father's education level of a child with diabetes the better glucose control (Faulkner & Chang, 2007). On the other hand, those with inadequate control were more likely to come from a single-parent home, a lower-income family, and an ethnic minority (Johns, Faulkner, & Quinn, 2008). Children with little to no parental supervision have less favorable treatment adherence, less diabetic knowledge, higher hospitalization rates, and poorer glycemic control (Faulkner & Chang, 2007).

Insulin pumps can be started at any age if the family has a pump-trained pediatric diabetes team for support (Wilson, 2008). Shared goals between a particular child and parent are pre-requisites to successful diabetes management (Faulkner & Chang, 2007). Teens view directive guidance and tangible assistance as helpful in promoting diabetes management responsibility, but being too forceful is seen as a possible barrier to learning diabetes management (Faulker & Chang, 2007). Adolescents who have families that provide more diabetes-specific guidance have improved HbA1c levels and are less impacted by the diabetes (Valenzuela, Patino, McCullough, Ring, Sanchez, Edison, Nemery, & Delamater, 2006).

A study by Mednick, Cogen, and Streisand (2004) have shown that both parents and children report being somewhat satisfied to very satisfied with the insulin pump therapy and that they were well prepared for the transition from their previous insulin therapy. There is a 97% long-term continuation with CSII because of the benefits of a more normal lifestyle and the simplification of meal schedules and unplanned activities (Bode, Tamborlane, Davidson, 2002).

Studies have also shown that CSII reduces parental anxiety, and that parents report high levels of satisfaction due to a greater sense of control, independence, fewer physical complaints, and increased flexibility in diet and daily schedules (Phillip, Battelino, Rodriguez, Danne, & Kaufman, 2007). Children and adolescents with diabetes want to be seen as normal and fitting in with their peers, this is an important perspective for all adults interacting with children who have diabetes (Herrman, 2006).

The transition from MDI to CSII is described as a process that involves reeducation on three levels: parent, child, and other care givers (Sullivan-Bolyai, Knafl, Tamborlane, & Grey, 2004). Parents in the process of relearning diabetes are constantly addressing misperceptions of school staff, family and friends. The child is involved in the reeducation process by just having the constant presence of the pump (Sullivan-Bolyai, Knafl, Tamborlane, & Grey, 2004). Parents of children with insulin pumps report that day-to-day diabetes management with the pump had many benefits, but also involved some work and stress, especially changing the catheter insertion site (Sullivan-Bolyai, Knafl, Tamborlane, & Grey, 2004). Parents express that one of the biggest differences between MDI and CSII is an overall improvement in quality of life for them, the child, siblings, and the family as a whole (Sullivan-Bolyai, Knafl, Tamborlane, & Grey, 2004).

Keys to Success with CSII

Ninety-seven percent of insulin pump patients preferred the pump to their previous injection regimen because of ease of use, convenience, improvement in glycemic control, and overall well-being (Bode, Tamborlane, & Davidson, 2002). The key to success with insulin pumps is frequency of blood glucose monitoring. With insulin pumps there is a need for increased blood sugar testing up to 6-9 times per day, and scrupulous attention to precise carbohydrate counting and infusion set function which increases the diabetes workload after

transition to CSII (Eugster, Francis, Lawson-Wilkins Drug & Therapeutics Committee, 2006). Patients who monitor their blood glucose 3+ times a day have a lower average hgbA1c than patients who monitor their levels 1-2x per day (Bode, Tamborlane, & Davidson, 2002).

Concerns Regarding CSII

Risks and concerns of CSII should be discussed with adolescents and their families when the choice to use an insulin pump has been made. Some concerns regarding the use of insulin pumps in adolescents include the cost of the pump. Depending on insurance plans CSII can require an upfront cost of \$5000, with monthly costs of \$100 (Eugster, Francis, Lawson-Wilkins Drug & Therapeutics Committee, 2006).

Side effects specific to the insulin pump are infusion site reactions which can include catheter site related reaction, infusion site erythema, induration, irritation, pruritus, rash, swelling, or vesicles (Weinzimer, Ternand, Howard, Chang, Becker, Laffel, & the Insulin Aspart Pediatric Pump Study Group, 2007). There is also a concern of weight gain, but this is with any type of intensive insulin therapy so should not be a deciding factor (Svoren, Volkening, Butler, Moreland, Anderson, & Laffel, 2007). There are also concerns that remain regarding adolescents and their A1C levels and the severe risks of hypoglycemia. Problems such as postprandial hyperglycemic excursions and late postprandial hypoglycemia are common with insulin pumps and are expected to be exaggerated in adolescents (Weinzimer, Steil, Swan, Dziura, Kurtz, & Tamborlane, 2008). Extra doses of insulin can be given by mistake during sleep or because of confusion during a hypoglycemic episode (Hanas & Ludvigsson, 2006).

One of the major advantages with an insulin pump is the flexibility of the basal rate but this is also one of the major disadvantages because of the increased risk of DKA related to the small insulin depot (Hanas & Ludvigsson, 2006). Most DKA episodes occur early after pump

initiation which indicates a learning curve as with all new forms of treatment (Hanas & Ludvigsson, 2006). Insulin pumps are safe and have a high technical quality but that doesn't fully exclude technical errors that can happen (Hanas & Ludvigsson, 2006). A surprising finding is that improved control achieved with an insulin pump is associated with a more rapid progression of early retinopathy than with conventional treatment (Tamborlane, 2006).

Other factors that can limit the use of insulin pumps are psychological issues about wearing an external device and uncertainty of clinicians regarding the long-term benefits of the intensive treatment (Tamborlane, 2006). Using an insulin pump requires some work for the person on CSII including becoming educated about CSII, frequent blood glucose monitoring, calculation of carbohydrate intake, and careful consideration of physical activity (Valenzuela, Patino, McCullough, Ring, Sanchez, Edison, Nemery, & Delamater, 2006).

It is also important to know when to terminate CSII which includes the child/adolescent wishing to return to injection therapy, recurrent DKA related to pump mismanagement, ineffective pump management, intentional insulin overdosing, or recurrent side effects (Phillip, Battelino, Rodriguez, Danne, & Kaufman, 2007).

CHAPTER III

METHODS

An adolescent with diabetes mellitus faces greater challenges in compliance and blood glucose control than adults who have diabetes mellitus. Multiple daily injections of insulin have been the mainstay treatment for adolescents with diabetes mellitus for many years. The use of insulin pumps and continuous subcutaneous insulin infusions has been gaining popularity among adolescents because of the increase in flexibility within their lifestyle. The purpose of this project was to review current literature to see if insulin pump therapy among adolescents increases their compliance of their medical regimen and to increase awareness of diabetic educators of insulin pump therapy and it's appropriateness among adolescent patients. At the culmination of this project, local diabetic educators will be educated about insulin pump therapy in adolescents and its effects on compliance.

Population

The target population of this project is diabetic educators, who have direct contact with adolescents with diabetes mellitus and their families. The primary population in the review was adolescents with diabetes mellitus, and also included was their families. This project was focused primarily on bringing awareness to diabetic educators regarding the appropriateness and possibility of insulin pump therapy as a treatment option for diabetes mellitus in the adolescent population. A presentation on the use of insulin pump therapy in adolescents, characteristics of those who the insulin pump would be appropriate, and advantages and concerns of insulin pumps was developed as an informational in-service for diabetic educators, along with an educational pamphlet for diabetic educators to use with their adolescent patients.

Process

An intensive review of current literature was performed using several search engines and other resources. Resources included: CINAHL full text database, MDConsult database, Scopus database, PubMed database, and Ebsco Electronic Journals Service. Key terms used for the literature review search were as follows: diabetes mellitus, insulin pump therapy, diabetes mellitus in adolescents, continuous subcutaneous insulin infusion. Years included in the review were from 2000 through 2009.

The “Diabetes Management with Insulin Pump Therapy and it’s Compliance in Adolescents” presentation was developed based on the findings of an intensive review of literature. The presentation was focused on application at the clinical level by diabetic educators with adolescent patients and their families. Objectives of the presentation include identification of the clinical problem of lack of awareness of insulin pump therapy in adolescent patients; identification of characteristics of adolescent patients who would benefit from insulin pump therapy; discuss advantages and concerns of insulin pump therapy in adolescents; and be able to identify the keys to success with insulin pump therapy. Each audience member in attendance at the presentation will be given a copy of the presentation with references (see appendices). A copy of the educational pamphlet (see appendices) designed for adolescent patients with diabetes, thinking about an insulin pump, will also be given to each person in attendance. The pamphlet can be given to an adolescent and their family to discuss whether or not an insulin pump is the right decision for them.

Expected Outcomes

The expected outcome of this project was to bring awareness to diabetic educators of the current evidence of insulin pump therapy being an effective treatment option for adolescents with diabetes mellitus. The goals were to promote awareness among diabetic educators of the benefits of insulin pump therapy and the flexibility it can bring to the adolescents lifestyle, define what characteristics an adolescent should have to be prescribed an insulin pump, and to describe the advantages and concerns of insulin pump therapy among adolescents. It was expected that the diabetic educators in attendance developed an increased awareness of the insulin pump as an appropriate treatment option for adolescents with diabetes mellitus and incorporate the information into their clinical practices.

CHAPTER IV

DISCUSSION

Introduction

Insulin pump therapy is an appropriate treatment option for adolescents with diabetes mellitus. CSII with an insulin pump can provide the adolescent with an increased flexibility of their schedule, improved blood glucose control, and less restrictions on daily activities. It was determined by the literature review that healthcare providers are often hesitant to prescribe an insulin pump to an adolescent. They need to be made aware that insulin pumps are an appropriate treatment option in managing diabetes for many adolescent patients. This need is based on the fact that adolescents have poor glucose control and the use of an insulin pump can improve glucose control.

Implications for Nursing

Nursing Practice

The nurse has a significant role in caring for people with diabetes. The 2004 NICE guidelines specify that management of type 1 diabetes should be patient centered and involve the multidisciplinary team including nutrition services, patient education, therapeutics, foot care and psychological care (Lawal, 2008). The nurse's role in caring for those with type 1 diabetes involves regular blood glucose monitoring, observing for any signs and symptoms of complications, preventing and treating complications, and to provide adequate information to help patients self-manage their diabetes (Lawal, 2008). The nurse also must be sure the patient and their family understands diabetes and the nurse needs to be prepared to provide any necessary information on diabetes, home glucose monitoring, diet, exercise, eye screening, foot care, and the need to carry a medical identification card (Lawal, 2008). Nurses and healthcare

providers have the responsibility to know the most current information and use it to create evidence based practices. The findings of this project have an affect on not only nursing but also other healthcare providers who care for adolescent patients. Adolescents and diabetes mellitus can be seen in almost every area of healthcare from pediatrics, obstetrics, and family practice to school nursing. It is the nurse's responsibility to educate patients and families at each meeting and opportunity on how best to manage their diabetes.

Nursing Education

Nurses must be well versed on the different types of treatment available for diabetes mellitus and be comfortable with the information to be able to educate their patients. Continuing education is important in diabetes care. The options of treatment for patients are constantly improving and/or changing and nurses need to be proactive in researching the different options. Evidence-based practice should guide nurses and healthcare providers in caring for their diabetic adolescent patients. Education provided to patients and families should focus on the prevention of long-term consequences of poorly controlled diabetes mellitus and on the best and most effective way to control their diabetes. Each patient needs to be educated on all treatment options, including the insulin pump, and their decision needs to be made based on what they are comfortable with and what will work best in their life.

Nursing Policy

After conducting the literature review it has become apparent that policies need to be developed in relation to insulin pump use in adolescent patients. Criteria need to be composed that guides health care providers in deciding if insulin pumps are appropriate treatment options for their adolescent patients.

There also is a need for policies or guidelines on helping the adolescent patient transition from childhood into adolescence and then from adolescence into adulthood as these are the times when diabetes control is most at risk. This should include such things as encouraging the adolescent to become the decision maker, family support to help the parents in letting go of their developing adolescent, emphasis on self-advocacy and self-determination skill building, and adult mentors for adolescents (Betz, 2004).

Nursing Research

More research needs to be conducted on children and adolescents using insulin pump therapy. Specifically research needs to be conducted on the use of regular insulin versus rapid-acting insulin with an insulin pump and the action it has in adolescents. Research also needs to be conducted on the use of real time glucose sensors that are used in combination with insulin pumps and the effectiveness they have on achieving glycemic control. Other areas of research needed include the perceived burden of the different aspects of pump therapy and also the social impacts the pump has on interactions (Valenzuela, Patino, McCullough, Ring, Sanchez, Edison, Nemery, & Delamater, 2006). Also, research needs to be conducted on CSII and if it improves a person's quality of life.

Summary

In conclusion, type 1 diabetes mellitus is difficult to control in adolescent patients. From changes of puberty to wanting to fit in with peers adolescents have multiple factors affecting their compliance of their diabetic regimen which ultimately affects their glycemic control and overall health. Continuous subcutaneous insulin infusion with an insulin pump is one way adolescents can acquire more flexibility in their schedule and lifestyle and gain more control with their blood glucose levels. As with any type of treatment, CSII also has advantages and

disadvantages that adolescents and their families need to consider before making a decision.

CSII with an insulin pump is a very effective method to treat adolescents with type 1 diabetes mellitus and fits into their lifestyle more appropriately which enhances their compliance of their diabetic regimen. This project was designed to increase awareness among diabetic educators of the appropriateness of using insulin pumps in adolescent diabetic patients. It is important that the education reaches the target audience of diabetic educators who have direct contact with adolescent diabetic patients to have the most effect.

APPENDICES

Diabetes Management with Insulin Pump Therapy and its Compliance in Adolescents

Jacqueline Reep-Jarmin
Graduate Nursing Student
University of North Dakota
2009

Objectives

- Identification of the clinical problem
- Identification of characteristics of adolescent patients who would benefit from insulin pump therapy
- Be able to discuss advantages and concerns of insulin pump therapy in adolescents
- Be able to identify the keys to success with insulin pump therapy

Clinical Problem

- Diabetes is difficult to treat in adolescents
 - Severe insulin deficiency, physical & psychosocial changes
- Transition from childhood to adolescence
 - Decreased adherence in diabetes management
- Goal HgbA1c <6% for children & <7.5% for adolescents
- Average is 0.7-0.07%
- Are insulin pumps appropriate for adolescents?

Adolescents who will benefit from CSII with an Insulin Pump

- A want for better glucose control and easier diabetes management
- Achieved target HgbA1c but frequent hypoglycemic episodes
- High HgbA1c with fluctuations in blood glucose and further reductions will result in hypoglycemia

Best Candidates for CSII

- | | |
|---------------------------------------|--|
| - Practicing diabetes self-management | - Experienced in MDI |
| - Control has deteriorated | - Psychologically stable |
| - Insulin dose omissions common | - Preference for high flexibility with strict glycemic control |
| - Morning glucose control troublesome | - Failure of injection therapy |
| - Severe hypoglycemic events | - Pregnancy |
| - Presence of eating disorder | - Competitive athletes |
| | - Needle phobias |

Advantages of Insulin Pumps

- Reduction in risk of severe hypoglycemia
- Decreased variability in insulin absorption
- Fewer variables to deal with
- Children in *better moods*
- More flexibility in diet, sleep, & activities
- More convenient
- One injection every 2-3 days!
- *Improved quality of life*

Keys to Success

- Developing shared goals between parents and adolescent
- Accepting guidance
- Realistic expectations
- Frequent blood glucose monitoring
- Precise carbohydrate counting
- Education on insulin pump use

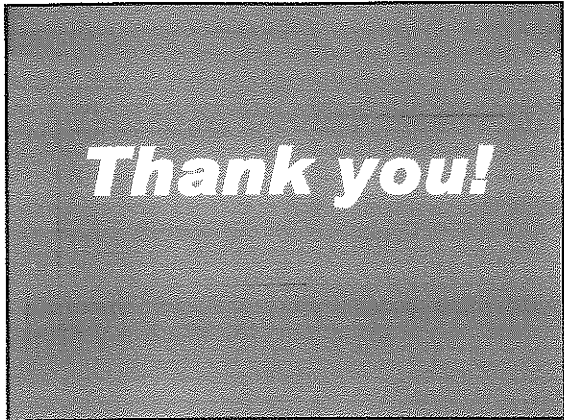
Concerns with Insulin Pumps

- Cost
- Infusion site reactions
- Weight gain
- Postprandial hyperglycemia & late postprandial hypoglycemia
- Accidental extra doses of insulin
- Increased risk of DKA
- Psychological issues with wearing the pump

QUESTIONS

- ?
- ?
- ?
- ?
- ?
- ?
- ?
- ?





An Adolescent's Guide

To
Living with

DIABETES

&

Insulin Pumps



Jacqueline Reep-Jarmin
University of North Dakota
College of Nursing
Graduate Nursing Student

Why are my blood sugars to high?

* During puberty you are going through many changes that cause your body to resist insulin this means you will have to see your doctor more often to take care of your diabetes.

How do I control my blood sugars?

* Monitor your blood sugars often, don't forget or not give yourself your insulin, maintain an active lifestyle, eat a healthy diet, and maintain a healthy stress level.

What are the concerns & risks with insulin pumps?

* There are some risks with an insulin pump that include catheter site reactions, hypoglycemic episodes, & an increased risk of DKA.

* Concerns with insulin pumps are the cost, possible weight gain, possibility of technical errors, need for education, and the psychological issues of wearing the pump

Advantages of Insulin Pumps

- Less Hypoglycemic episodes
- A1C levels improve
- One type of Insulin
- Feel better & in a better mood
- Increased concentration
- Eat what & when you want
- Can sleep-in & go to sleepovers
- Lifestyle flexibility
- Improved quality of life



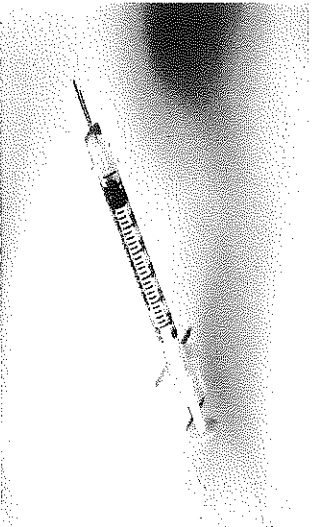
Would an Insulin Pump work for me?

If any of these things describe you talk to your doctor about an insulin pump:

- Monitor blood glucose levels often
- Record blood glucose levels and insulin in a log book
- Count carbohydrates
- Experience with multiple daily injections
- Early morning high blood sugars
- Severe hypoglycemic episodes
- Insulin doses are forgotten or just not given
- Suffer from an eating disorder
- See your doctor on a regular basis
- Unsuccessful injection therapy
- Pregnancy
- Want a flexible lifestyle & strict glycemic control!!!

Insulin Pumps

- Use only rapid-acting insulin - you will no longer have to worry about 2 kinds of insulin
- Insulin is continuously delivered through a soft cannula and a catheter tubing
- **NO DAILY INJECTIONS!!**
- Insertion site only needs to be changed every 2-3 days.
- Lowers the risk of low blood sugars.
- Programmable insulin basal rates and boluses with meals or snacks.



How do I get an Insulin Pump?

- Talk to your parents/guardians
- Talk to your Diabetic Educator
- Talk to your Doctor



Keys to Success

- Develop shared goals between you and your parents on how you will successfully manage your diabetes.
- Accept guidance and help from your family in managing your diabetes.
- Ensure you and your parents have realistic expectations of what an insulin pump can do.
- Frequently monitor your blood glucose levels, up to 6-9 times a day

Evaluation

The evaluation of the presentation to the diabetic educators will be conducted in two ways. The first way will be with the use of the pre and post quizzes given to the participants. Each participant will be given a pre-quiz to determine their knowledge of the topic before the start of the presentation and at the completion of the presentation the same quiz will be given again to determine any growth in knowledge or understanding of the topic. There also will be a separate evaluation form addressing the objectives of the presentation given to the participants at the end of the presentation.

“Diabetes Management with Insulin Pump Therapy and its Compliance in Adolescents”

Pre-Quiz

1. Diabetes management is easier to achieve in adolescent patients compared to adult patients.
 - a. True
 - b. False

2. The use of insulin pump therapy in adolescents with T1DM is not appropriate.
 - a. True
 - b. False

3. The following characteristics identify adolescent patients who would benefit from insulin pump therapy:
 - a. A want for better glucose control
 - b. Achieved target HgbA1c with frequent hypoglycemic episodes
 - c. HgbA1c levels are high and patient has fluctuations in blood glucose levels
 - d. All of the above

4. Adolescent patients who have problems controlling morning glucose levels, have experience in multiple daily injections, and have had a failure with injection therapy are good candidates for insulin pump therapy.
 - a. True
 - b. False

5. Which of the following is not an advantage of insulin pump therapy:
 - a. Reduction in risk of severe hypoglycemia
 - b. Patient can eat whatever they want
 - c. Improved quality of life
 - d. One injection every 2-3 days

6. Which of the following identifies keys to success with insulin pump therapy:
 - a. Shared goals between adolescent and parents
 - b. Realistic expectations
 - c. Precise carbohydrate counting
 - d. All of the above

7. A major concern with insulin pump therapy is the cost of the pump and monthly supplies.
 - a. True
 - b. False

“Diabetes Management with Insulin Pump Therapy and its Compliance in Adolescents”

Post-Quiz

1. Diabetes management is easier to achieve in adolescent patients compared to adult patients.
 - a. True
 - b. False
2. The use of insulin pump therapy in adolescents with T1DM is not appropriate.
 - a. True
 - b. False
3. The following characteristics identify adolescent patients who would benefit from insulin pump therapy:
 - a. A want for better glucose control
 - b. Achieved target HgbA1c with frequent hypoglycemic episodes
 - c. HgbA1c levels are high and patient has fluctuations in blood glucose levels
 - d. All of the above
4. Adolescent patients who have problems controlling morning glucose levels, have experience in multiple daily injections, and have had a failure with injection therapy are good candidates for insulin pump therapy.
 - a. True
 - b. False
5. Which of the following is not an advantage of insulin pump therapy:
 - a. Reduction in risk of severe hypoglycemia
 - b. Patient can eat whatever they want
 - c. Improved quality of life
 - d. One injection every 2-3 days
6. Which of the following identifies keys to success with insulin pump therapy:
 - a. Shared goals between adolescent and parents
 - b. Realistic expectations
 - c. Precise carbohydrate counting
 - d. All of the above
7. A major concern with insulin pump therapy is the cost of the pump and monthly supplies.
 - a. True
 - b. False

Answers to Pre & Post Quiz

1. False
2. False
3. d
4. True
5. b
6. d
7. True

“Diabetes Management with Insulin Pump Therapy and its Compliance in Adolescents”

Please circle the number that corresponds to how you feel the following objectives were met.

- 5- Strongly agree
- 4-Agree
- 3-Somewhat agree
- 2-Disagree
- 1-Completely Disagree

1. I can identification the clinical problem that exists among adolescents with T1DM.

5 4 3 2 1

2. I can identify characteristics of adolescent patients who would benefit from insulin pump therapy.

5 4 3 2 1

3. I can discuss advantages and concerns of insulin pump therapy in adolescent with T1DM.

5 4 3 2 1

4. I can identify the keys to success with insulin pump therapy in adolescents with T1DM.

5 4 3 2 1

Thank you!



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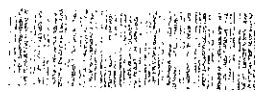
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Education Shelf

Thesis on Independent Study
Reep-Jarvis, Jacqueline L.



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