Reinforcement of a Preoperative Insulin Protocol

Matthew Newton MS, CRNA

A Project Report Submitted to

the Faculty of The School of Nursing at

The University of North Carolina at Greensboro

in Partial Fulfillment

of the Requirements for the

Doctorate in Nursing Practice

Greensboro

2021 (2022)

Approved by:

Angela Kabbe, PhD, FNP-BC	Project Team Leader
Gloria Walters PhD, RN, NPD-BC, CCRN-K	Project Team Member
Dr. Lori Lupe, DNP	DNP Program Director

Abstract

Purpose: Patients with type 1 diabetes (T1DM) often arrive for surgery with blood glucose readings out of target goal for the healthcare facility. This often leads to surgical delays, increased healthcare expenses and increases the risk of patient complications. The purpose of this project was to evaluate an institution's preoperative insulin management protocol and reinforce its usage by providing an education session to the preoperative clinic providers. The ultimate goal was to improve blood glucose readings and better prepare the patient for surgery. A secondary aim of this study was to improve provider confidence by expanding comprehension of the current insulin protocol. **Background:** Glucose management for the patient with T1DM is a highly debated topic among medical providers. Too much or too little insulin can have dramatic effects on the patient's health and wellness. Diabetes can significantly impact patient outcomes and healthcare expenses. Barriers to consider when educating advanced practice providers is their time, willingness to learn new information, obtaining buy in, and promoting future adherence to the protocol. **Method:** This was a quasi-experimental design quality improvement project. Documented blood glucose readings the morning of surgery were collected for a random 50 preoperative T1DM patients. Preoperative clinic providers were surveyed on their current understanding of the preoperative insulin management protocol, followed by an educational session explaining it in detail. Two months after the educational sessions another random 50 blood glucose levels of patients were selected for comparison. The same survey was distributed to the preoperative providers to assess for change in understanding of the use of the preoperative insulin management protocol. **Results:** The results showed no significant change in the pre-

intervention and post-intervention blood glucose readings among patients with T1DM presenting for surgery. Even though the providers all stated positive levels of confidence with managing insulin preoperatively, and all cited the protocol as their resource for decision-making regarding preoperative insulin recommendation, the answers to the sample clinical questions asked in the survey showed that the protocol was not consistently being used correctly. **Conclusion and Future Recommendations:** There was limited interest and participation from the providers during this project which may have impacted the results and reduced its applicability to other settings. In the future, researchers would benefit from developing protocols with the input of the providers and fully engage with upper management to promote provider buy-in and greater adherence to the new program.

Table of Contents

Background and Significance

The World Health Organization (WHO, 2021) states that diabetes affects 422 million people worldwide. Diabetes is a disease that is characterized by a chronic deficiency in insulin production or function. Type 1 diabetes mellitus (T1DM) patients require daily injections of basal and bolus insulin to maintain their blood glucose levels in an appropriate range. Too much or too little insulin can have dramatic effects on the diabetic patient's health and cause a variety of issues ranging from seizures to diabetic ketoacidosis (DKA). According to the Juvenile Diabetes Research Foundation (2020), T1DM accounts for 5% of diabetes cases and affects roughly 1.6 million Americans. The WHO (2021) states that between 2000 and 2016 there was a 5% increase in mortality in the diabetic patient population and in 2016 it is estimated that 1.6 million deaths alone were a direct cause of diabetes. By 2050 it is expected that five million Americans will have T1DM. Major complications associated with diabetes include cardiovascular disease, increased rates of stroke, limb amputation, kidney failure and blindness (WHO, 2021).

As the incidence of diabetes rises worldwide, it is common for medical providers to encounter patients with T1DM presenting for surgery (WHO, 2021). Mismanaged diabetes can have numerous negative effects, such as increasing cost for both patient and the healthcare system and increased patient complications (Frisch et al., 2010). There is a lack of consensus among the medical community surrounding a target blood glucose level in the perioperative area (Joshi et al., 2010). Complications associated with hyperglycemia in the T1DM population arriving in the perioperative area can delay surgery and cause unnecessary delays in patient care (Joshi et al., 2010).

According to The American Diabetes Association (ADA, 2020), the total cost of diagnosed diabetes in 2017 was 327 billion, with 237 billion being direct medical costs. On average, diabetic patients incur 2.3 times higher medical expenses then a patient without the disease (*ADA*, 2020). When a patient arrives for surgery with a blood glucose that is out of the hospital's acceptable range, the provider must choose between correcting the patient's blood glucose and delaying the procedure, canceling the surgery, or attempting to manage the blood glucose during the procedure. These options pose significant moral, ethical, and safety concerns. Each option can potentially place increased stress and expense on the patient and healthcare institution.

According to Shrank et al. (2019), 25% of total healthcare cost is attributed to waste. Fraud, abuse, failure to deliver care, and failure of care coordination are among many of the factors that contribute to inflated healthcare cost and waste. A study by Frisch et al. (2010) states that ineffective diabetes and insulin management in the perioperative area has been associated with increased complications, longer hospital stays, increased cost, and increased morbidity and mortality. Surgical services constitute approximately 40% of hospital revenue (Macario et al., 1995). At an estimated cost of $15 per minute, even small delays in the operating room can have costly ramifications (Bacchetta et al., 2005). It is prudent for healthcare organizations to have an efficient perioperative area. Since blood glucose is a modifiable factor, effective perioperative glycemic control can be used to decrease long term health complications and decrease overall healthcare waste and cost.

There are many opinions but no definitive research as to what the optimal preoperative blood glucose should be, the correct dose of basal insulin preceding surgery,

and if in fact glycemic control even correlates with positive patient outcomes. While there is no consensus among providers, it's generally agreed the patient's blood glucose should be below 180mg/dl (Joshi et al., 2010). A recent study recommended a narrower preoperative blood glucose target of 140-180 mg/dl (Duggan et al., 2017).

Numerous factors influence a patient's blood glucose; variables such as medications, exercise, insulin regimens, hydration, insulin resistance, injection site, carbohydrate intake, stress, and hormones must all be considered when dosing insulin (American Diabetes Association, 2018). Too little insulin can result in DKA, and too much insulin can result in hypoglycemia and possibly seizures. Whereas both are serious complications, Grunzweig et al, (2016), speculated that the latter often influenced provider insulin recommendations. Insulin has a unique reaction with each patient and their varying sensitivity, and due to this, providers are often hesitant when making insulin dosing decisions (Grunzweig et al., 2016). Insulin management education would reinforce the advanced practice provider's decisions when advising patients.

At the institution where this project took place, there is an inconsistently used preoperative insulin management protocol for making recommendations to T1DM patients. Due to a lack of understanding, provider reluctance or overgeneralized order sets, basal insulin is often inappropriately reduced or completely withheld the night before surgery. Within this facility, reinforcing the perioperative insulin protocol can improve provider usage and help standardize preoperative insulin management in the T1DM population.

Purpose

The purpose of this project was to evaluate an institutions preoperative insulin management protocol and then reinforce its usage by providing an education session to the preoperative clinic providers with a goal of improving blood glucose readings and ultimately better preparing the patient for surgery. A secondary aim of this study was to improve clinician confidence by expanding comprehension of the current insulin guidelines.

Review of Current Evidence

Search Strategy

I conducted a literature review regarding glucose management in the perioperative period and the successful implementation of medical protocols. The purpose of this literature review was to ascertain the current level of knowledge and practice standards within the medical community regarding perioperative insulin management protocols in patients diagnosed with T1DM. I also searched for strategies for providing an educational session to medical providers. CINAHL and PubMed databases were utilized for obtaining information. The following key words and phrases were used: “preoperative type 1 diabetes insulin protocol guidelines,” “diabetes and operating room,” “perioperative insulin management,” “reinforcing protocols,” “nurse and continuing education barriers,” and “operating room delays and diabetes.” I reviewed 40 articles and selected the 28 most up-to-date based on year and relevance to the topic. Inclusion criteria for the articles included discussing patients with type 1 diabetes, optimal range of preoperative blood glucose, and the implementation of healthcare protocols. Exclusion criteria were studies designed to manage blood glucose during the hospital stay. The goal of the literature review was to specifically target type 1 diabetic insulin management, however most

studies found were conducted with both type 1 and type 2 patients dependent on insulin. The four themes that emerged were the relationship between glycemic management and surgical outcomes, perioperative glycemic goals, optimal dosing of insulin preceding surgery and barriers to educating providers.

Relationship Between Blood Glucose Management and Surgical Outcomes

I reviewed several studies measuring the relationship between blood glucose management and postoperative outcomes. Multiple studies demonstrated the importance of tight glycemic control and its effect on surgical complications, infection rate, length of stay and thirty-day readmission rate in the T1DM patient population (Sudhakaran & Surani, 2015; Lovecchio et al., 2014). A study by Merchant et al. (2009) stated that diabetic patients had a 3.6% greater chance of complications with poorly controlled blood glucose. Alfonso et al. (2019) found that patients with diabetes had a higher infection rate and a 8.9% higher hospital readmission rate. Multiple studies demonstrate there is a benefit to the patient when their blood glucose is monitored, and a plan of care is followed. Shah et al. (2020) stated that it was only when the patient's blood glucose was greater than 250mg/dl that the researchers identified an increase in complication rates. Shah et al., (2020) suggested that glycemic control should be less strict to avoid hypoglycemia. Lenguerrand et al. (2018) found that as opposed to increased blood glucose readings, body mass index was a greater predictor of post-operative complications and increased length of stay. They stated that patients with an increased weight were more likely to have other compounding comorbidities like diabetes, hypertension, chronic obstructive pulmonary disease and heart disease, which in turn may result in greater complications, infection rates and increased length of stay. Generally, the

studies suggested a benefit to maintaining a surgical patient's blood glucose between 100 and 200mg/dl.

Lovecchio et al. (2014) found that patients with insulin dependent diabetes have a 7% higher incidence of complications, stroke, pneumonia and infections after joint surgery. Joshi et al. (2010) suggested that patients start preparing for surgery 3 to 4 months in advance to bring their hemoglobin A1C (HgA1C) below 7%. Although there is a great deal of conflicting information on risks associated with the diabetic patient undergoing surgery, all these studies support a degree of glucose management while taking the patient's individual history and comorbidities into account. It appears that patients with greater comorbidities and diabetes may require more preoperative consideration, testing and management to provide safe patient care. Since the role of perioperative blood glucose and its correlation to a patient's comorbidities and outcomes is not fully understood, further research may be needed.

Preoperative Glycemic Goals

Although there are many differing opinions regarding preoperative blood glucose targets, no studies recommended a blood glucose level higher than 180mg/dl. Both Demma et al. (2017) and Rosenblatt et al. (2012) recommend optimal perioperative blood glucose readings between 100 and 180mg/dl. The Society for Ambulatory Anesthesia (SAMBA)(Joshi et al., 2010) consensus statement recommends a blood glucose less than 180mg/dl. Sudhakaran & Surani (2015) also supports these findings by recommending a glucose target between 140 and 180mg/dl. Even though current evidence recommends these targets, factors like nothing by mouth (NPO) status, stress, medications and amount of basal insulin must be considered when making insulin adjustments. Each of these

variables should be taken into consideration and can influence a patient's blood glucose in the hours leading up to surgery (American Diabetes Association, 2018). It is important for the providers to understand that it is impossible to guarantee any blood glucose but by following a standardize protocol there is a greater chance that the patient will arrive for surgery with a blood glucose level in target range.

Optimal Dose of Basal Insulin Prior to Surgery

The T1DM patient population requires supplemental insulin in the hours leading up to surgery in order to avoid surgical delays, hypoglycemia and DKA (Demma et al., 2017). There are many reasons medical providers may deviate from a protocol or reduce basal insulin the night prior to surgery. The fear of hypoglycemia plays a large role in the decision process of medical providers (Grunzweig et al., 2016; Finfer et al., 2009). They state that complications from unrecognized hypoglycemia can involve seizures, neurologic deficits or even death. While a patient is under anesthesia and unresponsive to normal stimulus, recognizing hypoglycemia can be difficult (Schwenk et al., 2012). For these reasons the clinician must be vigilant and acutely aware of the patient's preoperative and intraoperative glucose.

Multiple studies recommended that the T1DM patient take between 75% and 100% of their basal insulin the night prior too surgery and consider reduced doses if the patient has a history of nocturnal hypoglycemia (Joshi et al., 2010; Demma et al., 2017; Duggan et al., 2017). Demma et al. (2017) noted that patients receiving 100% of their basal insulin were at greatest risk for hypoglycemia and suggest that efforts should be made to decrease fasting time and surgery should be scheduled before 10am. Large

reductions in basal insulin may result in the patient arriving in the perioperative area with a blood glucose level out of target for the surgical facility.

Challenges Educating Providers

There are many considerations that must be made when attempting to educate advanced practice providers. Goldberg and Inzucchi (2005) noted the numerous barriers to success when implementing an insulin management protocol. They recommended recruiting allies and implementing multiple educational sessions for the providers. Two studies demonstrated the need for providers to improve communication channels, allow them to ask questions, make suggestions, and voice concerns (Goldberg & Inzucchi, 2005; Stacey et al., 2012). Taking such actions should encourage provider buy-in, decrease fear, increase confidence and help prevent the program from being rejected by the clinicians. Graham (2005) noted that allowing the providers to voice their opinions will increase the chances of protocol adoption. If not presented properly the providers may reject the education and protocol regardless of the intended change or efficacy. These studies demonstrate that obtaining stakeholder support, allowing the providers to participate in the formation of the policy and promotion of open conversation will help to encourage buy-in and protocol adoption.

Summary

Based on this review, a diabetic, pre-surgical patient should take between 75-100% of their basal insulin the night prior to surgery to achieve a perioperative blood glucose between 100-180mg/dl. Although there is a lack of ubiquitous agreement, the SAMBA report (Joshi et al., 2010) is the closest to a comprehensive set of guidelines to treat the diabetic patient in the perioperative period. This review also demonstrates how

mismanaged insulin may have negative effects on a patient's health and the healthcare institution. This review of evidence has shown that providers may be resistant to change. Obtaining provider buy-in is an important step when trying to make significant, long-lasting change. The information reviewed suggests that providing education and reinforcement of current insulin management guidelines to preoperative clinic providers may promote protocol compliance and positively impact the healthcare institution and patient population.

Conceptual Framework

The Diffusion of Innovation Theory (DOI) describes the phenomena at work in the adoption of new behaviors and ideas. This can be used when reinforcing the use of a protocol for preoperative insulin administration with healthcare providers in the preoperative clinic. DOI, originally developed by Rogers in 1962, describes how ideas and new systems diffuse through social systems and are integrated over time. This theory identifies the many communication channels within a social system (1983). Healthcare providers may be resistant to change and ideas that challenge their long-held beliefs and practices. The DOI guided my project in an effort to promote adoption and acceptance of the insulin management protocol.

The Diffusion of Innovation Theory is comprised of five stages: knowledge, persuasion, decision, implementation and confirmation. Singer (2020) describes the steps required for the introduction of information into a system. The first step in the innovation-decision process is knowledge. In this project, the advanced practice providers became aware of the innovations existence and its intended purpose. During the second step, persuasion, the providers developed an opinion regarding the innovation and

decided if there is a need for its existence. During these stages I tried to demonstrate to the providers the importance of the insulin management protocol and gain provider buy-in. In the third step, decision, the providers either adopted or rejected the innovation. In the fourth step, implementation, the providers made the choice to use the protocol and work through any issues that arose. In the final step, confirmation, the providers either accepted or rejected the protocol. Answering questions and facilitating an open conversation among providers was intended to reinforce protocol usage and comprehension.

DOI can be used to assist in the adoption of new evidence-based practice, protocols and social ideas which are aimed at changing the methods and behaviors in healthcare settings. Actively engaging the clinic providers, demonstrating the need for the preoperative insulin management protocol, and collaborating with them to identify barriers to compliance can help promote protocol utilization with the ultimate goal to improve patient care.

Methods

Design

This was a quasi-experimental project with purposive sampling. The purpose of this project was to evaluate an institution's current preoperative insulin protocol, and once assessed, to reinforce the up-to-date protocol, provide education to the preoperative clinic providers, and attempt to improve blood glucose readings in patients to better prepare them for surgery. A secondary aim of this study was to improve clinician confidence by expanding comprehension of the current insulin guidelines.

The preoperative clinic managers provided me a copy of their current preoperative insulin protocol. The protocol was found to be up-to-date and based on current evidence. Based on conversations with clinic managers, I concluded that the clinics' preoperative staff were not consistently using the hospital's standard insulin protocol. To improve utilization of the evidence-based preoperative insulin management protocol, I had the advanced practice providers complete a brief survey then provided education and reinforced the current insulin protocol. Two months later, a post-intervention survey was completed by the providers. I then conducted a retrospective chart review using the hospital's EHR charting system and examined the blood glucose levels of the T1DM patients presenting for surgery pre- and post-intervention.

Translational Model

The Knowledge to Action Framework (KAF) is organized into two pieces, knowledge creation and action cycle, which serve to facilitate change with in a group (Field et al., 2014). The initial components of the framework focus on knowledge inquiry, synthesis and identifying tools for success. The framework has a seven-step process to help the researcher achieve their goals. The first step identifies the problem, including identifying the knowledge gap and reviewing current literature. Patients with T1DM arriving with their blood glucose out of target the morning of surgery is the problem addressed by this project. The second step helps the researcher adapt knowledge and see how it influences their patient population. For this project I provided an educational session for preoperative clinic providers to increase awareness and comprehension of the preoperative insulin management protocol. The researcher identifies barriers to success in step three. I anticipated provider resistance to change,

lack of knowledge about the protocol and limited provider availability due to COVID-19. In step four I implemented my intervention and reinforced the insulin management protocol. During the initial meetings, I provided an easy-to-read laminated copy of the protocol for each provider's own personal use. In step five, I assessed provider knowledge and answered the perioperative clinic providers questions. For step six, I evaluated the providers comprehension of the educational material with a survey and sample insulin management questions. Reviewing the post-education blood glucose values and clinical questions provided in the survey allowed me to evaluate provider comprehension and gauge if the protocol was being followed. Step seven ensures the protocol is adhered to in the future. This is beyond the scope of this project but allows opportunities for further investigation. Continuing education units (CEU) should be encouraged to ensure the protocols continued use. Electronic health record (EHR) prompts and yearly CEU's are encouraged to reinforce the protocol in the future.

The Knowledge to Action Framework provides a structure that considers the many barriers to success. Efforts to reinforce protocols and provide education in a large hospital system is a formidable undertaking with many barriers to success but can be accomplished when combined with a strong action plan, institutional support and provider participation.

Sample and Setting

The setting for this project was a major medical center where greater than 100 surgeries are performed daily. This project consisted of two samples. The first sample contained blood glucose levels from a group of T1DM patients presenting the morning of surgery before and after project implementation. The second sample was preoperative

clinic nurse practitioners and physician assistants who use the insulin management protocol to advise the patient prior to surgery.

I requested one month of preoperative blood glucose level data pre- and post-intervention. A total of 186 T1DM patients in the pre-education month and 212 T1DM patients in the post-education month underwent surgery. The data collected were from both men and women of various ethnicities, with type 1 diabetes. I excluded patients who underwent emergent procedures, and those who did not attend a preoperative clinic, and patients with non-insulin-dependent forms of diabetes.

I met with six providers in the pre-education sessions. They were asked to complete a survey gauging their experience, comfort level advising patients with T1DM and two clinical sample questions. Five of the six chose to fill out the survey. I distributed the survey to five providers in the post-education period. Three of the five chose to return the survey. All education sessions were presented in person in the facility's preoperative clinic or hospital conference room of the providers' choosing.

Intervention

This project was reviewed by the University of North Carolina Greensboro's and the medical facility's Institutional Review Board and determined to not be research. There were three preoperative clinics at the project site. Patients were directed to each clinic based on several factors such as acuity, surgery type, medical discipline and surgeon preference. One clinic does not see patients with T1DM and was excluded from participation. The other two clinics were staffed by nurse practitioners and physician assistants. Upon investigation, I discovered that there was a current insulin management

protocol in place. Best practices and up-to-date research were used to evaluate the hospital's current insulin protocol and it was found to be accurate and current.

I was unable to arrange a single meeting with all providers, therefore I scheduled to meet the nurse practitioners and physician assistants in small groups. The managers provided contact information for the lead providers within their teams. For the pre-intervention session, I scheduled three meetings at three separate locations. Each educational session had two providers attend. During these meetings, the pre-intervention survey was distributed and completed by those willing to participate, followed by questions and clarification regarding the current preoperative diabetes protocol. The post-education survey was distributed at two separate locations. The first location had three providers and the second had two.

During the initial meetings, after survey completion, I gave a ten-minute education session on evidence-based preoperative insulin management, distributed a copy of the preoperative insulin protocol and explained its usage and significance. I provided information on the various types on insulin and action time. After the presentation I allowed the providers to ask questions. Two months after the intervention I invited the providers to participate in another educational session, the providers declined. The post-intervention survey was identical to the initial survey. I handed out five post-intervention surveys, only three chose to participate. I provided the participants two handouts, see Appendix A and B.

Data Collection

Provider Survey

I designed the survey completed by the preoperative clinic nurse practitioners and physician assistants. The survey assessed three areas: clinicians perceived comfort with diabetes, insulin management, and adherence to the preoperative insulin management protocol. I asked the providers to rate their comfort providing preoperative insulin instruction to a T1DM patient on a five-point Likert-type scale. I asked open-ended questions about what resources providers used when making insulin recommendations. The final two questions provided a sample patient and asked the provider to recommend an insulin dosage.

I collected provider survey responses in person and on paper. I asked the providers to complete the survey anonymously and place them in an envelope when finished. The paper surveys were stored in a locked file cabinet. I transferred all survey responses to an Excel spreadsheet for analysis. Once the paper surveys were recorded into Excel, the original copies were shredded. The pre- and post-education surveys were identical and consisted of seven questions. Each survey was comprised of open ended or Likert-type questions.

T1DM Blood Glucose Levels

From the hospital EHR personnel I obtained a list of medical record numbers for T1DM patients presenting to the operating room in the month prior to the provider education session and a second list of medical record numbers for all T1DM patients presenting to the operating room two months after the intervention. All glucose data was collected by myself, at the project site with permission from the facility. All data was deidentified to maintain patient confidentiality.

For the 186 pre-intervention T1DM patient medical record numbers and 212 post-education medical record numbers, I used Microsoft Excel's (2018) random number generator until 50 patients from each sample met the criteria for this project. I then proceeded to manually extract all blood glucose data from the patient charts. Only patient blood glucose readings were recorded; all identifying information was removed.

The initial collection was 50 T1DM patients during a one-month period before protocol reinforcement. The second data collection was another 50 T1DM patients two months after the insulin management protocol had been reinforced. The medical record numbers were sent to my personal email by the EHR personnel. I transferred this data to my offline, password-protected private computer. All information containing medical record numbers and blood glucose data has been erased.

Data Analysis

I calculated mean and median descriptive statistics for the blood glucose data using Microsoft Excel (2018). I utilized Microsoft Excel (2018) to perform a t-test to gauge if a statistically significant change had been noted in T1DM patient blood glucose values post-intervention. After reviewing all the provider post-survey questions, I performed a descriptive statistics analysis. In total there were five providers who completed the pre-intervention survey and the three providers who completed the post-intervention survey.

Results

Current Protocol

I reviewed the institution's preoperative insulin protocol and found it to be current and up-to-date. Protocol recommendations to reduce basal insulin by 20% corresponded

with the literature reviewed. Joshi et al. (2010) and Demma et al. (2017) support the recommendation for T1DM patients to receive 75-100% of their basal insulin the night prior to surgery.

Demographic Data

Of the six providers who attended an education session five medical providers (two nurse practitioners and three physician assistants) completed the pre-intervention survey. Post-intervention, I invited five providers to fill out a survey and three providers (one nurse practitioner and two physician assistant) chose to participate. All respondents had greater than ten years of experience.

Provider Comfort Managing T1DM Patients

Providers reported comfort advising insulin dosage in a type 1 diabetic patients preoperatively. The results are displayed in Table 1.

Table 1
Provider Comfort Level

	Pre-Education Response	Post-Education Response
I feel comfortable giving insulin recommendations.		
Strongly Agree	3	2
Agree	1	1
No Answer	1	0

Resources Used by Providers

All providers on the pre- and post-intervention survey stated they use the facility's insulin management protocol as a resource. One provider reported they use their attending physician as a resource. No other responses were recorded to this open-ended question.

Insulin Management Practice

Two survey questions presented scenarios that asked the providers to make an insulin recommendation to sample patients. The results of the pre-education and post-education scenarios are displayed in Table 2.

Table 2 *Provider Responses to Insulin Recommendation Scenario #1 and #2.*

	Pre-education Correct	Pre-education Incorrect	Post-education Correct	Post-education Incorrect
Insulin scenario #1	2	3	3	0
Insulin scenario #2	3	2	1	2

Blood Glucose the Morning of Surgery

Table 3 shows the mean, median and range of blood glucoses collected the morning of surgery. The statistical results of the data collected is displayed in Table 3.

Table 3 *Fasting Blood Glucose Results the Morning of Surgery Pre- and Post-education*

	Mean (BG)	High (BG)	Low (BG)	<100 (BG)	> 180 (BG)	Median(BG)	% in Target
Pre	148.78	448	59	12	10	138	76%
Post	150.98	394	66	9	10	145.5	82%

Note. BG= Blood Glucose

The mean blood glucose pre- and post-intervention were compared using an F-Test Two-Sample for Variances (Appendix C) and a Two Sample T-Test assuming Equal Variances (Appendix D). The results are displayed below in Table 4. From these results, I can fail to reject the null hypothesis and say there is no statistical difference between the patients' blood glucose readings prior to and after the intervention.

Table 4
Mean Blood Glucose and p-value

Pre-Education Blood Glucose (BG)	Post-Education Blood (BG)	p-value
148.78	150.98	0.874

Note. BG= Blood Glucose

Discussion

The purpose of this project was to evaluate an institution's preoperative insulin management protocol and then reinforce its usage by providing an education session to the preoperative clinic providers with a goal of improving blood glucose readings and ultimately better preparing the patient for surgery. A secondary aim of this study was to improve clinician confidence by expanding comprehension of the current insulin guidelines. I anticipated my intervention would result in more patients with T1DM arriving for surgery with a blood glucose range between 100 and 180mg/dl.

The results of this project are mixed and may have been impacted by numerous factors such as low provider participation and a lack of institutional support. All providers stated they were comfortable with and used the insulin management protocol, but results showed they were using it incorrectly. Between the pre-education to the post-education period there was no statistical change in blood glucose readings prior to surgery. Complications arising from the COVID-19 pandemic and my failure to achieve provider buy-in were among the many significant issues and challenges that may have impacted this project.

Only five providers chose to complete the pre-education survey and three providers chose to complete the post-education survey. Scheduling meeting times with the providers proved difficult for both data collection times. Design errors may be to blame for the low response rate and incorrect answers on the two application questions. Ockene and Zapka (2000), state that clinician time and resources are limited and that educational information should be promoted by leadership and use a variety of ways to engage the participants. Failing to gain institutional support and use a multifaceted approach to education most likely reflected in the lack of provider interest and incorrect

answers on the survey. Goldberg and Inzucchi's (2000) research suggested that collaborating with providers and gaining greater institutional support would promote increased provider buy-in. If I had collaborated closer with the clinic managers, I may have seen improved survey participation and increased usage of the insulin management protocol.

A single ten-minute education session proved insufficient to gain the interest of providers and promote retention of the information. Pre- and post-intervention survey results showed that all providers expressed a positive level of comfort when advising a T1DM patient and stated they use the protocol. However, when posed with application questions, they failed to answer correctly. These results lead me to believe that even though the providers feel comfortable and state they use the protocol, they are not consistently using it or are incorrectly interpreting the guidelines. Due to the small number of providers that participated, it is difficult to make any definitive conclusions.

Pre-provider education blood glucose levels for preoperative T1DM patient were in target 76% of the time and 82% of the time post-education. Recent studies recommended a preoperative target of 100-180mg/dl (Demma et al., 2017; Joshi et al., 2010). The project results show no statistical difference in the mean and median blood glucose readings among T1DM patients arriving for surgery pre- and post-intervention. Numerous reasons may account for this, such as the patients not following the providers advice, lack of provider comprehension regarding the insulin management protocol or provider haste to return to work when filling out my survey (Clark, 2007; Kodner et al., 2017).

This project took place during the COVID-19 pandemic. A recent study regarding consequences of the COVID-19 pandemic among health care professionals showed 43% suffered from work overload and 49% demonstrated an increase in burnout (Prasad et al., 2021). Scheduling meetings with the preoperative clinic provider proved difficult. The providers cited difficulties relating to working during the COVID-19 pandemic as reasons. During the presentation and when completing the survey, the providers seemed preoccupied and uninterested in participation.

Another challenge presented itself during the data collection phase. The EHR staff had difficulty providing the data I requested. A recent study showed that COVID-19 saw an increase in role overload which can have a negative effects on performance (Zhang et al., 2022). The initial blood glucose data request took place when the EHR personnel were implementing the healthcare system's new vaccine mandate. I received responses from the EHR staff ranging from, "I'm too busy at the moment," to "I'll see what I can do, check back in a week." Eventually, I received a list of medical record numbers corresponding with all T1DM patients that presented for surgery in the month requested. I then had to manually sort who met my inclusion criteria. I assume due to the increased workload and role strain caused by the COVID-19 pandemic my request was a low priority. Post-intervention I requested another data set of all T1DM patients presenting for surgery. After multiple requests, they sent a similar list of T1DM patients who presented to the operating room during the allotted time and I again had to manually create my dataset.

Limitations

This project was conducted during the COVID-19 pandemic and may have seen reduced participation by the preoperative clinic providers due to email and survey overload and reduced onsite work hours. During these unprecedented times, some providers saw resources cut, workload increase, job insecurity and workflow dramatically change (Zhang et al., 2022). These complications may account for the resistance to participating in optional in-services, optional surveys, and optional education. Having a larger provider sample size would have increased the accuracy and applicability of my results. Engaging with the providers at an earlier date and working with the team to evaluate their protocol may have provided increased provider-buy-in.

Manager influence may have impacted my initial survey results. During the last pre-education in-service, I noticed a laminated copy of the insulin protocol on the wall of the office. The clinicians stated that two weeks prior to my education session, their manager called a meeting to review the protocol and insisted that they post it in their office for reference. Having recently reviewed the protocol may have artificially improved the clinicians scores on my pre-intervention survey.

When my initial participation invitations were sent to the preoperative clinic leads, they hand-selected the group of clinicians that would join my in-service. Due to this, I have no way of verifying from which preoperative clinic each provider was invited. Therefore, I cannot verify that I was able to in-service all providers at both clinics and some clinicians may have been unavailable or completely overlooked.

During the pandemic, hospital operating rooms saw varying levels of traffic due to the limiting of non-emergent cases. Therefore, my potential sample size was reduced and may have included an increased selection of critically ill than if I were to have

conducted this project in normal operating conditions. Since the EHR staff provided me with a list of the patients that met my criteria, human error in transcription of the data may have compromised the outcome of this project and data collection.

Recommendations for Future Study

The notable gaps and non-specificity in the literature shows there is a need for further study regarding perioperative management of the T1DM patient's blood glucose. Focusing specifically on the type 1 diabetic patient population in the perioperative period would be beneficial. Even though there is a great deal of conflicting data, most of the literature agrees that the SAMBA consensus statement (Joshi et al., 2010) is the most comprehensive look at managing a diabetic patient in the perioperative setting. SAMBA recommends that the type 1 diabetic patient would benefit from taking 75-100% of their basal insulin dose the night before surgery and should be the first case scheduled in the operating room in order to avoid possible hypoglycemia (2010). Most studies agree that when paired with a postoperative management plan, the patient experiences less complications and readmission to the hospital within a thirty-day period, if their blood glucose is managed properly. Following an insulin management protocol in the preoperative clinics would be beneficial for both the economics of the hospital and patient outcomes.

Relevance for Clinical Practice

Optimization of a patient's blood glucose should be a priority for any clinician preparing a patient for surgery. Creating, maintaining, understanding and following an evidence-based insulin protocol would help achieve this goal. My literature review focused on best practices in managing a T1DM patient's blood glucose with insulin. It

should have focused more on provider education and methods for adopting and sustaining evidence-based policy. My experiences in dealing with the clinicians and managers aligned with my literature review. As predicted, I experienced resistance to the incorporation of ideas and educational sessions. My project would have had a greater impact if I would have followed the KAF and DOI theory more closely.

Educating advanced practice providers is a challenging process that requires many steps and has many barriers. For a protocol to have the best chance of adoption and comprehension it is important that it is created by a multidisciplinary team within the hospital, which would encourage provider buy-in. Beginning this venture at an earlier date and forming a relationship with the providers would have improved the success of this project. Having both managers and clinicians involved in the protocol creation would have helped ensure its continued success.

When implementing practice change in the future, once all relevant parties have been educated, steps should be taken to ensure continued understanding and use of the practice change. Medical facilities should consider yearly education modules, prompts on the EHR and offering continuing education credits. These steps would help increase compliance and improve efficiency and patient safety.

Conclusion

Over the past few years, I have noticed numerous type 1 diabetic patients arriving in a hyperglycemic state in the preoperative area. My project demonstrated that patients arrive with an appropriate blood glucose level 76%-82% of the time. Preoperative orders regarding basal insulin management can vary greatly from provider to provider and are often based on the clinician's own experience or comfort level instead of evidence.

Preoperative surgical instructions are given by numerous providers in different fields, with varying degrees of experience in dealing with the T1DM population. Increasing multidisciplinary communication and educating providers on current up-to-date evidence-based guidelines would assist the provider to make confident and informed decisions. Once a protocol has been established, the managers must take an active role in educating their staff and reinforcing its use. Resistance to new and emerging evidence-based practice is common among advanced practice providers and medical professionals. Preoperative clinic providers will most likely need multiple education sessions for proper reinforcement and comprehension of this insulin management protocol. The reinforcement of education and protocols can often be a challenging process and will need continual reinforcement. If these requirements can be met and a preoperative insulin management protocol is successfully adhered to, the healthcare system and patients may see improvement in numerous efficiencies and safety-based areas.

References:

Alfonso, A. R., Kantar, R. S., Ramly, E. P., Daar, D. A., Rifkin, W. J., Levine, J. P., & Ceradini, D. J. (2019). Diabetes is associated with an increased risk of wound complications and readmission in patients with surgically managed pressure ulcers. *Wound Repair and Regeneration*, *27*(3), 249–256. https://doi.org/10.1111/wrr.12694

American Diabetes Association. (2018). Good to Know: Factors Affecting Blood Glucose. *Clinical Diabetes*, *36*(2), 202–202. https://doi.org/10.2337/cd18-0012

Bacchetta, M. D., Girardi, L. N., Southard, E. J., Mack, C. A., Ko, W., Tortolani, A. J., Krieger, K. H., Isom, O. W., & Lee, L. Y. (2005). Comparison of Open Versus Bedside Percutaneous Dilatational Tracheostomy in the Cardiothoracic Surgical Patient: Outcomes and Financial Analysis. *The Annals of Thoracic Surgery*, *79*(6), 1879–1885. https://doi.org/10.1016/j.athoracsur.2004.10.042

Clark, M. (2007). Psychological insulin resistance: A guide forpractice nurses. *Journal of Diabetes Nursing*, *11*(2).

Demma, L. J., Carlson, K. T., Duggan, E. W., Morrow, J. G., & Umpierrez, G. (2017). Effect of basal insulin dosage on blood glucose concentration in ambulatory surgery patients with type 2 diabetes. *Journal of Clinical Anesthesia*, *36*, 184–188. https://doi.org/10.1016/j.jclinane.2016.10.003

Duggan, E. W., Carlson, K., & Umpierrez, G. E. (2017). Perioperative Hyperglycemia Management. *Anesthesiology*, *126*(3), 547–560. https://doi.org/10.1097/ALN.0000000000001515

Field, B., Booth, A., Ilott, I., & Gerrish, K. (2014). Using the Knowledge to Action Framework in practice: A citation analysis and systematic review. *Implementation Science*, *9*(1), 172. https://doi.org/10.1186/s13012-014-0172-2

Finfer, S., Heritier, S., & NICE Study Management Committee and SUGAR Study Executive Committee. (2009). The NICE-SUGAR (Normoglycaemia in Intensive Care Evaluation and Survival Using Glucose Algorithm Regulation) Study: Statistical analysis plan. *Critical Care and Resuscitation: Journal of the Australasian Academy of Critical Care Medicine*, *11*(1), 46–57.

Frisch, A., Chandra, P., Smiley, D., Peng, L., Rizzo, M., Gatcliffe, C., Hudson, M., Mendoza, J., Johnson, R., Lin, E., & Umpierrez, G. E. (2010). Prevalence and Clinical Outcome of Hyperglycemia in the Perioperative Period in Noncardiac Surgery. *Diabetes Care*, *33*(8), 1783–1788. https://doi.org/10.2337/dc10-0304

Goldberg, P. A., & Inzucchi, S. E. (2005). Selling Root Canals: Lessons Learned From Implementing a Hospital Insulin Infusion Protocol. *Diabetes Spectrum*, *18*(1), 28–33. https://doi.org/10.2337/diaspect.18.1.28

Graham, I. D. (2005). Evaluation and adaptation of clinical practice guidelines. *Evidence-Based Nursing*, *8*(3), 68–72. https://doi.org/10.1136/ebn.8.3.68

Grunzweig, K., Nair, B. G., Peterson, G. N., Horibe, M., Neradilek, M. B., Newman, S.-F., Van Norman, G., Schwid, H. A., Hao, W., Dellinger, E. P., & Hirsch, I. B. (2016). Decisional practices and patterns of intraoperative glucose management in an academic medical center. *Journal of Clinical Anesthesia*, *32*, 214–223. https://doi.org/10.1016/j.jclinane.2016.02.027

Joshi, G. P., Chung, F., Vann, M. A., Ahmad, S., Gan, T. J., Goulson, D. T., Merrill, D. G., & Twersky, R. (2010). Society for Ambulatory Anesthesia Consensus Statement on Perioperative Blood Glucose Management in Diabetic Patients Undergoing Ambulatory Surgery. *Anesthesia & Analgesia*, *111*(6), 1378–1387. https://doi.org/10.1213/ANE.0b013e3181f9c288

Kodner, C., Anderson, L., & Pohlgeers, K. (2017). Glucose Managment in Hospitalized Patients. *American Family Physician*, *10*, 648–654.

Lenguerrand, E., Beswick, A. D., Whitehouse, M. R., Wylde, V., & Blom, A. W. (2018). Outcomes following hip and knee replacement in diabetic versus nondiabetic patients and well versus poorly controlled diabetic patients: A prospective cohort study. *Acta Orthopaedica*, *89*(4), 399–405. https://doi.org/10.1080/17453674.2018.1473327

Lovecchio, F., Beal, M., Kwasny, M., & Manning, D. (2014). Do Patients With Insulin-dependent and Noninsulin-dependent Diabetes Have Different Risks for Complications After Arthroplasty? *Clinical Orthopaedics & Related Research*, *472*(11), 3570–3575. https://doi.org/10.1007/s11999-014-3891-4

Macario, A., Vitez, T. S., Dunn, B., & McDonald, T. (1995). Where Are the Costs in Perioperative Care?: Analysis of Hospital Costs and Charges for Inpatient Surgical Care. *Anesthesiology*, *83*(6), 1138–1144. https://doi.org/10.1097/00000542-199512000-00002

Marchant, M. H., Viens, N. A., Cook, C., Vail, T. P., & Bolognesi, M. P. (2009). The Impact of Glycemic Control and Diabetes Mellitus on Perioperative Outcomes

After Total Joint Arthroplasty: *The Journal of Bone and Joint Surgery-American Volume*, *91*(7), 1621–1629. https://doi.org/10.2106/JBJS.H.00116

Prasad, K., McLoughlin, C., Stillman, M., Poplau, S., Goelz, E., Taylor, S., Nankivil, N., Brown, R., Linzer, M., Cappelucci, K., Barbouche, M., & Sinsky, C. A. (2021). Prevalence and correlates of stress and burnout among U.S. healthcare workers during the COVID-19 pandemic: A national cross-sectional survey study. *EClinicalMedicine*, *35*, 100879. https://doi.org/10.1016/j.eclinm.2021.100879

Rogers, E. M. (1983). *Diffusion of innovations* (3rd ed). Free Press ; Collier Macmillan.

Rosenblatt, S. I., Dukatz, T., Jahn, R., Ramsdell, C., Sakharova, A., Henry, M., Arndt-Mutz, M., Miller, V., Rogers, K., & Balasubramaniam, M. (2012). Insulin glargine dosing before next-day surgery: Comparing three strategies. *Journal of Clinical Anesthesia*, *24*(8), 610–617. https://doi.org/10.1016/j.jclinane.2012.02.010

Schwenk, E. S., Mraovic, B., Maxwell, R. P., Kim, G. S., Ehrenfeld, J. M., & Epstein, R. H. (2012). Root causes of intraoperative hypoglycemia: A case series. *Journal of Clinical Anesthesia*, *24*(8), 625–630. https://doi.org/10.1016/j.jclinane.2012.04.009

Shah, N. J., Leis, A., Kheterpal, S., Englesbe, M. J., & Kumar, S. S. (2020). Association of intraoperative hyperglycemia and postoperative outcomes in patients undergoing non-cardiac surgery: A multicenter retrospective study. *BMC Anesthesiology*, *20*(1), 106. https://doi.org/10.1186/s12871-020-01022-w

Shrank, W. H., Rogstad, T. L., & Parekh, N. (2019). Waste in the US Health Care System: Estimated Costs and Potential for Savings. *JAMA*, *322*(15), 1501. https://doi.org/10.1001/jama.2019.13978

Stacey, D., Bakker, D., Ballantyne, B., Chapman, K., Cumminger, J., Green, E., Harrison, M., Howell, D., Kuziemsky, C., MacKenzie, T., Sabo, B., Skrutkowski, M., Syme, A., & Whynot, A. (2012). Managing symptoms during cancer treatments: Evaluating the implementation of evidence-informed remote support protocols. *Implementation Science*, *7*(1), 110. https://doi.org/10.1186/1748-5908-7-110

Sudhakaran, S., & Surani, S. R. (2015). Guidelines for Perioperative Management of the Diabetic Patient. *Surgery Research and Practice*, *2015*, 1–8. https://doi.org/10.1155/2015/284063

The Cost of Diabetes. (2020). https://www.diabetes.org/resources/statistics/cost-diabetes#:~:text=Results,%2490%20billion%20in%20reduced%20productivity.

Zhang, N., Xu, D., Li, J., & Xu, Z. (2022). Effects of role overload, work engagement and perceived organisational support on nurses' job performance during the COVID-19 pandemic. *Journal of Nursing Management*, jonm.13598. https://doi.org/10.1111/jonm.13598

Appendix A

Pre and Post Education Survey

Introduction: My name is Matthew Newton and I am working on my Doctorate of Nursing Practice project. This project focuses on the provider's decisions when dealing with a type 1 diabetic patient in the pre-operative setting. By completing this survey and turning it in you are consenting to participation in this project.

Circle the answer that best describes you.

1. Select your role: Nurse Practitioner Physician Assistant

---

2. How many years have you been practicing as a NP/PA?

<1 1-3 4-6 7-9 >10

---

3. I am comfortable giving preoperative insulin instructions to type 1 diabetic patients.

Strongly Disagree Disagree Neutral Agree Strongly Agree

---

4. When advising diabetic patients in the preoperative setting what resources do you use to help with your decision-making?

_____

5. You are advising a healthy well-controlled type 1 diabetic patient with no other comorbidities.

- No history of nocturnal or early morning hypoglycemia.
- Most recent Hgb-A1c is 7.
- 50 units Lantus at 10PM.
- Surgery: Laparoscopic Cholecystectomy
- Surgery time: 7am.

How much Lantus would you recommend he take the night prior to surgery?

---

6. You are advising a healthy well-controlled type 1 diabetic patient with no other comorbidities.

- No history of nocturnal or early morning hypoglycemia.
- Most recent Hgb-A1c is 7.
- Insulin Pump Basal rate: 1unit per hour for 24 hours with no variations.
- Each day he receives a total of 24units in basal insulin.
- Surgery: Laparoscopic Cholecystectomy
- Surgery time: 7am.

What would your basal and bolus recommendations be beginning the night before and morning of surgery?

_____

7. The following will allow me to pair the pre- and post-survey without collecting any identifying information.

1. Enter the first two letters of your father's birthday month (example January=Ja)
2. Enter the first two letters of your mother's maiden name.
3. Enter the number of siblings you have (include step/half siblings

The resulting code will look something like FeMa3.

Appendix B

Preoperative Diabetes Management Protocol

Preoperative Diabetes Management Protocol

Medication Recommendations

Medication	***Recommendation***
Oral Diabetic Agents[1] (excluding metformin) (Sulfonylurea, DPP-IV, TZD, SGLT-2, meglitinide, alpha-glucosidase inhibitors)	Hold morning of surgery
Metformin[2] (including combinations)	Hold 24-36 hours prior to surgery
Non-Insulin Injectables (GLP-1 agonist, amylin analogue)	Hold on the morning of surgery
Insulin Pump[3]	Continue basal rate No bolus on morning of surgery
Long-acting Insulin[4] glargine (Lantus), detemir (levemir), degludec (Tresiba)	20% reduction of evening and/or morning dose
Intermediate-acting Insulin NPH	50% reduction of evening and morning dose

Short-acting Insulin, (regular) or **Rapid-acting Insulin,** lispro (Humalog), aspart (Novolog), glulisine (Apidra)	Hold on the morning of surgery
Pre-mixed Insulin (NPH/lispro, NPH/aspart, NPH/regular)	Hold on the morning of surgery May administer 50% of Intermediate-acting component prior to procedure

1. May continue **TZDs** (caution in CHF patients) and **DPP-IV inhibitors.** Hold **longer acting sulfonylureas**(chlorpropamide, tolazamide, tolbutamide) for 24-48 hours.

2. Hold **metformin** 36-48 hours prior to surgery if known reduced EF/CHF, Cirrhosis, CRI or procedure involves risk for renal hypoperfusion (or procedure>6 hours).

3. Schedule patients with **insulin pumps** as close to first case as possible, notation needs to be made on O.R. schedule that patient has continuous "insulin pump". May consider reduction of up to 50% of basal rate based on patient FBG history.

4. Recommendations vary for **long-acting insulin** reductions between 0%-50% of dose, larger reductions reserved for patients with history of AM hypoglycemia.

- All Diabetic patients must have **HgB A1C** on record within 3 months of surgery.
    - **HgA1C results (preoperative recommendations)**:
        - <8% = OK to proceed with surgery as scheduled
        - >8-10 % = Associated with longer hospital LOS , proceed with surgery, follow glucose q 1hr perioperatively, note average serum glucose 250 - 300 mg/dl with this range
        - >10 % = High, prefer to reschedule case as pt requires further medical management prior to surgery referral to endocrinology or internal medicine for improved glucose regulation/ medical management.

Sulfonylurea	First generation: Chlorpropamide (Diabinese), Tolbutamide (Orinase), Tolazamide (Tolazamide)

	Second generation: Glimepiride (Amaryl), Glipizide (Glucotrol), glyburide (Diabeta, Glynase),
alpha-glucosidase inhibitors	Acarbose (Precose), Miglitol (Glyset)
TZD (Glitazones)	Pioglitazone (Actos), Rosiglitazone (Avandia)
meglitinide	Nateglinide (Starlix), Repaglinide (Prandin)
DDP-IV	Alogliptin (Nesina), Linagliptin (Tradjenta), Saxagliptin (Onglyza), Sitagliptin (Januvia)
SGLT-2	Canagliflozin (Invokana), Dapagliflozin (Farxiga), Empagliflozin (Jardiance)
GLP 1 agonist	Albiglutide (Tazeum), Dulaglutide (Trulicity), Exenatide (Byetta, Bydureon), Liraglutide (Saxenda, Vicotza)
Amylin Analogue	Pramlintide (Symlin)

Appendix C

Part 1: Glucose levels

F-Test Two-Sample for Variances

	Pre	*Post*	
Mean	148.78	150.98	
Variance	5828.13429	3755.08122	
Observations	50	50	
df	49	49	
F	1.5520661		
P(F<=f) one-tail	0.06367191		0.12734381
F Critical one-tail	1.60728946		

Appendix D

t-Test: Two-Sample Assuming Equal Variances

	Pre	*Post*
Mean	148.78	150.98
Variance	5828.13429	3755.08122
Observations	50	50
Pooled Variance	4791.60776	
Hypothesized Mean Difference	0	
df	98	
t Stat	-0.1589103	
P(T<=t) one-tail	0.43703328	
t Critical one-tail	1.66055122	
P(T<=t) two-tail	0.87406657	
t Critical two-tail	1.98446745	