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Readiness for Insulin Pump Use in Pediatric Type I Diabetes: A Quality Improvement Project

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READINESS FOR INSULIN PUMP USE IN PEDIATRIC TYPE I DIABETES:

A QUALITY IMPROVEMENT PROJECT

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Abstract

Background. Insulin pumps are essential in the management of type 1 diabetic pediatric patients because of their versatility in meeting the developmental needs of childhood and adolescence. ***Summary of the Evidence.*** There is lack of evidence for standardized pump initiation program in pediatric patients (ADA, 2019). Moreover, adverse events from insulin pump misuse, such as diabetic ketoacidosis, arise from lack of anticipatory guidance of pump management and troubleshooting (Evert et al., 2016; Grunberger et al., 2014, Wheeler et al, 2014). ***Project Purpose.*** The purpose of this quality improvement (QI) project was to reduce and prevent adverse outcomes of insulin pumps secondary to an inefficient initiation process, management, and patient/family understanding. ***Project Objectives.*** Objectives of this QI were: the implementation of a streamlined initiation process, assessment of patient knowledge through an additional education session including a pre-and post-test patient skills questionnaire, and to decrease adverse effects related to new insulin pump use. ***Results.*** 100% staff education was achieved, 67.5% of patients/families attended the new education session achieving an average score of 80% or higher on the skills questionnaire, and adverse effects related to new insulin pump usage decreased from a rate of 66% to 50% after implementation. ***Implications for Practice.*** Use of practice guidelines to implement a structured process for insulin pump initiation is a cost-effective strategy to promote patient ownership, improve patient knowledge, lower potential costs of clinic or hospital visits for adverse effects, and guide provider oversight in effective use of technology to improve patient outcomes and decrease barriers to care.

Keywords: Insulin pumps, pediatric type 1 diabetes, CSII, insulin pump initiation

Readiness for Insulin Pump Use in Pediatric Type 1 Diabetes:

A Quality Improvement Project

Type 1 diabetes mellitus is a chronic disease most common in children and adolescents, which is marked by an autoimmune process requiring the need for a lifetime of exogenous insulin dependence. According to the Centers for Disease Control and Prevention (CDC, 2017), during 2011-2012, there were 17,900 new diagnosed cases of type 1 diabetes in the United States in individuals younger than 20 years old. This chronic disease commonly affects non-Hispanic whites. However, Mayer-Davis et al. (2017) stated that between 2009-2012, Hispanic children and adolescents had an annual 4.2% higher incidence rate of type 1 diabetes than non-Hispanic whites. Currently, data about the incidence and prevalence of pediatric type 1 diabetic cases in the state of Texas, nor Bexar County are available. However, these national statistics exhibit implications for need of improved management of pediatric type 1 diabetes within its populations.

The landmark Diabetes Control and Complications Trial highlighted the importance of intensive insulin treatment to prevent the progression of both macrovascular and microvascular comorbidities (Diabetes Control and Complications Trial Research Group, 1993). As a result of this clinical trial, the American Diabetes Association's (ADA, 2018) clinical guidelines recommend tight metabolic control through strict insulin administration partnered with adherence to daily blood glucose monitoring, a carbohydrate-controlled diet, and active lifestyle to guide optimal health outcomes. It is imperative for pediatric type 1 diabetic patients to maintain therapeutic management since childhood is a crucial period for brain development and continuous maturation of brain functions (ADA, 2018). Therefore, this population has an increased risk for neurocognitive complications from diabetic ketoacidosis (DKA), such as

cerebral edema, hypoglycemia, seizures, and altered mental status (Cameron et al., 2014). Moreover, diabetic children just like diabetic adults are at risk of macrovascular comorbidities such as hypertension and atherosclerotic disease, as well as, microvascular complications, such as peripheral neuropathy and retinopathy (ADA, 2018).

Although insulin pumps have existed for over 30 years, due to advancements in emerging health technologies in the past two decades, continuous subcutaneous insulin pumps (CSII) have become essential in type 1 diabetic care for pediatric patients because of their versatility in meeting the unique needs of children and adolescents. A significant barrier to achieving metabolic control within this population is disease burden due to changes in growth and development that influence insulin sensitivity, changes in parent and child roles, and need for external psychosocial support (ADA, 2018). Therefore, providers must meet the challenge of creating individualized treatment regimens that meet standards of care to achieve glycemic control, prevent complications of the disease, and are conducive to a healthy childhood (Woerner, 2014).

Ehrmann et al. (2018) stated that in contrast to multiple daily injections (MDI), CSII therapy can replicate the body's physiologic function of insulin secretion through advanced insulin infusion settings allowing for basal and bolus rates and advanced technology that provide real-time data of the body's insulin needs. CSII therapy is a tool that individualizes care for children and adolescents due to their increased energy and metabolic needs and allows for normality of care in the management of type 1 diabetes. Insulin pump therapy also lessens the burden of multiple daily needle sticks, a significant stressor of diabetes management in pediatric populations. CSII pump therapy requires a one-time injection every 2 to 3 days compared to multiple daily injections for insulin administration (Sherr et al., 2018; Woerner, 2014). However,

the success of adhering to insulin pump therapy in children and adolescents is dependent on the patient and family readiness to transition from MDI to CSII. Preparation for insulin pump use is determined through education, health literacy, access to care, and continuation of a therapeutic relationship with the healthcare team.

Statement of the Problem

The selected DNP project site was an urban pediatric endocrinology clinic located in south Texas. The problem was the lack of a standardized protocol for the providers' initial readiness assessment and for the continuous evaluation of barriers to successful insulin pump adherence with children and adolescents. It is essential for providers to assess the pediatric patient's motivation to adhere to the use of this technology and anticipate needs, such as health literacy, cost/medical insurance, and social support that can create obstacles in the transition process from multiple daily insulin injections to use of a wearable continuous insulin infusion pump (Grunberger et al., 2014). Furthermore, providers must be capable of managing these devices to provide satisfactory patient education that will improve patient outcomes related to their diabetes, such as decreasing the hemoglobin A1C level, preventing hypoglycemic events, and decreasing symptoms of hyperglycemia. Also, clinical providers must reinforce the training by being part of a diabetic care team which provides holistic clinical support during the transition to CSII pump therapy (Grunberger et al., 2014; Shulman et al., 2016).

Background and Significance

The cornerstone of diabetic care and management is aimed at preventing the progression of disease morbidity and comorbidity. Complications of mismanaged type 1 diabetes in children can have debilitating pathophysiological complications that affect the neurologic, cardiovascular, and urinary systems. The body's central nervous system uses glucose to carry out essential

cognitive and sensorimotor functions which can be easily disrupted by frequent abrupt imbalances of normoglycemia. Hypoglycemia can impede cognition, causing altered mental status, hypoglycemia unawareness, and fatal seizures (Bratina et al., 2018; Cameron et al., 2014). On the other hand, hyperglycemia can also cause altered cognition, diminish body energy, and result in a medical emergency such as DKA (Bratina et al., 2018; Cameron et al., 2014). These glycemic extremes can also stress peripheral nerves causing progressive sensorimotor loss exhibited by retinopathy and peripheral neuropathy (Donaghue et al., 2018). In the cardiovascular system, macrovascular complications are related to the early development of hypertension and hyperlipidemia increasing the risk for cardiovascular disease especially for adolescents with type 1 diabetes (Donaghue et al., 2018). Moreover, the lack of glycemic control also affects the urinary system through alterations of renal function and morphology that can result in progressive loss of kidney function (Donaghue et al., 2018).

With advanced diabetic technology, routine diabetic care is not enough to prevent complications of type 1 diabetes, and additional competence, knowledge, and responsibility are required**.** Currently, consensus among clinical guidelines for the use of diabetic technology recommend criteria for insulin pump use in pediatric patients to include the ability to self-monitor blood glucose at least four or more times a day, lack hypoglycemic control despite adherence to MDI therapy, fluctuating glucose levels from day to day, and recurrent episodes of hypoglycemia (ADA, 2019; Grunberger et al., 2014; Sherr et al., 2018). However, without adequate education, resources, and efficient communication between patients/ families and the multidisciplinary healthcare team during the initiation of CSII therapy, informed clinical decisions cannot be made even if guideline criteria are met. Providers must increase their awareness of modifiable and nonmodifiable barriers to insulin pump initiation. Modifiable

barriers are health literacy, problem-solving in the event of a pump malfunction/accidental discontinuation, and overall family and social support of using an insulin pump.

Pulgaron et al. (2014) identified that the patient and family's level of health literacy, especially numeracy skills, is a significant predictor of successful pediatric diabetes management and glycemic control. Pulgaron suggested the use of the Diabetes Numeracy Test, a valid screening tool that tests numeracy skills used in standard diabetic education such as insulin-to-carbohydrate ratio and interpretation of blood glucose levels to insulin coverage, as part of routine diabetes care. Evaluating the degree of competence in these necessary skills prior to insulin pump initiation is crucial because the patient and his or her parents will be required to learn new terminology that involves knowing how to adjust insulin pump settings for basal and bolus rates which are also dependent on blood sugar monitoring and an insulin-to-carbohydrate ratio (Hirose et al., 2012). The benefits of advanced pump settings are that they help decrease the risk of hypoglycemic events since they tailor insulin administration to meet a child's day-to-day activities/ energy needs and insulin sensitivity trends (Sherr et al., 2018).

Patient and parental knowledge of advanced insulin pump settings and understanding of pump alarms influence their ability to troubleshoot their pump in case of a pump malfunction. Results of a prospective study by Wheeler et al., (2014) exhibited increased adverse effects, such as diabetic ketoacidosis or blocked insulin delivery, in children younger than 10 years old. Therefore, providers must educate parents about realistic, anticipatory challenges in acknowledging pump malfunction due to their child's age and development. Problems that present in early childhood are the growth of autonomy, increased susceptibility to illness, the variability of diet and physical activity, and lack of ability to verbalize or identify signs and symptoms of both hypoglycemia and hyperglycemia (Markowitz et al., 2015). In contrast,

though adolescents may have the understanding and developmental skills to manage the technology of insulin pumps, too much autonomy in their diabetes care can also increase the risk of adverse effects through a lack of adherence to diabetes care management (Markowitz et al., 2015). In anticipation of these challenges, the American Academy of Clinical Endocrinologists/ American College of Endocrinology (AACE/ACE) guidelines recommend that healthcare providers distribute a diabetes action plan prior to pump initiation to patient and families to help guide them in how to assess their pump, reinstate a new pump, or if needed, return to insulin injection therapy for a short time frame (Grunberger et al., 2014).

Lastly, due to the increased skills needed to adhere to insulin pumps, overall sociodemographic support outside the clinical setting can also present nonmodifiable barriers to proper insulin pump initiation. Since children spend most of their day-to-day lives in school or extracurricular activities, the provider and diabetes healthcare team need to assure communication between a school nurse or teacher and partner with community resources, like a support group, in order to enhance the child and the family's transition to a pump and promote continuity of regimen (Corathers et al., 2015). Moreover, the most significant barrier to obtaining an insulin pump is medical insurance coverage, especially for minority pediatric patients, African Americans, and Hispanics, and those with public health insurance or no health insurance (O'Connor et al., 2018). In Texas, Sheikh et al., (2018) assert that despite increased coverage of insulin pumps from Medicaid and CHIP, disparities in the use of insulin pumps in minority groups and those with lower English proficiency persist. Additionally, evidence in the literature suggests in the United States, higher HbA1c and lack of glycemic control are seen in minority children with type I diabetes as well as those who have public insurance (Sheikh et al., 2018; Watson et al., 2017). Awareness of these disparities can also prompt a provider to acknowledge

any personal biases in their recommendations for insulin pumps and to offer comprehensive learning materials that are culturally sensitive, easy to read, or are available in different languages so that equity of insulin pump benefits is provided (O'Connor et al., 2018; Sheikh et al., 2018; Shulman et al., 2016).

Organizational Assessment

A key component to improving clinical practice is through an assessment of the day-to-day functions and interactions between the clinical setting, the healthcare team, and its patients. The selected site for this quality improvement project was a pediatric endocrinology outpatient practice in south Texas. The clinic was located inside a comprehensive diabetes center from a recognized healthcare system that is also an academic learning facility. The clinic not only seeks to offer quality care to children with endocrinologic conditions in the urban area, but also those from surrounding south Texas communities extending to the Rio Grande Valley. The top three diagnoses treated in the clinic are both type 1 and type 2 diabetes mellitus, thyroid conditions, and disorders of growth & development. Each provider sees between 16 to 18 patients a day, with six to eight of them being diabetic patients.

The multidisciplinary diabetic care team consisted of five physicians, one family nurse practitioner (FNP), three certified diabetes educators (two who are certified dieticians, and one who is a registered nurse), and a licensed clinical social worker. Clinic hours ran Monday through Friday from 7:30 a.m. to 4:30 p.m. The providers had set clinic days and a rotating on-call schedule during the week and weekends for patients' admissions at two different hospitals in the city. A minimum of two providers saw patients within a given day. Since it was a learning facility, medical students, residents, and fellows also saw patients under the supervision of the designated provider. The NP worked part-time and was in the clinic three times a week. At least

one diabetes educator (CDE) was present every day, and they also had an on-call schedule to see hospitalized patients due to a new diagnosis of diabetes. The licensed social worker was also present in the clinic Monday through Friday but shared some responsibility in care coordination for an additional pediatric subspecialty clinic. The supportive staff that were also present during clinic hours were two front desk staff, three medical assistants, three LVNs, a nurse educator, and the clinic supervisor who was a RN.

Since this clinic was part of a non-profit health system, most of the patient population had Medicaid (Superior Star)/CHIP or were uninsured. However, as this was a pediatric subspecialty clinic that served more than just the one urban community, the clinic also had a significant population of patients with private health insurance. This clinic had a comprehensive, interprofessional approach to care, which allowed them to have adequate resources to help pediatric diabetic patients and their families afford high-quality care even with insurance barriers.

The sociodemographic characteristics of the clinic's type 1 diabetic patients were predominately 82.1 % white and 19.4% of the total population spoke Spanish (see Table 1). Three of the providers, the NP, and one CDE, spoke fluent Spanish, and one MA was also a certified Spanish interpreter. Patients' ages range from a couple of months old to 17 years of age. The healthcare team follows ADA 2019 standards of care through focusing on health indicators such as glycemic control by checking HbA1c in clinic every 3 months, offering continuing diabetic education with a CDE at each visit, routinely communicating with patients and families through phone calls, and providing resources of support for diabetes management such as access to affordable medications and diabetic devices.

Table 1

Demographic Characteristics of Clinic's Type 1 Diabetic Population

Demographic	No. (%) of Patients (n = 134)
Gender	
Male	86 (64.2%)
Female	48 (35.8%)
Race/Ethnicity	
White	110 (82.1%)
Black, non- Hispanic	14 (10.4%)
Asian	6 (4.5%)
Other	4 (2.9%)
Language	
English	108 (80.6%)
Spanish	26 (19.4%)

Note. Data derived from clinic's 2019 records.

In 2019, there were estimated 134 type 1 diabetic pediatric patients seen at the clinic, and between 20-40 patients had started managing their disease with an insulin pump. While provider preference determined to whom he or she recommended insulin pump therapy, there was no standard protocol that they followed to initiate the insulin pump process or evaluate the patient and family's readiness for change. In meeting with three of the MDs and the FNP, a consensus among their decision to start a patient on an insulin pump was determined by the patient's ability to consistently check blood sugars more than twice a day, have been diagnosed for more than a year, be compliant with an adjunct care regimen such as carb counting, and have parental/guardian support.

When a provider offered insulin pump therapy to a patient, the benefits of insulin pumps to daily insulin injections were discussed. Due to clinic visit time constraints, the provider then alerted the CDE to provide patient information brochures to the patient and family and they also

briefly discussed the different types of insulin pumps. The patient and family were given time to ask questions. Then, the CDE and provider encouraged the patient and family to look over the information provided, to do some online research of their own, and to consult their insurance to inquire what type of coverage they could obtain with the desired insulin pump. One barrier identified in this step was that the patient and family were not always told to call the clinic back when they had made a decision on a pump or that additional information was needed to order an insulin pump, such as blood sugar logs 3 months prior and demographical information. The CDEs verbalized that significant delays in the waiting period from when a pump is decided to the time of the patient and family receiving the pump occurred because parents didn't understand the process of ordering a pump, or the importance of following through with their health insurance about cost and coverage. Additionally, the LVNs and MAs verbalized breakdowns in current communication between providers and CDEs regarding when to initiate the order for an insulin pump, and lack of available patient data such as blood sugar logs that they needed to follow up on, which also delayed the delivery of an insulin pump. On average, the waiting period for the approval and delivery of an insulin pump from insurance companies, both public and private, ranged from 1 to 4 months.

Once an insulin pump was delivered to the patient's home, the family was expected to notify both the insulin pump company representative and their clinic provider. The insulin pump representative provided an insulin pump start class that covers the mechanical aspects and settings about how to use the pump, and it was also the first time when the pump was placed on the child. For this class to occur, the provider needed to be notified to write for insulin delivery orders with the pump. This pump start class also took place in the clinic in an education room; however, it was not considered an in-clinic visit. Rather it was a courtesy, free-of charge

education session provided by the representative for the insulin pump company. After this session, the pump representative walked the patient family to the front desk for them to schedule a follow up appointment within 1 week with the CDE to obtain more insulin pump education. The provider may or may not see them on that visit, but providers stated that usually the patient was seen within 3 months. The providers verbalized their awareness of issues with patient's lack of knowledge on how to use the device during the first months after insulin pump initiation, which resulted in the self-discontinuation of the device or incorrect use of the pump. The CDEs also verbalized issues with parents not understanding the importance of following up for pump initiation class after receiving their pump.

Organization's Readiness for Change

To assess the clinic's readiness for a change process to take place, key stakeholders of the diabetic care team were interviewed to gain perspective on what are the needs for improving the insulin pump initiation process. Using the Practice Improvement Capacity Rating Scale, a physician leader, the nurse practitioner, a CDE, and an LVN were interviewed to assess the practice's readiness for quality improvement to take place (Aligning Forces for Quality, 2014). By using a scoring system, this tool also evaluates how current resources in practice can facilitate change. Results from the interviews exhibited an average score of 200, which identifies the practice that has a limited capacity initiation of a QI process (Aligning Forces for Quality, 2014).

The barriers identified during the interviews, are related to the lack of a QI officer or QI team in place at this clinic that incorporates both providers and clinical staff. Past QI projects were carried out by the provider team with little to no input of the clinic staff or have been QI projects carried out by the larger health system with little provider input. There was also lack of

communication between clinic staff and provider staff about change processes and initiatives due to the lack of regular all clinical staff meetings.

A facilitator identified in these interviews was that both the clinical staff and the providers recognized a need for a change process regarding a streamlined initiation process for insulin pumps. The staff also recognized the need to have better team cohesiveness in quality improvement initiatives so that everyone who is involved in patient care or interaction has a voice. Overall, the staff showed support for improved communication strategies and were motivated to take part in quality improvement initiatives.

Additionally, ten patients and their parents who had recently been recommended to start an insulin pump therapy or had recently initiated a pump were interviewed to explore their needs. The feedback provided by the patients and families revealed unawareness of insurance coverage/cost and confusion about what to do when the pump arrives. Therefore, the cumulative stakeholder interviews supported the need for an improved process of insulin pump therapy.

Project Identification

The purpose of this DNP quality improvement project was to reduce and prevent adverse outcomes of insulin pumps secondary to an inefficient initiation process, management, and patient/family understanding by implementing a streamlined process, increasing assessment of patient management strategies, and improving patient education.

Project Outcomes

There were four project outcomes for this project. The first outcome was to streamline the insulin pump initiation process and educate staff about the new process. The second outcome was to increase patient and family knowledge about insulin pumps before starting CSII therapy by incorporating an additional CDE visit before the insulin pump initiation. The third outcome

was to increase the number of patients that receive appropriate standard of care insulin pump management education. Lastly, the fourth outcome was to reduce the number of adverse events related to pump mismanagement leading to decreased control of diabetes.

Anticipated Outcome Measures

1. By February 12th of 2020, 100% of staff and providers will receive education about the new insulin pump approval process.

2. By August 1st of 2020, 75% of patients that have requested insulin pump therapy will attend both CDE educations visits and receive appropriate pump management education.

3. Patient-level of knowledge will show improvement from pre-pump start education to post-pump start secondary education, evidenced by achieving a score of 80% or higher on both the diabetes care assessment test and pump terminology test. Also, patients will have 90% of the education checklist completed by post-insulin pump start visit.

4. By July 2020, there will be a 30% decrease of insulin pump-related adverse events such as calls about pump malfunction or issues, and unexpected hospitalizations from the current rate of 66% related to an insulin pump issue.

Summary and Strength of the Evidence

Guideline Recommendations

Evidence-based guidelines from the ADA, AACE/ACE, and ISPAD provided high-quality evidence of the safety and efficacy of insulin pumps for child and adolescent type 1 diabetic patients (ADA, 2018; Grunberger et al., 2014; Sherr et al., 2018). The ADA (2018) recommends that providers who initiate CSII therapy on pediatric patients must perform an initial comprehensive patient readiness assessment which includes:

- Assessment of individual patient and family knowledge and health literacy regarding CSII and diabetes management.
- Selection of pump type (loop pump, closed loop, or CGM sensor augmented) and prescribing initial pump settings.
- Insurance coverage of insulin pump and supplies.
- Family education about potential pump complications and pump failure action plan to be prepared in an emergency, an episode of DKA, or a pump malfunction
- Introduction and education of pump settings and terminology.

The ISPAD guidelines assert that an assessment of these focus areas aids providers in exploring potential barriers to successful CSII therapy (Sherr et al., 2018). Nevertheless, the three guidelines do not mention the use of valid screening tools or decision aids that can be used to assess these potential barriers. Rather, the guidelines recognized the need for further research and implementation of successful tools, frameworks, or clinical processes of cost-effective insulin pump-focused diabetes education (ADA, 2018; Grunberger et al., 2014; Sherr et al., 2018).

Benefits of CSII

There is limited evidence from systematic reviews and RCTs showcasing the success of CSII in pediatric type 1 diabetes management over multiple daily injections for significant improvement in HbA1c control over long-term periods. However, there is successful evidence of the benefits of CSII over MDI therapy in children and adolescents (Ly et al., 2013; Rosner & Roman-Urrestarazu, 2019; Yeh et al., 2012). Yeh et al. (2012) is a systematic review and metanalysis that found CSII therapy to reduce hypoglycemic rates in children due to the usage of certain pumps which incorporate a continuous glucose monitor device to correctly administer

insulin based on real-time blood sugars or are sensor augmented to stop infusing when the blood sugars are low preventing the administration of too much insulin. Ly et al. (2013) supported this finding in an RCT that compared a sensor augmented insulin suspension pump group to a regular pump group. Results of the study found a lower incidence of moderate to severe hypoglycemic events, from 175 to 35, in the sensor augmented pump group compared to the regular pump group, 28 to 16 (Ly et al., 2013). Hypoglycemia unawareness is a common symptom of pediatric type 1 diabetic patients under the age of 12. Therefore, advance insulin pumps settings and features are beneficial in preventing adverse effects.

Versality of care that CSII therapy provides has also been studied in a recent systematic review focused on the association between health-related quality of life and pediatric type 1 diabetes management (Rosner & Roman-Urrestarazu, 2019). Out of the fifteen studies reviewed, the researchers found improved pediatric quality of life scores and increased patient satisfaction with the use of CSII therapy than MDI therapy from baseline to post intervention follow up. Yeh et al., (2012) also stated increased patient satisfaction with diabetes management due to lack of multiple daily needle sticks and flexibility of adjusting insulin basal and bolus rates with activities that such as exercise or meal and snack times.

Many of the limitations seen in these studies are related to small sample sizes of child participants. Recommendations offered by these systematic reviews and the RCT is the need for better studies, like RCTs, that account for larger sample sizes, increased diversity in selected participants, and studies with extended implementation periods to fully understand benefits and complications of CSII use in children and adolescents and their long-term effects of morbidity and mortality (Ly et al., 2013; Rosner & Roman-Urrestarazu, 2019; Yeh et al., 2012).

Provider Role in Management

Provider role in management of CSII therapy is crucial since providers can influence how well a pediatric patient and his or her family adapt to new diabetes technology and how well a patient adheres to its proper use. Markowitz et al., (2015) highlighted the importance of the provider's acknowledgment and understanding of the dynamic roles in diabetes management between children and parents since growth and development of an individual child can influence behaviors in care. An evidence-based strategy that providers can use with school age and adolescent patients who are initiated on a pump therapy is motivational interviewing, a communication style which reinforces a child's personal motivational behaviors and tailors them to specific care goals such as lowering A1c, better eating habits, increasing self-sugar checks (Markowitz et al., 2015). Including the pediatric patient in the decision-making process of selecting a pump they will feel comfortable in wearing and allowing them to be an active participant in age-appropriate, shared responsibilities of diabetes care is another way that providers can support successful insulin pump adherence (Grunberger et al., 2014; Markowitz et al., 2015).

Another vital part of the provider role is the frequency and continuity of patient follow up after insulin pump initiation to reassess how insulin pump therapy is benefiting an individual patient. By ADA and ISPAD standard of care, children with insulin pumps need to be seen in clinic every 3 months for routine care (ADA, 2018; Sherr et al., 2018). Moreover, Johnson et al. (2013) found that additional patient education hours at pump initiation by a diabetic care team and provider follow-ups phone calls in between routine clinic visits during the first months of using a pump resulted in a decreased rate of diabetic ketoacidosis in the insulin pump group that received education compared to standard diabetic care with MDI.

Culture, Health disparities and Access

Cross-sectional studies found in the literature provided high-quality evidence of research about potential strategies to overcome barriers to successful adherence to CSII in pediatric type 1 patients. Shulman et al., (2016) highlighted the importance of provider self-awareness of any personal biases for whom they recommend insulin pumps to ensure health equity, as decreased rates of insulin pump use are seen in minority children and families with public health insurance, and low socioeconomic backgrounds. For that reason, providers must also be aware of current insurance coverage for this type durable medical equipment since access to insulin pumps is also influenced by cost. Despite increased Medicaid and private insurance funding for insulin pumps in recent years, the cost of insulin pumps and supplies can range from $3,000 to $8,000 a year (Sherr et al., 2018). Since CSII is notably more expensive than MDI therapy, a structured education process for insulin pump initiation could be a cost-effective strategy to not only secure the therapy benefits but also lower potential costs of frequent clinic visits or hospital admissions due to therapy non-adherence.

Moreover, Sheikh et al. (2018) also stated that there are evident disparities in the equity of insulin pump use in Spanish-speaking patients due to limited English proficiency and possible low socioeconomic backgrounds. Implications for practice from this study recommend that providers and clinics have comprehensive education materials in both Spanish and English or provide readily available translation services to improve access to diabetic care technology (Sheikh et al., 2018).

For low English-proficient individuals, health literacy is another contributor to the lack of proper insulin pump use and access. Pulgaron et al. (2014) studied the relationship between the health literacy independent variables of parental numeracy skills, parental reading skills, and

parental perceived diabetes self-efficacy on type 1 diabetes glycemic control in a cross-sectional study. The results of the study found an inverse correlation between higher parental numeracy skills and lower HbA1c scores ($r = -.52$, $p < .01$) as well as higher parental self-efficacy and lower HbA1c scores ($r = -.47$, $p < .01$) (Pulgaron et al., 2014). This study added to the importance of providing the right education tools that reinforce of health literacy skills for parents of type 1 diabetic children and the need for recurrent evaluation of these skills with diabetic technology since its success relies heavily on parents having these skills to properly use the device for their child's disease management. By improving the delivery of care and combating these barriers, providers can positively influence minority patients and low English proficiency individuals to increase compliance with disease management and decrease unplanned adverse events such as medication errors or emergency room visits.

Complications from Misuse of Pumps

Both human and technological factors can impact how well a patient succeeds in safely using insulin pumps. Rosner and Roman-Urrestaruzau (2019), found that there was a higher incidence of DKA in CSII therapy than MDI therapy and could be a result of human factors such as pump malfunction, lack of knowledge of correct pump settings, and relaxed attitude to self-management. Relaxed management is a significant factor in the case of a pediatric patient. A child or adolescent may discontinue their pump without their parent's knowledge due to factors such as device discomfort or self-consciousness of body image in front of peers (Grunberger et al., 2014). Blood sugar levels can rise quickly, 1mg/dL for every minute of being off the insulin pump for more than 1 hour (Deiss et al., 2016). Additionally, when school age children and adolescents are given too much independence in their diabetic care, such as being the ones responsible for inputting their blood sugar data or carbohydrate counts into their pump, they can

incorrectly put in data in an effort to not get in trouble for eating a snack that increased their blood sugar, which will then prompt the pump to administer incorrect doses of insulin. These actions can lead to detrimental effects of incorrect pump usage. Moreover, Deiss et al. (2016) noted the importance of patient and parents in recognizing causes pump failure events. For example, an interruption of insulin flow should be suspected with any insulin pump-dependent patient that experiences unexplained glycemic variability, unexplained hyperglycemia, or frequent hypoglycemic/hyperglycemic episodes (Deiss et al. 2016). With the help of downloadable pump data, providers can also help recognize and evaluate these events prompting education reinforcement for safe use of the devices.

Process of Initiation

There is lack of evidence evaluating a standard pump initiation program for pediatric type 1 diabetic patients (ADA, 2018). However, a recent RCT by Ehrmann et al. (2018) showed promise of the efficacy of a structured program called Insulin Pump Treatment (INPUT) for type 1 diabetic adolescent and adult insulin pump users. In this study the intervention arm attended the INPUT program which provided 12, biweekly, 90-minute group education sessions provided by a diabetes educator and the control group received no intervention. Participants of the study were between the ages of sixteen and seventy-five years of the sample population of n =266, n = 125 participants were in the intervention group. Significant results of this RCT showed that INPUT group had an improved HbA1c scores (20.28% [23.1 mmol/mol]; P , 0.0001), had a lower incidence of severe hypoglycemic events requiring help from another person, increase self- reported use of pump advance settings, as well as decreased diabetes distress and depression symptoms compared to the control group (Ehrmann et al., 2018). The success of this RCT

highlights the need for studies that reflect the efficacy of structured insulin pump initiation and management education in pediatric patients.

Methods

Project Intervention

The focus of the project implementation was to deliver a more effective transition to insulin pump therapy process for patients and families. The details of this action plan are provided in Appendix A. Before the implementation of the new streamlined process for insulin pump initiation, the clinic staff and providers completed an education session given by the DNP student. This education session was given in person during the February monthly staff meeting and on an individual basis for those who were not able to attend. The DNP student provided a handout to the staff outlining the new streamlined process. This handout was also emailed to all clinic staff, and a printed copy was stored within the clinic protocol folder to be available for staff reference.

Identification of Readiness for Insulin Pump Use

The new process began with the initial routine clinic visit when the provider decided if a patient meets the guideline criteria for the initiation of an insulin pump. The provider introduced the patient to insulin pumps and discussed how they differentiated from insulin injections and their benefits to improve diabetes lifestyle and management. The CDEs distributed patient education brochures, already available in the clinic, about the different types of insulin pumps. Prior to implementation, this was all that occurred in the initial visit. However, in the organizational assessment, the clinic staff recognized the lack of consistent information given to patient families about the steps required before an insulin pump is ordered and delivered to the patient. For this reason, a patient education handout that outlined the steps for preparing for

insulin pump therapy, “Pathway to Insulin Pump Therapy”, was distributed to the patient and family. This patient education handout (Appendix B) was made by the DNP student and written at a 6th grade reading level in both English and Spanish. It was given at the end of the clinic visit with the patient’s discharge paperwork. Both the providers and CDEs were responsible for documenting, respectively, what was discussed, and the educational materials given to the patient during this initial visit. The provider SOAP note also stated that part of the care plan is for the patient to attend a pre-insulin pump education visit with the CDE. To encourage continuity of care, during discharge, the front desk staff was responsible for making an appointment for the pre-insulin pump education with CDE, which took place 3 to 4 weeks after the initial visit.

Orders for Implementation

The second implementation step was a follow-up phone call by the LVNs to the patient within 1 to 2 weeks of the original clinic visit when an insulin pump was discussed to inquire if the family had decided on which insulin pump they wanted to use. The LVNs oversaw the submission of diabetic device order forms to insurance companies; therefore, they also were responsible for documenting this communication in the patient’s electronic chart and messaging/communicating to the patient’s provider and CDEs about the family’s decision. With the old process prior to implementation, there was no consistent follow through with the patient’s family leading to miscommunication between the LVNs, the CDEs, and providers about the patient’s decision and the personal information needed. This resulted in increased wait times for insulin pump ordering. A facilitator for this step was that the clinic’s staff and providers use a secure messaging system and the institution’s email to communicate about patient matters and these messaging applications were used on a daily basis in the clinic by all staff. The LVN then

notified the CDE through secure messaging about the patient's insulin pump choice. Once the CDE was notified, they were responsible for contacting the insulin company representatives to alert them that they had a new patient with their device which helped speed up both the insurance approval process and waiting period for insulin pump delivery to the patient.

Patient Education for Pump Utilization

In the past, the patient was not seen back in the clinic until the insulin pump was delivered. At that time, an insulin pump start class was provided by the respective insulin pump company representative in the clinic, but the patient was not be seen by a provider, nor one of the CDEs. This was an area with a need for improvement because of the lapse in time since the patient had been seen in the clinic and lack of re-evaluation for overall readiness for insulin pump management. Therefore, an additional CDE education visit took place during the waiting period of insulin pump approval/delivery, at least 1 month before the insulin pump start class with the company representative.

The CDE visit focused on an introduction to the insulin pump ordered, assessment of patient/family diabetic management skills, and pump malfunction emergency action plan. The patient education visit took place in the clinic's education room or available patient exam room and would last about 1 hour. The DNP student made a checklist of the diabetic education to be completed at this education session and finished at the follow up CDE visit post insulin pump start (Appendix C). The CDEs used demonstration insulin pumps to allow the patient and their family a first hands-on experience with their respective pump. The CDE screened the patient and family for insulin pump readiness with two short tests created by the DNP student. The first assessment, the Diabetes Pump Care assessment, was an eight-item test assessing the patient's diabetic management skills and pump care knowledge (Appendix D). The second test, the Insulin

Pump Terminology test, assessed the patient's and family's level of knowledge about specific terminology related to insulin pump settings (Appendix E). The CDE also created a patient/family-centered pump malfunction emergency action plan with the help of the patient and family. This plan described what to do with a possible pump malfunction or unexpected pump disconnection. Once the plan was completed, the patient/caregiver was given a copy for their home and another for the school nurse. The CDE also contacted the respective school nurse to notify them about new insulin pump therapy.

The CDE would discuss with the family the importance of notifying both the clinic and the insulin pump company representative when their pump is delivered to their home so that the insulin pump-start class can take place. Once the education session is over, the CDE was responsible for documenting what was discussed in the EHR, collect the tests and checklist, and store them in the assigned project folder. At that time, the CDE was also responsible for communicating to the provider that the patient attended the education visit so that the provider could write a prescription for insulin delivery orders with the pump. This allowed the patient to initiate pump therapy when they came in for their pump start-up class with the company representative. If a patient did not show for the pre-pump start education session, the front desk staff was responsible to contact them via telephone to reschedule the session.

Pump Initiation

Once the insulin pump was delivered to the patient, the patient and family attended the insulin pump-start class with the pump company representative in the clinic. Before leaving the clinic, the patient made an appointment for a follow-up education session with the CDE within a week of pump initiation. During this 1 week follow up, the CDE re-tested the patient and family about the Diabetes Pump Care assessment and the Pump Terminology test. At this time, if the

patient was not able to attend the first education session, completion of the educational checklist took place. In addition, the CDE was responsible for asking the patients if they had enough prescription medication refills with their fast-acting insulin used for the insulin pump as well as their basal insulin, which were needed in case of a pump malfunction. The CDE answered questions about issues with the management of their insulin pump for the first week and inquired about what the patient and family experienced. At the end of this educational visit, the CDE prompted the front desk staff to help schedule a routine follow-up appointment with their Pediatric endocrinologist within 2 to 3 months. The CDE then messaged the providers about who was seen to prompt the provider to follow up with the patient and family by phone 1 week after.

Setting/Population

The quality improvement project was conducted at an outpatient pediatric endocrinology clinic. In 2019, there were around 20 to 40 pediatric patients between the ages of 1 to 18 years that were initiated on insulin pumps and currently close to 300 with them already in use. The DNP student and mentor estimated that about 10 patients would participate in the quality improvement project.

Organizational Barriers

A barrier present in this clinic was the lack of availability for provider appointments due to the large population of patients seen at this clinic that are not type 1 diabetic patients. Initially, the new streamlined process required the patient to have their 1-week follow-up with their provider or at least 1 month post insulin pump start. However, in the organizational assessment, the average rate of the next available appointment was 42 days, which is higher than the benchmark goal of 14 days. The providers also voiced concerns that patients' third-party

insurance would not cover the additional follow up visit. So, it was decided a follow up phone call would be included instead of an office visit.

An additional barrier was that the clinic had a change to a different EHR system during the implementation process. Initially, none of the clinic staff had been trained on the new system and training occurred at different intervals for each staff member. The change in EHRs caused obstacles during data collection and effective communication regarding the patients' status in the new initiation process due to different charting processes and a new secure messaging system.

Barriers related to patients and families included lack of follow up communication notifying the clinic about their pump selection or when the pump arrives to their home. Also, lack of insurance approval of pump which required the provider to appeal the insulin pump order and show more detailed soap notes and clinical data such as blood sugar logs to validate the medical necessity of the device. These barriers also prolonged the wait time between pump decision to pump initiation. Lastly, differences patient/family primary language can cause issues since the insulin pump features are typically in English, not Spanish. Cultural barriers such as the roles of caregivers can also affect who receives proper training with the patient. For example, for toddlers and school age children, it is important for both parents or additional caretakers such as a grandparent or nanny, to receive education since children in this age group tend to be taken care of by additional adults outside of school hours, especially if the child is from a single parent home or if both parents work full time.

Organizational Facilitators

A driving facilitator of this quality improvement project is that the providers, the CDEs, and the clinic staff shared a common responsibility for improving patient outcomes with insulin pumps, ensuring patient safety with the use of insulin pumps, and improving communication

with each other. Another facilitator is that since the clinic sees a large population of Spanish speaking patients and low socioeconomic backgrounds, the staff also recognized the need for this change process to provide high-quality care for this population who they felt needed more help in understanding and managing an insulin pump device. Also, the clinic has a reported 87% patient satisfaction experience score for the past 2 months, which is close to, but still less than their goal of 90%. Additionally, the clinic's no-show rate is at 14%, which is less than the health system cut off a benchmark of 20%. This gives a hopeful perspective that the patients and families will be willing to attend the additional education visit and not miss it.

Ethical Considerations

The QI project exhibited limited physical risks and harm to the participants of the interventions. No compensation was given to patients or families for participating. The QI project offered a 6th grade reading level and language education materials to patients in both English and Spanish. Additionally, translation services support was provided with the use of staff certified translator or a tablet with video translation services app to ensure that correct information was given to the participating families. Participants' privacy and confidentially was maintained and protected throughout the project. Paper checklists and forms with patient data collection were maintained in the endocrinology clinic in an identified, confidential folder, secured in the Mentor's office at the clinical site. The paper checklists, patient tests, and education checklist had a patient label placed on the paper, which was only used for these forms. Electronic data remained under the DNP student's Microsoft desktop at the clinical site with assigned clinical site student login from the clinic's health system.

The University of the Incarnate Word and the clinic site institutional review boards reviewed the QI project to ensure its compliance with local, state, and university regulations

before implementation. It was deemed as non-research by both institutions. The DNP student also obtained approval and support from the clinical manager, interim pediatric endocrinology department director, and mentor to implement the project and a letter of support was provided (Appendix F).

Evaluation Plan

In order to evaluate the effectiveness of the new streamlined process and improvement in patient outcomes, specific variables and data were measured and collected for each of the four project objectives. First, before the implementation of the new insulin pump initiation process, the clinic's staff and providers were educated on new steps and project objectives. A sign-in sheet captured the number of staff members who attended the educational training meeting or who obtained individual learning from the DNP student. The goal was for 100% of staff to receive education by February 1st of 2020, and data of attendance were completed by that time as well.

Second, patient attendance to both CDE education appointments were observed. The goal was for 75% of participating patients to attend both CDE education appointments. The variables measured for this objective were the number of scheduled CDE pump education visits per week, the type of CDE visit (pre-pump or follow-up post-pump), and the no show rate for both pre-pump visit and follow-up post-pump CDE visit. This data were collected on a weekly basis by the DNP student. The DNP student collected the type of CDE visit through chart review of CDE notes. The reports on no show rates and the number of scheduled visits were collected by the front desk secretary.

Third, the level of patient and family knowledge improvement was measured with the test scores from the Diabetes Care Assessment and Pump Terminology Test and the completed

education checklist of the CDE education appointment. The goal was for the patient and family to make an 80% passing score on both tests and to have at least 90% of the education checklist done by the second education session. The CDE collected these scores and checklist after each visit. The DNP student reviewed the education checklist for completeness weekly, and the test scores were reviewed weekly.

Fourth, the goal of decreasing 30% of adverse effects related to insulin pump misuse or issues was measured by the number of unexpected phone calls/clinic visits and the number of monthly patient hospitalizations or ER visits with insulin pump issues of patients initiated on insulin pumps at the start of the project. These reports were collected by front desk staff on a weekly and monthly basis. Furthermore, additional patient variables regarding adverse effects collected were the level of HbA1c at the initial visit and routine provider visits, blood glucose levels, the patient's weight, growth curves, and signs and symptoms of uncontrolled diabetes such as polydipsia, polyphagia, polyuria, and hypoglycemic events. These were collected through chart review by the DNP student.

Results

Demographic Data

A total of eight type 1 pediatric diabetic patients were initiated on insulin pump therapy during the implementation period, but a total of n =5 patients were able to complete the new standardized process between February 2020 through June 2020. The mean age for the new insulin pump patients was 10.2 years old with a mean baseline hemoglobin A1C of 9.4%. Of the five patients who participated in the intervention, three were male and two were female, three were White, two were Black non-Hispanic. Main caregivers that participated in the new process with patients were two parents, two grandparents, and a guardian. Additionally, 80% of the

patients who participated in the new process had Medicaid insurance and 60% of the participating families were English speaking. See table 2 for demographic data of participants.

Table 2

Demographic Characteristics of New Insulin Pump Use Participants

Demographic	No. (%) of Patients (n =5)
Gender	
Male	3(60%)
Female	2(40%)
Race/Ethnicity	
White	3(60%)
Black, non- Hispanic	2(40%)
Asian	0 (0%)
Other	0(0%)
Caregiver	
Parent	2 (40%)
Grandparent	2 (40%)
Guardian	1 (20%)
Insurance	
Medicaid/CHIP	4(80%)
Private	1(20%)
Self-Pay	0(0%)
Language	
English	3(60%)
Spanish	2(40%)

Outcome 1

The first anticipated outcome was met by 100%. Successful training was achieved by all clinic providers and staff about the new process through an education session before project implementation. Though not every provider attended, education was provided on a one to one basis by the DNP student to those who were not present during the education session so that

prior to implementation of the new process all providers were trained appropriately and understood their role in the project.

Outcome 2

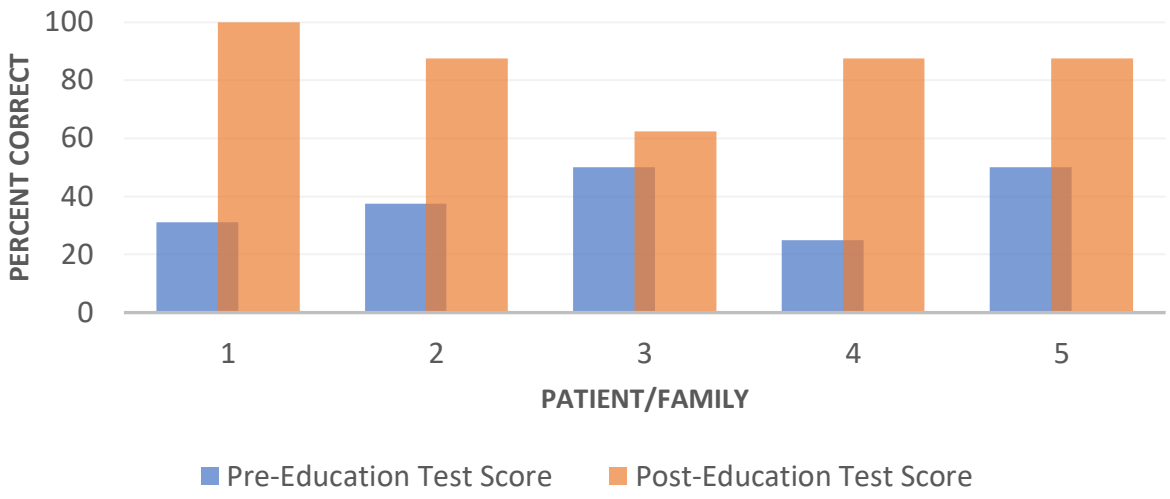
Initially, 100% of the new insulin pump patients were scheduled for the new pre pump-start education visit. However, only 62.5% of patients attended this visit and 37.5% did not attend, nor reschedule their visit. On the other hand, the post pump-start visit had 100% attendance. The combined attendance rate for both education visits was 62.5% attendance and 37.5% did not attend. The anticipated outcome was not met at 75%; however, five out of the eight patients received appropriate standard of care insulin pump management education.

Outcome 3

Five out of the eight patients/families were able to take the diabetes care assessment and completed 100% of the CDE education checklist. All eight patients, however, completed 100% of the CDE worksheet. Pre pump-education diabetes care assessment scores had a mean average score of 38.7% and post-test scores showed a mean average of 85%. The outcome was partially met. Additionally, 80% of the five patients who took the pre-pump class were able to achieve a score of 80% and above (see Figure 1).

Figure 1

Diabetes Pump Care Assessment Scores

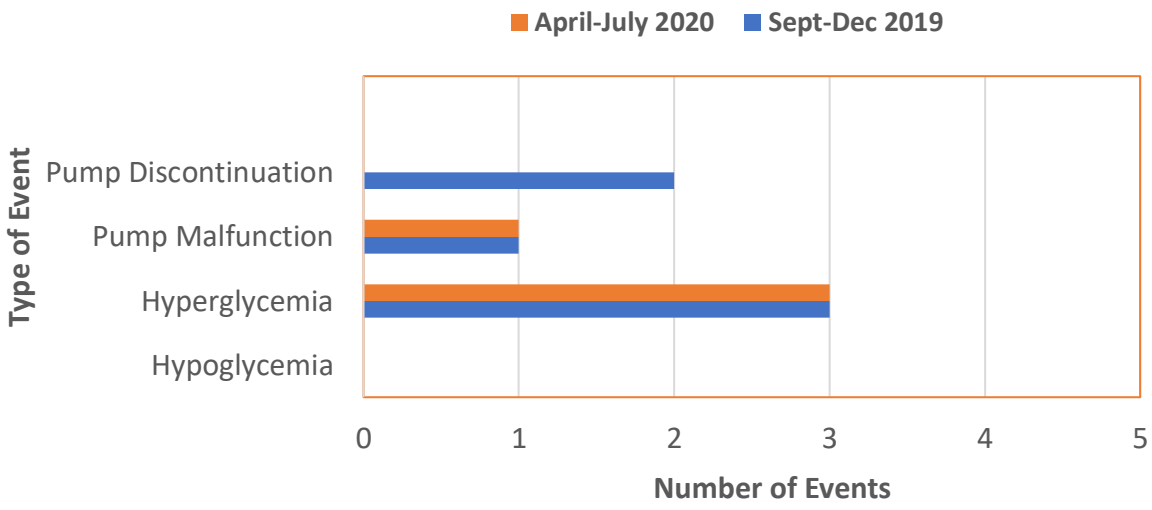


Outcome 4

At baseline from the last quarter of 2019, out of the nine patients that had begun using insulin pumps, there were six different adverse events and one hospitalization related to pump malfunction. The baseline rate of adverse events related to insulin pump use was 66%. After implementation, only four adverse events from a total of eight new insulin pump users occurred, 50% adverse event rate: three hyperglycemia episodes and one pump malfunction. The anticipated outcome to decrease the adverse event rate by 30% was not met. However, a 16% decrease from 66% was seen (see Figure 2). Moreover, with the implementation of the new process no hospitalizations related to insulin pumps were seen.

Figure 2

Adverse Events Related to New Insulin Pump Use



Discussion

While not all objectives were met, an essential outcome of this quality improvement project was the implementation of a new standardized workflow process of insulin pump initiation and pre-pump patient education at the facility. This allowed the use of a common language regarding insulin pump initiation, and timely completion of DME orders for insulin pumps by clinic staff, which decreased the waiting period for insulin pump delivery. Also, providers completed insulin pump setting orders before pump-start. This change process represents the use of an evidence-based approach of improving patient education and provider oversight of patients initiated on insulin pumps supported by the American Diabetes Association clinical guidelines for diabetic technologies (2019) and the American Association of Diabetes Educators practice statement (2018).

Due to the COVID-19 global pandemic that occurred during the implementation period, amendments to the project interventions were made for use through telemedicine. While

additional challenges arose with the use of telemedicine for the pre-pump start education session, it provided unique patient benefits such as decreased transportation costs, decreased missed time from school or work, and additional clinical support and healthcare access. These benefits are consistent with the literature that state a major benefit of telemedicine in chronic disease management is the ability to provide cost-effective healthcare access and disease prevention by allowing patients who live in rural areas or in low socioeconomic communities to have access to their healthcare specialist from their home (Dougherty et al., 2014; Smith & Satyshur, 2016). The situation also showcased the future sustainability of this quality improvement project due to the versatility of the project interventions to be used with telemedicine since CMS allows for reimbursement of diabetic education by providers and certified diabetes educators (Centers for Medicare and Medicaid Services, 2020).

Moreover, a fifth outcome for the project was created due to the COVID-19 pandemic. In order to adhere to best practice health measures during this time, it was crucial to track how many insulin pump users had documented routine care measures of hemoglobin A1C, lipid and thyroid panels, an annual influenza vaccine, and a blood sugar log. By ADA guidelines, hemoglobin A1C, must be checked every 3 months to monitor disease management (ADA, 2019). Through a chart review of 54 insulin pump users, we found 62.5% had a documented hbA1C, 50% had documented lipid and thyroid labs, 42.2% had a documented annual influenza vaccine, and 36.3% had documented blood sugar logs. Capturing this data allowed the clinic to identify insulin pump users who would otherwise be missed for preventive measures during a pandemic where a majority of the patients are not being seen in clinic, nor going to get routine labs.

Relation to Other Evidence

Similar to larger studies regarding insulin pump use in type I diabetes pediatric patients this QI project had a small sample size. Despite evidence of inequity of insulin pump use by minority patients in the literature, this project showed that 90% of the new insulin pump users had Medicaid as their insurance plan, 40% were African American, and 40% of the patients/families spoke Spanish as their primary language. Moreover, while the intervention only provided an additional 1-hour education session, the five patients/families that participated in the extra class had less adverse events than those who did not participate. Two of the hyperglycemia events were experienced by two patients that did not attend the pre-pump start class. Evidence from the INPUT RCT supports that increased education prior to pump start can lead to improved patient outcomes (Ehrmann et al., 2018). Another finding was that there were no hypoglycemic events following pump initiation with the new process. A decrease in hypoglycemic events has been noted with CSII therapy compared to multiple daily injections (Ly et al., 2013; Yeh et al., 2012).

Limitations

A significant limitation during the implementation period of this quality improvement project was the COVID-19 pandemic, which forced the project interventions to be carried out by a different approach. In order to enforce public health department and government mandates of social distancing to decrease virus transmission, 90% of clinic appointments were done through telehealth, which prompted all CDE education visits as a non-priority appointment. Initially, our first education sessions were canceled, and the providers of the clinic decided to defer the insulin pump starts during the first month of the stay-home mandate. In addition, the clinical staff, especially the CDEs, had limited training with telemedicine resources and limited knowledge of

telemedicine billing for diabetic education visits. The clinic also had to accommodate to address issues with HIPAA regulated telehealth apps. However, as patients received their pumps at home and pump orders were prescribed, an opportunity arose for the project to continue with the help of the provider team. As a result, the pre-pump education was carried out by two providers (the DNP student's mentor and the NP), and the DNP student through phone and video conference with the patients/families. The DNP student also amended the interventions to be more online/phone call friendly. Both assessments were combined into a PowerPoint presentation that was emailed to the patient's parent the day before the education and only the diabetes care assessment was used in a pre and post-test before and after the education session (Appendix D).

Additionally, another limitation was the lack of patient/family access to a computer or personal email to receive educational materials. For one of the six families, the education was given orally over the phone since the parents did not have access to a computer or email. Though it did not affect their scores on the post-education assessment, they were restricted on the telehealth experience of video interaction and lack of availability of materials at hand to look over, which can impact the patient and family's understanding of insulin pump management. O'Connor et al. (2018) stated that minority, low-income households who primarily have public health insurance are noted to have less exposure to technology resulting in decreased comfort in using it properly. This is a crucial barrier to long term provider oversight, and patient ownership of insulin pump therapy since an advanced setting of insulin pumps is that patient data of insulin pump administration can be uploaded to cloud software and made available to both the patient and clinician. These comprehensive logs include information about insulin administration, carbohydrate intake, and blood sugars levels providing an overview of a patient's day-to-day glycemic control with the use of a pump. Therefore, this patient data are as important as a

patient's hemoglobin A1C level in diabetes care management since providers use a patient's comprehensive insulin pump log to assess where to make changes in insulin requirements in relation to the patient's glycemic variability.

A third limitation was the limited implementation time frame due to the COVID-19 pandemic for accurate capturing of improvements in long-term patient outcomes such as improvements of HbA1c while being on pump therapy since changes can only be seen after 3 to 4 months. Additionally, since the insulin pump users only make up about 20% of the patient population of the clinical facility, another limitation was a small number of participants for this quality improvement project.

Recommendations

A multidisciplinary team approach that includes IT and data analysts is needed to sustain this change process by further exploring the addition of the education checklists and documentation of patient assessment scores in the facility's EHR to keep track of patient issues with insulin pump readiness or pump malfunction especially since the health system made a switch to a comprehensive EHR. Gathering and quantifying data of clinic patients who were admitted in the hospital for DM type 1 complications or had pump malfunction issues was difficult to obtain during this project. However, access to a seamless EHR system that allows real time provider notification of clinic patients who are admitted to the health system's hospital or seen in the hospital's emergency room for a pump malfunction and DM type 1 complications could improve tracking of patient outcomes and gaps in this clinical process.

Due to the impact of the COVID-19 pandemic, back up telemedicine resources, and clinical staff education about state and insurance plan policies regarding telemedicine are vital. Literature has shown that telemedicine as an adjunct tool to standard outpatient diabetes

management can lead to optimal patient outcomes (Dougherty et al., 2014). It is a cost-effective option to continued clinician oversight when patients are presented with barriers to care such as lack of transportation, lack of in-clinic visit availability/ time constraints, and in this case, a global pandemic. For this reason, additional ways to distribute the educational materials to patients, especially for those without access to a computer, must be addressed. An innovative way to address this issue would be by creating a pump therapy educational video or sound recording that is uploaded to clinic's website or assigned to the patient's clinic portal account so that it can be easily accessed through a cell phone, tablet or computer. This is a feasible idea since a majority of parents and children currently have access to mobile devices or tablets that have access to the internet.

Additionally, observations made by the two providers who participated in the project implementation were the success of improved patient/family engagement and communication. Both the providers agreed that educating the patients themselves and having that one-on-one time through a video and/or phone call outside of the clinic setting allowed patients and parents to be more comfortable in asking questions and voicing concerns they had in their diabetes management. This is an area to explore for its effects on patient satisfaction. Perhaps, after initiation of insulin pump therapy patients and families can request a telemedicine visit, whether it be with a CDE or provider, to reinforce evaluation of proper insulin pump use or obstacles in care instead of having to wait for an available in clinic appointment. This is an innovative possibility of extending the patient-provider-healthcare team relationship.

Implications for Practice

Informed problem-solving skills in response to insulin pump failure was the focus of the education provided in both education sessions. Evidence shows that adverse events from insulin

pump misuse, such as DKA, arise from lack of anticipatory guidance of pump-troubleshooting strategies (Evert et al., 2016; Grunberger et al., 2014; Wheeler et al., 2014). Evert et al. (2014), recommended the use of a short waiting room questionnaire to be given to address insulin infusion set issues during the clinic visit. Therefore, it calls attention to continue to carry out quality improvement of continuous assessment of these patient skills at every future routine visit to cue providers of education gaps.

Advanced practice registered nurses are experts of patient and family-centered care. Therefore, they play a vital role in leading quality improvement by not only using evidence-based strategies that encourage patient ownership of insulin pump therapy, but also support interprofessional collaboration and effective use of innovative technology and communication methods to improve patient outcomes. The new protocol is a sustainable systematic change since each staff member had their own responsibilities and the DNP prepared nurse was able to initiate, guide, and support the implementation of evidenced-based standards of care. Through a multidisciplinary approach and provider leadership, the project was able to be amended to use telehealth. An additional sustainable outcome was that after discussion of the project results with the provider team, the chief department head requested that the patient educational materials be incorporated into the medical residents' educational curriculum in order improve future pediatric provider competence of insulin pump management. Ultimately, it is the provider's responsibility to assess patient/family readiness for change in therapy as well as to monitor patient outcomes. A DNP prepared nurse recognizes this responsibility by tailoring the change process to decrease health disparities and barriers to care.

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Appendix A

Action Plan for Project Implementation

Action Plan

Task	Materials	Space	Finance / Budget	Time Frame	Personnel
Arrange an education session/meeting to introduce QI measure to staff	N/A—inform staff of the upcoming meeting through email and in person.	Office	No associated cost	Verbally inform staff of meeting; 1 min Send email by January 24th.	DNP Student
Create teaching handout for education session of staff.	Computer and printing paper	n/a	No Cost - will print handout (15 pages) in office	Print by January 28th.	DNP student
Create teaching materials for project intervention • Teaching checklist • Patient education handout "Pathway to Insulin pump Therapy"	Student's computer and printing paper	n/a	No associated cost	Estimated 1-2 hours to create each handout. Create all materials by January 17th.	DNP student

• Diabetes Numeracy Test • Insulin Pump terminology Test • CDE education checklist					
Obtain approval of materials from project advisor.	Insulin Pump educations materials.	Office	No cost associated	Communication with project advisor; 20 mins	DNP student and project advisor
Education Session/Introduction of QI measure to staff	Teaching Handout about QI.	Educati on room in TDI.	Meal (estimated cost-$25) No cost associated with printing	30-min education session to take place before initiating QI project. To be scheduled for Friday February 7th, 0800-0830.	All staff members—MDs, NP, CDEs, MAs, clinic manager, and front desk receptionists
Obtain buy-in and input of staff regarding QI measure	N/A—communication with staff	Office	No associated cost	Communication with staff regarding QI project; 20 mins	DNP student and staff
Place copy of streamlined QI project at MA/Nurse station in protocols folder And in provider workroom	Checklist	Lobby/ Front Desk Provider work room	Cost of printing the handout	Before initiating QI project; 1 min	DNP student

Place confidential folder for completed education packet that includes tests and CDE checklist in provider office	Designated folder for confidentiality of education tests and checklist	Provider office	Cost of folder (estimated cost $2.00)	Before initiating QI project; 1 min	DNP student
Initial Provider Visit					
Check-in patient	Sign-in sheet, patient chart, copy of insurance	Lobby/ Front Desk	N/A—already a process practiced and funded by the clinic	At the start of every appointment; 5 mins	Front Desk Receptionist
Call back to patient room and obtain patient's vital signs	Chart with labs and SOAP note, medical equipment—BP cuff, hemoglobin A1C, upload of glucometer log	Hallway and patient exam room	N/A—process of the clinic; MA paid by health system	After receiving patient chart; the start of the patient care process; 5 mins	Medical Assistant
Documentation of patient's medication and blood sugar log from glucometer if with patient	EMR	Patient exam room	N/A—process of the clinic	At the beginning of patient's appointment; 5 mins.	Medical Assistant
Physician enters room; assesses patient and evaluates eligibility for insulin pump therapy	Stethoscope, log of blood sugars, most recent A1C result, SOAP note	Patient exam room	N/A—process of the clinic	During patient's appointment; 20 mins	Physician

Physician documents treatment plan—child meets eligibility for insulin pump therapy	SOAP note,	Patient exam room	N/A-process of the clinic	During patient's appointment 5 mins	Physician
CDE enters room; provides patient and family brochures about different insulin pumps and "Pathway to Insulin Pump Therapy" handout	CDE note in EMR	Patient exam room	No cost-brochures are available in clinic; patient education handout printed in clinic Already a clinic process	During patient's appointment 5-10 min	CDE
Patient check-out	n/a	Hallway or Front Desk	N/A	Conclusion of patient's appointment; 5 mins	Medical Assistant, Front Desk Receptionist
Contacting patient/family about insulin pump decision	Office phone & patient EMR	LVN station	N/A	Patient will be called 2 weeks before scheduled CDE education 2-5 min	LVN
CDE Pre-pump education session	Education packet- Checklist of education topics, Diabetes Care assessment test,	Educ. room	No Cost of printing education materials-will be printing them in office)	Education session will take 1-2 times a week during implementation period. Allotted 1-hour period	CDE

	Terminology test, Completed education tests & checklist will be placed in secure confidential project folder in provider office			Will be Scheduled to take place Mondays or Fridays	
CDE messages Provider of session and Provider writes Insulin Pump orders	EMR Insulin pump order form	Office	n/a	1-3 min	CDE & provider
Pump-Start Education Session Schedule post pump CDE education visit at end of this visit.	n/a	Educ. room	n/a- provided by insulin pump company; already a clinic process	Usually takes place 1-2 times a week. 1-2 hrs	Pump Representative
Post Pump- start CDE education session	Complete education checklist, retest diabetes assessment test and pump terminology test, Insulin pump Action plan	Educ. room	No Cost of printing education materials- will be printing them in office)	Should take place one-week post pump start. Allotted time -1 hour Mondays or Fridays	CDE
CDE charts in SOAP note about completed	EMR SOAP note	Office	n/a	5 min	CDE

education session and messages provider of completed education					
Provider receives message and calls patient and family by phone	Office Phone	Office	n/a	3-5min Should take place within a week after last education session with CDE	Provider
DATA COLLETION					
100 % of staff will attend education session	Sign in- sheet	Office	N/A	Will be collected during first education session and on one-one basis within first week of project implementation	DNP student
75% of participating patients to attend both CDE education appointments ○ The number of scheduled CDE pump education visits per week ○ The type of CDE visit (pre-pump or follow-up post-pump), ○ The no show rate for both pre-pump visit and follow-up	Excel sheet Patient EMR	Office	N/A	30 mins-1 hour Collected weekly Fridays or Mondays	DNP student and Front desk secretary

post-pump CDE visit.					
The patient and family to make an 80% passing score on both tests and to have at least 80% of the education checklist by second education session	Education tests Education Checklist	Folder and filing drawer in mentor office	N/A	The CDE will be collecting these scores and checklist at every visit (1-2x a week). The DNP student will be reviewing the education checklist test scores for completeness weekly.	CDE and DNP student.
Decreasing 30% of adverse effects related to insulin pump misuse or issues is measured by the number of unexpected phone calls/clinic visits and the number of monthly patient hospitalizations or ER visits with insulin pump issues	Excel sheet EMR	Office comp.	N/A	Unexpected phone calls or visits to the clinic will be collected weekly by front desk and providers. Hospitalizations or ER visits will be collected monthly.	• Provider • Front desk • DNP Student

Additional staff meetings and education sessions	Results of the QI measure	Office's break room	Meal; costs of any paper to print out visual diagrams of the results of QI measure	30 min. meetings/educ. session during the staff's lunch hour ○ A meeting will be scheduled at the half-way point of the QI project ○ Additional meetings may be scheduled if there are any issues, questions, or concerns	DNP student; all staff members including MD, MA, OM, and front desk receptionist

Appendix B

English and Spanish Patient Education Sheet

Texas Diabetes Institute
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701 S. Zarzamora St. 78207
San Antonio, TX 78207
Ph. (210) 358-7551
Fax: 210-358-7595

University Hospital
4502 Medical Drive
San Antonio TX, 78229
Rio Tower, 5th Floor

UT Health San Antonio | University Children's Health

Pathway to Insulin Pump Therapy

Your child has met the requirements for an insulin pump. This treatment option may improve your child's blood sugar levels. Your child's diabetes care team will work together with you and your child to achieve your desired blood sugar goals with this therapy. This is a guide that describes the steps to take before your child receives his or her insulin pump device for use.

1. Pre-Pump Checklist

- ☐ Contact your child's insurance provider for cost coverage and pre-pump requirements.
- ☐ Learn about the different types of insulin pump options. Your diabetes health care team will provide you with brochures and additional online resources to explore.
- ☐ Choose an insulin pump that will work best for you child's and family's lifestyle.
- ☐ You will need to provide proof of your child's insurance information, home address, your child's name/age, and blood sugar logs for the last 30 days or more. This will help your provider start the ordering process.

2. Waiting for your Pump

The clinic will schedule an education clinic visit with your diabetes educator within two weeks of your doctor's appointment it is important for you and your child to attend this 45 min education session to gain better understanding of the insulin pump of your choice.

You can expect a review of:

- Checking blood sugars
- Carb counting
- Differences between insulin injection therapy and insulin pump therapy
- Insulin pump terms
- Hand on time with demo Insulin pump

Once the pump is ordered, the insurance approval process may take a few weeks. Continue to keep in contact with the clinic and your insurance company to track the approval process. The estimated wait time for insulin pump delivery after approval can be between 1-4 months.

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3. Pump is delivered

Your insulin pump will be delivered to your home. Once your pump arrives, contact the insulin pump company to schedule your pump start-training with a company representative. DO NOT start using the pump until the training class.

4. Pump-Start Training

This is a free 1-2-hour class in the clinic with your insulin pump company representative. The training will walk you through setting up your insulin pump and understanding the materials that come with your pump. On this day, insulin will also be started on your pump. You will need to bring your child's fast-acting insulin and their blood sugar meter. Other caregivers are welcomed to attend.

5. Post Pump-Start

You will have a second education visit with a diabetes educator in the clinic 1-2 weeks after insulin is started on the pump. You can expect a review of basic pump features and will have time to discuss topics such as:

- Updated Diabetes Action Plan
- Advanced features of the pump
- Traveling with a pump
- What to do when you Pump fails
- Ordering pump supplies
- Insulin prescriptions

Your provider will also follow up by phone call to check in during the first two weeks of your child's insulin pump start.

6. Insulin Pump Care

Follow up with your child's endocrinologist every 3 months for routine visits.

Contact your provider and the clinic for any questions or concerns such as:

- Pump discontinuation
- Insulin prescription refills
- High or low blood sugars

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Camino a la terapia de la bomba de insulina

Su hijo ha cumplido los requisitos para una bomba de insulina. Esta opción de tratamiento puede mejorar los niveles de azúcar en la sangre de su hijo. El equipo de atención de la diabetes de su hijo trabajará junto con usted y su hijo para lograr sus objetivos deseados en los niveles de azúcar en la sangre con esta terapia. Esta es una guía que describe los pasos a seguir antes de que su hijo reciba su dispositivo de bomba de insulina para su uso.

1. Lista de verificación previa a la bomba

- ☐ Comuníquese con el proveedor de seguro médico de su hijo o hija para conocer la cobertura de costos y requisitos para un dispositivo de bomba de insulina.
- ☐ Conozca los diferentes tipos de bomba de insulina. Su equipo de atención médica para la diabetes le dará folletos y recursos adicionales en Internet para explorar sus opciones.
- ☐ Elija una bomba de insulina que funcione mejor para el estilo de vida de su hijo y su familia.
- ☐ Necesitara dar informacion sobre el proveedor de seguro médico de su hijo o hija, el nombre y edad de su hija o hijo, registros de azúcar en la sangre por los últimos 30 dias o mas para que su endocrinólogo pueda ordenar su bomba de insulina.

2. Esperando su bomba de insulina

La clínica le agendara una visita de educación con su educadora de diabetes. Es importante que usted y su hijo asistan a esta sesión de educación de 45 minutos para obtener un mejor conocimiento y manejo de su bomba de insulina.

Usted puede esperar una revisión de:

- Cuidado básico de la diabetes
- Diferencias entre la terapia de insulina inyección y la terapia con bomba de insulina
- Problemas con la bomba de insulina
- Ajustes y vocabulario de la bomba de insulina

Una vez que su endocrinólogo ordene su bomba de insulina, el proceso de aprobación del seguro puede tomar unas semanas. Continúe en contacto con la clínica y su compañía de seguros para realizar un seguimiento del proceso de aprobación. El tiempo de espera para la entrega de la bomba de insulina después de la aprobación es estimado a ser entre 1-4 meses.

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3. La bomba se entrega

La bomba de insulina será enviada a su casa. Una vez que la bomba llegue, contacte a la compañía de bombas de insulina para programar su entrenamiento.

NO empiece a usar la bomba en su hijo o hija hasta el entrenamiento.

4. Entrenamiento de inicio de terapia con la bomba de insulina

Este entrenamiento será una clase gratis de 1 a 2 horas en la clínica con el representante de la bomba de insulina. Esta clase se enfocará en la configuración de la bomba de insulina y el manejo de los materiales que vienen con su bomba. En este día, su hijo o hija iniciara a usar la bomba de insulina. Es importante traer la insulina de acción rápida y su medidor de azúcar de la sangre. Otros cuidadores de su hija o hija son bienvenidos a asistir.

5. Después del entrenamiento de inicio

Usted tendrá una segunda visita con su educadora de diabetes en la clínica de 1 a 2 semanas después de que se inició la nueva terapia. Usted puede esperar una revisión de las características básicas de la bomba y tendrá tiempo para aprender:

- Plan de Acción de Diabetes Actualizado
- Características avanzadas de la bomba
- Como viajar con una bomba
- Qué hacer cuando la bomba falla
- Como ordenar suministros de bombas
- Receta medicas de insulina

Su endocrinólogo también hará un seguimiento por teléfono para registrarse durante las dos primeras semanas del inicio de la bomba de insulina de su hijo o hija. Igualmente, cada 3 meses usted hará su visita rutinaria con su endocrinólogo.

6. Cuidado de la bomba de insulina

Comuníquese con su endocrinólogo y la clínica para cualquier pregunta o inquietud si surgen problemas con la bomba. Tales como:

- Interrupción de la bomba
- Recarga de receta de insulinas
- Niveles altos o bajos en sangre

Appendix C

CDE Education Checklist for Pump Therapy

TOPIC	DATE	INITIALS
Understating Pump Therapy ☐ Insulin Type ☐ Basal Rate ☐ Meal Bolus ☐ Insulin Sensitivity/ Correction Factor ☐ Infusion Set ☐ When to change Set ☐ Pump Terminology Quiz: _____ score		
Skin Safety ☐ Checking pump placement ☐ Lipohypertrophy ☐ Rotating sites		
Blood Glucose Testing ☐ Schedule while on pump ☐ A1c		
Nutrition ☐ Carb counting ☐ Using Food Labels ☐ Insulin to carb ratio ☐ Correction scale ☐ Proper Snacks ☐ Diabetes Care Assessment: _____ score		
Exercise ☐ Pump Safety ☐ BG checks ☐ Hypoglycemia ☐ Proper snacks		
Hypoglycemia/ Hyperglycemia/ DKA ☐ Diabetes Action Plan ☐ Signs and Symptoms ☐ Ketone testing ☐ Glucagon ☐ Sick Days		
Pump Therapy ☐ When to call the doctor/clinic ☐ What do if pump fails or is discontinued ☐ How to order pump supplies ☐ Pump back up Plan ☐ Pump Orders: date_____		

Appendix D

Diabetes Pump Care Assessment in English and Spanish

Diabetes Pump Care Assessment

Circle the correct answers.

1. Which type of insulin is used in insulin pump therapy?
   A. Fast acting
   B. Long Acting
2. Which is a fast-acting insulin? Circle the correct answers.
   A. Lantus
   B. Humalog
   C. Tresiba
   D. Novolog

3. When using a pump, which type of insulin delivery should keep blood sugar stable when you are not eating?
   A. Basal
   B. Bolus
   C. Temporary Basal

4. When using a pump, which type of insulin delivery is used to cover food eaten or to lower a high blood sugar?
   A. Temporary Basal
   B. Basal
   C. Bolus

5. If your child has an unexpected high blood sugar and you give them a correction dose of insulin with their pump, when should you recheck their blood sugar to make sure the pump is working properly?
   A. Every 15 minutes for 1 hour
   B. 30 minutes after
   C. 1 hour after

6. If your child's blood sugar does not go down after a correction dose given with the pump, what is the first thing should you do?

   A. Call your provider
   B. Trouble shoot your pump
   C. Call 911 or go to ER

7. What is the longest amount of time your child can be disconnected from their pump before you need to check their blood sugar?

A. 30 min
B. 1 hour
C. 3 hours
D. 4-5 hours

8. If your pump fails, you are told to follow the sliding scale shown here.

Insulin you take based upon your blood sugar levels. **If Blood sugar is:**	**Units of Insulin**
0-150	0
151-200	1
201-250	2
251-300	3
301-350	4
351-400	5

8a. How many units would you take for a blood sugar of 295? _____units

8b. What type of insulin would you use if your pump stops working?

A. Humalog and Lantus
B. Tresiba only
C. Novolog only
D. Tresiba and Lantus

Revisión del Cuidado de Diabetes con el Uso de Una Bomba de Insulina

Encierre en un círculo la respuesta correcta

1. ¿Qué tipo de insulina se usa en la terapia con bomba de insulina?
    a. De acción rápida
    b. De acción larga

2. ¿Qué es una insulina de acción rápida? Circule las respuestas correctas.
    a. Lantus
    b. Novolog
    c. Tresiba
    d. Humalog

3. Al usar una bomba, ¿qué tipo de suministro de insulina debería mantener estable el azúcar en la sangre cuando no está comiendo?

    a. Basal
    b. Bolus
    c. Basal Temporal

4. Cuando se usa una bomba, ¿qué tipo de suministro de insulina se usa para cubrir los alimentos ingeridos o para reducir el nivel alto de glucosa en la sangre?
    a. Basal Temporal
    b. Basal
    c. Bolus

5. Si su hijo tiene un nivel alto de azúcar en la sangre y usted le da una dosis correctiva de insulina con su bomba, ¿cuándo debe volver a verificar su nivel de azúcar en la sangre para verificar que su bomba de insulina esté funcionando correctamente?

    a. Cada 15 minutos durante 1 hora
    b. 30 minutos después
    c. 1 hora después

6. Si el nivel de azúcar en la sangre de su hijo no baja después de una dosis de corrección administrada con la bomba, ¿qué debe hacer?

    a. Llamar a su doctor
    b. Chequear que su bomba esté funcionando como las indicaciones
    c. Llamar al 911 o ir a la sala de emergencias

7. ¿Cuál es la mayor cantidad de tiempo que su hijo puede desconectarse de la bomba antes de que necesite controlar su nivel de azúcar en la sangre?

a. 30 minutos
b. 1 hora
c. 3 horas
c. 4-5 horas

8. Si su bomba falla, se le indica que siga la escala deslizante que se muestra aquí.

Si el nivel de azucar esta en este rango:	**Unidades de Insulina**
0-150	0
151-200	1
201-250	2
251-300	3
301-350	4
351-400	5

a. ¿Cuántas unidades tomarías para un azúcar en la sangre de 295? ___ unidades

b. ¿Qué tipo de insulina usarías si tu bomba deja de funcionar?

a. Humalog y Lantus
b. Solo Tresiba
c. Solo Humalog
d. Tresiba y Lantus

Appendix E

Insulin Pump Vocabulary Review and Quiz in English and Spanish

Insulin Pump Vocabulary Review

TERM	DEFINITION
Rapid- Acting Insulin	Insulin that is used by the insulin pump. Will begin to work about 15 minutes after injection, peaks in about 1 hour, and continues to work for 2 to 4 hours.
Basal rate	The continuous dose of insulin that is delivered by the insulin pump 24 hours a day, measured by insulin units per hour
Bolus	Extra insulin needed before meals and other times when your child's blood sugar is high
Temp basal rate	A basal rate that that you can set to the amount of insulin temporarily delivered over a given amount of time.
Insulin sensitivity factor (ISF) or Correction Factor	The value that indicates how much one unit of insulin will lower your child's blood sugar
Active Insulin or Insulin on Board (IOB)	The length of time that insulin remains active and available in your child's body after a bolus
Insulin to Carb Ratio	Amount of carbs (in grams) covered by one unit of insulin
Target Blood glucose	The ideal range at which you would like your blood sugar to be

Insulin Pump Vocabulary Quiz

Match the term to the correct definition.

A. Basal Rate
B. Bolus
C. Temp Basal Rate
D. Insulin Sensitivity Factor/ Correction Factor
E. Insulin on Board
F. Insulin to Carb ratio
G. Target blood glucose

1. _____ The ideal range at which you would like your blood sugar to be.
2. _____ Amount of carbs (in grams) covered by one unit of insulin.
3. _____ The continuous dose of insulin that is delivered by the insulin pump measured by insulin units per hour.
4. _____ The length of time that insulin remains active and available in your child's body after a bolus.
5. _____ A basal rate that that you can set to the amount of insulin temporarily delivered over a given amount of time.
6. _____ The value that indicates how much one unit of insulin will lower your child's blood sugar.
7. _____ Extra insulin needed before meals and other times when your child's blood sugar is high.
8. _____ Insulin that is used by the insulin pump. Will begin to work about 15 minutes after injection, peaks in about 1 hour, and continues to work for 2 to 4 hours.

Revisión del vocabulario de la bomba de insulina

Término	Definición
Insulina de Accion Rápida	La insulina que usa la bomba de insulina. Comenzará a funcionar aproximadamente 15 minutos después de la inyección, alcanzará su punto máximo en aproximadamente 1 hora y continuará funcionando durante 2 a 4 horas.
Basal rate *velocidad basal*	La dosis continua de insulina suministrada por la bomba de insulina que estará medida por unidades de insulina por hora
Bolus *dosis de insulina rápida*	La insulina adicional necesitada antes de las comidas y otras veces cuando el nivel de azúcar en la sangre de su hijo esta alto
Temp basal rate *velocidad basal temporaria*	Una dosis basal que usted puede programar para suministrar temporalmente sobre un tiempo elegido.
Insulin sensitivity factor (ISF) o Correction Factor *Factor de sensibilidad de la insulina o Factor de corrección*	El valor que indica cuánto una unidad de insulina puede reducir el nivel de azúcar de la sangre de su hijo
Active Insulin or Insulin on Board (IOB) *Insulina activa o insulina abordo*	El tiempo que la insulina permanece activa y disponible en el cuerpo de su hijo después de un bolus
Insulin to Carb Ratio *Proporción de insulina a carbohidratos*	Cantidad de carbohidratos (en gramos) cubiertos por una unidad de insulina
Target Blood glucose *Objetivo del nivel de glucosa en la sangre*	El rango ideal en el que le gustaría tener su nivel de azúcar en sangre

Cuestionario de vocabulario de la bomba de insulina

Elija el termino con la definición correcta.

H. Insulina de Accion Rapida
I. Basal Rate
J. Bolus
K. Temp Basal Rate
L. Insulin Sensitivity Factor
M. Insulin on Board
N. Insulin to Carb ratio
O. Target blood glucose

1. _____ El rango ideal en el que le gustaría tener su nivel de azúcar en sangre.
2. _____ Cantidad de carbohidratos (en gramos) cubiertos por una unidad de insulina.
3. _____ La dosis continua de insulina suministrada por la bomba de insulina que estará medida por unidades de insulina por hora.
4. _____ El tiempo que la insulina permanece activa y disponible en el cuerpo de su hijo después de un bolus.
5. _____ Una dosis basal que usted puede programar para suministrar temporalmente sobre un tiempo elegido.
6. _____ El valor que indica cuánto una unidad de insulina puede reducir el nivel de azúcar de la sangre de su hijo.
7. _____ La insulina adicional antes de las comidas y otras veces cuando el nivel de azúcar en sangre de su hijo esta alto.
8. _____ La insulina que usa la bomba de insulina. Comenzará a funcionar aproximadamente 15 minutos después de la inyección, alcanzará su punto máximo en aproximadamente 1 hora y continuará funcionando durante 2 a 4 horas.

Appendix F

Letter of Support from Clinical Site Mentor

[redacted]

[redacted]

December 6, 2019

To Whom It May Concern:

I enthusiastically write this letter to support Valeria Marin's Doctor of Nursing Practice (DNP) quality improvement initiative project. As one of the primary Pediatric Endocrinologists, I grant permission for Valeria Marin to complete her project at the Texas Diabetes Institute Pediatric Endocrinology clinic. The purpose of this project is to reduce and prevent adverse outcomes of insulin pumps secondary to an ineffective initiation process, management, and patient/family understanding. The goals of this project are: (1) to streamline an approval process for patients to be transitioned to an insulin pump, (2) to increase patient/family knowledge of insulin pumps prior to using the devices, (3) to increase patient comfort/ satisfaction with using the devices, and (4) to assess and improve current provider management practices. The project will include staff education and retrospective chart review. For this reason, I have discussed the project with our clinic manager Barbara Martinez, RN, our division interim chief, Jane Lynch M.D, who also support this project. I, Maria Rayas, M.D, will be overseeing this project as the student's clinical mentor. The components of this project have been discussed and agreed upon.

Sincerely,

Maria S. Rayas, MD

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