9-13-2023

Evaluation of Provider Adherence to an Intraoperative Glucose Monitoring Guideline at a Midwestern Academic Hospital

Lauren Schoolfield  
*Barnes Jewish College, Goldfarb School of Nursing*

Taylor Crittenden  
*Barnes Jewish College, Goldfarb School of Nursing*

Follow this and additional works at: https://digitalcommons.wustl.edu/dnp_golfarb

*Part of the Nursing Commons*

**Recommended Citation**  
https://digitalcommons.wustl.edu/dnp_golfarb/10

This Other is brought to you for free and open access by the Barnes Jewish College Goldfarb School of Nursing at Digital Commons@Becker. It has been accepted for inclusion in Doctor of Nursing Practice (DNP) Student Projects by an authorized administrator of Digital Commons@Becker. For more information, please contact vanam@wustl.edu.
Evaluation of Provider Adherence to an Intraoperative Glucose Monitoring Guideline at a
Midwestern Academic Hospital

Taylor Crittenden and Lauren Schoolfield
Goldfarb School of Nursing
Barnes Jewish College

Chair: Julie Spencer
Committee Member: Brian Torres
Committee Member: Rachel Wolfe
Date of Submission: December 3, 2022
Abstract

Background and Review of Literature: Patients with diabetes (PWD) are at higher risk of requiring surgery and developing complications in the perioperative period making euglycemia an important component of intraoperative care. There is an association between dysglycemias and adverse perioperative outcomes. Implementation science evidence indicates that education with audit feedback strategies towards barrier identification to clinical practice guideline (CPG) uptake will improve implementation success.

Purpose: The purpose of this quality improvement project was to evaluate and improve adherence to intraoperative glucose monitoring outlined by the current intraoperative glucose management guideline at a midwestern academic hospital through barrier identification with tailored educational programs and audit feedback strategies.

Methods: Baseline patient data via a retrospective chart review were collected, organized, and analyzed along with, provider attitudes and barriers towards the blood glucose guideline via a provider Likert-type survey.

Implementation Plan/Procedure: An education component tailored to the identified barriers was presented in a PDF PowerPoint and distributed via email and in-service roving education to anesthesia providers in the operating room caring for PWD.

Implications/Conclusion: The purpose, aim, and objectives of the DNP project were met in regards to implementing an educational initiative to all anesthesia providers. An improvement was seen at the four-week interval during the roving in-service education. It is expected for adherence rates to continue to improve as additional system electronic health record changes are implemented in the upcoming months. In addition, the goals of identifying the top three barriers to the intraoperative guideline and providing a baseline adherence rate were achieved.
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL

*Keywords:* diabetes mellitus, diabetic patients, glucose control, glucose monitoring, hospital policies, protocols, guidelines, education, intraoperative care, guideline adherence, intraoperative monitoring, academic medical centers, education providers
Diabetes mellitus (DM) affects millions of Americans and is associated with a variety of undesirable effects that can be exacerbated by physiological stress such as that associated with surgery (Franco et al., 2019). Patients with diabetes (PWD) undergoing surgery have longer hospital stays, more infection complications and higher morbidity and mortality rates than those without diabetes (Franco et al., 2019). Even with the known complications there is still an unclear consensus on preoperative, intraoperative, and postoperative blood glucose monitoring and management of DM. There are current recommendations by the Endocrine Society and the Society for Ambulatory Anesthesia to target glucose levels of < 180 mg/dL during the intraoperative period but not for interval monitoring. With the known adverse effects of hyperglycemia and hypoglycemia healthcare providers and facilities have developed clinical decision support tools to help standardize care based on the currently available evidence.

Background

Kharroubi & Darwish (2015) defines DM as “a group of metabolic diseases characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both” (p. 851). Diabetes mellitus is associated with significant complications in multiple organ systems including myocardial infarctions, cardiomyopathy, chronic kidney disease, end stage renal failure, gastroparesis, and peripheral neuropathy (Galway et al., 2021). The disease can be classified as either type one or type two and affects millions of Americans every year (Kaur & Joyner, 2019). Type one diabetes mellitus (T1DM) is an autoimmune disorder where the body destroys the pancreatic insulin-producing beta cells. The pancreas can no longer produce insulin leading to a lifelong dependency of exogenous insulin administration. Type two diabetes mellitus
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL (T2DM) is caused by peripheral insulin resistance or a decreased amount of insulin secretion from the pancreas. Insulin is an important anabolic hormone that is responsible for the transport of glucose into cells for energy and allowing glucose to serve as a metabolic intermediate used “in the biosynthesis of cellular building blocks such as lipids, nucleotides, and amino acids” (Kumar et al., 2020, p. 1101).

Genetics along with a history of cardiovascular disease, hypertension, hyperlipidemia, polycystic ovarian syndrome, and obesity are some of the risk factors that can contribute to the complex endocrine disease (Galway et al., 2021). Major complications throughout the body can occur in PWD due to the microvascular and macrovascular changes that develop in the organs and vessels. In PWD, the body’s inability to produce insulin, control the release of insulin, or react to excessive or decreased circulating glucose can lead to hyperglycemia or hypoglycemia (Kaur & Joyner, 2019). Sources vary for the defined glucose levels of hyperglycemia, but in general it is when glucose levels are greater than 180 mg/dL. Hyperglycemia can also lead to a pro-inflammatory state, immunosuppression, vascular damage, ketoacidosis, and a hypercoagulable state. Hypoglycemia is defined as a blood glucose level less than 70 mg/dL (Drews et al., 2012). Hypoglycemia can lead to tremors, anxiety, palpitations, sweating, coma and even death (Galway et al., 2021). Blood glucose levels and insulin sensitivity vary among individuals and the side effects of hypoglycemia or hyperglycemia can be seen at different glucose levels. Both hypoglycemia and hyperglycemia can lead to multiple electrolyte disturbances putting the patient at risk for cardiac dysrhythmias, longer hospital stays, and increased mortality (Duggan et al., 2017).

**Problem Statement**
A significant fluctuation in glucose levels is seen in patients undergoing surgery and anesthesia (Kaur & Joyner, 2019). Fasting, adjusted dosing of antidiabetic medications preoperatively, surgical stress, and anesthetic agents are all stressors that can alter homeostasis (Galway et al., 2021; Kaur & Joyner, 2019). A patient under anesthesia is unable to detect if their glucose levels are too low or too high, making it critical for providers to closely monitor glucose levels and signs of glycemic derangement. The body’s natural stress response to surgery also contributes to hyperglycemia through the development of insulin resistance and through the production of glucose (Wolfe, 2018). This makes the maintenance of glycemic control more difficult in the perioperative period. It is essential to keep patients euglycemic during the intraoperative period to avoid the associated complications with dysglycemia (Galway et al., 2021). Anesthesia providers including anesthesiologists, anesthesiology fellows, anesthesiology residents, certified registered nurse anesthetists (CRNAs), and student registered nurse anesthetists (SRNAs) are responsible for glucose monitoring and management of patients under anesthesia. There are inconsistent provider practices with glucose monitoring intraoperatively in PWD undergoing surgical procedures. The most recent institutional data looking at adherence to blood glucose monitoring are not comprehensive (due to the inconsistent practices and data collection methods); thus, an analysis of the institution’s adherence to the current blood glucose guideline was lacking.

Purpose, Aims, & Objectives

The purpose of this project was to assess the adherence to the Washington University of St. Louis (WUSTL) Physicians and Barnes Jewish Hospital’s (BJH) System Guideline for Perioperative Glycemic Management of the Adult Surgical Patient-Perioperative/Surgery/Anesthesiology Guideline; specifically, Appendix 6 within the guideline
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL (See Appendix A) with current, valid data. The current guideline states that, during the intraoperative phase, patients with T1DM should have hourly blood glucose checks, and patients with T2DM should have bihourly glucose checks (Wolfe, 2022). This project allowed for a baseline understanding of how well providers followed the guideline. As intraoperative blood glucose monitoring is necessary to evaluate the quality of perioperative glucose management provided, this project verified the degree to which the institution was appropriately caring for PWD in their perioperative care areas. The project’s objective was to implement an educational program to all anesthesia providers tailoring the identified barriers to glucose monitoring at every one (Q1) and every two (Q2)-hour intervals for patients with T1DM and T2DM respectively per institutional guidelines adherence. The effect of the educational intervention was measured by comparing baseline adherence with post-intervention adherence rates. The overall objective was to improve anesthesia provider adherence by 20% of the current adherence rate by the 6-week post-education data collection point. Provider attitudes towards the current guideline were also measured via an electronic survey pre- and post-intervention.

**PICOT Question**

The project answered the PICOT question: In anesthesia providers caring for patients with diabetes at a midwestern academic hospital (P), does providing education tailored to providers’ barriers to adherence to the intraoperative glucose monitoring guideline (I), compared to standard education (C), lead to improved adherence to the guideline (O) over a 6-week period (T)?

**Significance**

The International Diabetes Federation (IDF; 2021) Diabetes Atlas 10th edition, reported 537 million adults living with DM globally. The Centers for Disease Control and Prevention
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL (CDC; 2022b) reported 37.3 million people with diabetes, which equates to 11.3 percent of the United States (U.S.) population. Of the 37.3 million, 28.7 million are diagnosed while 8.5 million people are undiagnosed (CDC, 2022b). Type 2 DM is more prevalent than T1DM. Of those diagnosed with DM, more than 95% are diagnosed with type two (World Health Organization [WHO], 2021). Globally, DM was responsible for 6.7 million deaths in 2021 (IDF, 2021). Diabetes was the eighth leading cause of death in the U.S. in 2020 at 102,188 deaths (CDC, 2022a). An estimated 25 percent of PWD will require surgical intervention (Loh-Trivedi & Croley, 2021). Health expenditure from DM was at least 966 billion U.S. dollars in 2021, a 316% increase over the last 15 years (IDF, 2021).

People with DM are more likely to require surgical procedures at some point in their life due to the associated macrovascular and microvascular complications in multiple organs (Galway et al., 2021). Since 11% of the U.S. population have DM, it is imperative that providers are following a guided approach to care for PWD (CDC; 2022b). A practice gap existed at a midwestern academic hospital regarding intraoperative provider adherence to the current perioperative glucose management guideline. In order to gauge adherence to a glucose management guideline, factors including evaluation of perioperative documentation and an assessment of barriers to adherence needed to be identified.

**Review of Literature**

**Evaluation of Search Strategies and Results**

PubMed, CINAHL, Science Direct, and Proquest databases were searched with a focus on setting and population. General terms regarding the setting, intraoperative, perioperative and midwestern United States were used. General terms of population included diabetes mellitus (DM) and diabetic patients. Additional terms used were glycemic control, glucose monitoring,
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL

hospital policies, protocols, guidelines, and education. In addition to the general terms used, Medical Subject Headings (MeSH) including DM or diabetic patients, intraoperative care, glycemic control, methods, guideline adherence, intraoperative monitoring, academic medical centers, and education providers were also used. The years searched were narrowed down to within the last five years; however, a larger range was used when less than 5 articles were found.

Grey literature, found online but not necessarily in literature databases, was also considered. The National Quality Measures Clearinghouse (NQMC) had some tools used to audit glucose monitoring with administration of insulin or audits for intraoperative debriefing which included elements of glucose monitoring. None of the tools reviewed fit the project criteria specifically but were used later when developing an audit form for glucose monitoring. The National Institute of Health (NIH) website produced an abundance of results for articles. However, the NIH website does not provide result filtering options, thus manual exclusion was implemented. After reviewing 140 articles, nine were considered potentially useful when screening for pertinence to intraoperative glucose management. The CDC website had useful information on DM and statistics surrounding the disease. After entering some general search terms there were no further articles found that were useful or specific to the project. The World Health Organization yielded similar results. The Clinical Trials website produced several research studies relevant to this project. Two themes identified in the literature were the adverse outcomes of abnormal glucose levels and healthcare protocol implementation strategies.

Adverse Outcomes of Abnormal Glucose Levels

The American Diabetes Association states hyperglycemia may lead to significant acute adverse outcomes such as a diabetic coma and severe acidosis, while hypoglycemia may lead to an increased heart rate, impaired/blurred vision, seizures, coma and death (American Diabetes
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL

Association [ADA], n.d.). An influential diabetes research study, the Diabetes Control and Complications Trial (DCCT), demonstrated the association with poorly controlled glucose levels and adverse clinical outcomes (Massachusetts Medical Society, 1993). The DCCT found that interventions aimed to achieve a normoglycemia reduced microvascular organs (eyes, kidneys, peripheral nervous system) and cardiovascular complications in PWD. The DCCT trial set the pathway for the clinical course of PWD, complications caused by diabetes, and the impact of a controlled blood glucose level. In a 17-year prospective, nonrandomized, interventional study, of 4,864 PWD who underwent an open-heart surgical procedure, increased blood glucose levels were directly associated with increased rates of mortality, sternal wound infections, length of stay, and hospital costs (Furnary et al., 2004).

The Johns Hopkins Nursing Evidence-based Practice (JHNEBP) process was used to evaluate the strength and quality of research evidence found in the earlier described database search (Dearholt & Dang, 2012). This system includes five levels of strength with level I considered the highest level of evidence obtained from an experimental study, RCTs, or with systematic review of RCTs with or without meta-analysis. Research is considered level II when it is a quasi-experimental study or systematic review of a combination of RCTs and quasi-experimental or quasi-experiment studies only, with or without meta-analysis. Level III is evidence obtained from a quantitative non-experimental study, systematic review of a combination of RCTs, quasi-experimental, non-experimental studies, or non-experimental studies only with or with meta-analysis. Level IV is evidence that includes clinical practice guidelines and consensus panels. Level V evidence includes literature reviews, quality improvements, and case reports. The quality rating scheme for evidence was graded high, good, or low.
Of the six recent articles found with the theme of adverse outcomes of abnormal glucose levels, three of these articles were level I RCTs and three were level III cohort studies. The three RCTs identified hyperglycemia effects in PWD undergoing surgery but are low quality, with low precision and reliability (Blixt et al., 2012; Blixt et al., 2021; Umpierrez et al., 2015). Two of these studies made significant efforts to reduce bias by sealing the allocations, blinding the individual evaluating the results, reporting attritions and exclusions, and having no statistical differences in demographics between groups (Blixt et al., 2012; Blixt et al., 2021). In addition, these three studies did not mention risk indices or confidence intervals. Power analysis was used in only one study (Umpierrez et al., 2015) but statistical significance could not be determined due to inadequate sample size. In addition, two studies had sample sizes less than 20 participants (Blixt et al., 2012; Blixt et al., 2021).

Multiple studies of varying strength and quality identified the importance of glucose control to improve clinical outcomes following surgery (Carlsson et al., 2021; Garg et al., 2018; Long et al., 2019). Two level III, good quality, cohort studies identified hypoglycemic incidences following surgery in those with and without diabetes (Carlsson et al., 2021; Garg et al., 2018). These studies had larger sample sizes but did not use power analysis for accuracy. Two cohort studies identified increases in hyperglycemia events in patients with and without diabetes undergoing surgery (Carlsson et al., 2021; Long et al., 2019). However, the evidence is limited by wide or unreported confidence intervals. Long et al. (2019) demonstrates strength with multiple odds ratios greater than one and significant efforts to reduce bias. In addition, they also use multivariable logistic regression to quantify the strength between single hyperglycemic events and negative postoperative outcomes.
Evidence demonstrates the association between abnormal glucose levels and adverse post-surgical outcomes. The search conducted found a lack of recent, high quality RCTs of intraoperative glucose management entailing the use of two articles published greater than 5 years ago. There is a gap in research focusing on the optimal interval of glucose monitoring during the intraoperative period.

**Implementation Strategies**

Implementation science is defined as “the scientific study of methods to promote the systematic uptake of research findings and other evidence-based practice into routine practice and, hence, to improve the quality and effectiveness of health services” (Eccles & Mittman, 2006 as cited in Bauer & Kirchner, 2020, sect. 3.2). Evidence in 36 RCTs supports the use of multifaceted approaches over single strategies for successful implementation of nursing practice guidelines within healthcare (Cassidy et al., 2021). Two effective strategies for the uptake of nursing clinical practice guidelines (CPGs) are identified in the literature.

Research in 53 RCTs and 23 systematic reviews emphasizes educational strategies and an audit and feedback strategy (Allanson et al., 2017; Cassidy et al., 2021; Chan et al., 2017). Educational strategies included educational meetings, educational materials, and educational outreach visits (Cassidy et al., 2021; Chan et al., 2017). Allanson et al. (2017) included any process of educating healthcare providers. Chan et al. (2017) defined educational outreach programs as “use of a trained person who met with providers in their practice settings to give information with the intent of changing the provider’s practice. The information given may have included feedback on the performance of the provider(s)” (table 1). Training packages (including onsite and distance), workshops, and in-service were included under educational outreach programs. Most studies found a combination of educational outreach with other strategies, such
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL as resource distribution, to be beneficial. Resource distribution included the provision of human or physical resources as a formal part of implementation (Allanson et al., 2017).

Chan et al. (2017) defined the audit and feedback strategy as “any summary of clinical performance of healthcare over a specified period. The summary may also have included recommendations for clinical action. The information may have been obtained from medical records, computerized databases, or observations from patients” (table 1). Audit and feedback included formal feedback, formal audit sessions, delivery of customized feedback, self-monitoring, and reporting of surveillance benchmarks.

Research provides evidence of the positive effects of these strategies on the process-of-care, professional knowledge outcomes, clinical effectiveness such as patient mortality and morbidity outcomes, and cost-effectiveness such as resource use. Process-of-care includes professional practice outcomes such as compliance. Using a combination of educational outreach, educational materials, and audit and feedback strategies resulted in positive effects on each outcome. In a systematic review, findings in 11 RCTs were statistically significant when assessing the positive effect of the implementation success outcomes measured (Cassidy et al., 2021). Process-of-care and clinical effectiveness were the outcomes where the research demonstrated the most effectiveness from the combination of implementation strategies (Chan et al., 2017).

Barrier identification of providers’ adherence to CPG was included in the research (Allanson et al., 2017; Cassidy et al., 2021). Barriers to clinician adoption or adherence to guidelines in research were expressed further as time constraints, limited staffing resources, clinician skepticism, clinician knowledge of guidelines, and higher age of the clinician (Chan et al., 2017). Qumseya et al. (2021) described a validated survey tool sent out via email to identify
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL

physicians’ barriers to guideline adherence in addition to their attitudes toward CPGs (see Appendix B). The survey tool was developed by an expert team in guideline development and survey methodology. The tool was validated by “establishing face, content, and constructs validity” (Qumseya et al., 2021. p. 7592). The tool was evaluated by 33 expert physicians. Expert feedback was taken into consideration when finalizing the tool (Qumseya et al., 2021). This survey could be tailored for use with other providers in other large academic hospital settings.

The evidence includes two level I systematic reviews with 86 RCTs reviewed and one level III systematic review with 55 SRs and 16 SR overviews evaluated with varying quality. Although the majority, RCTs were not the exclusive methodology used in the reviewed research, weakening the evidence. Validity was increased by using a vast variety of databases in each review. EMBASE and Medline were searched by Allanson et al. (2017) and Cassidy et al. (2021). Cassidy et al. (2021) also searched CINAHL, PsycINFO, and AMED databases. PubMed and other National Library of Medicine sources were searched by Chan et al. (2017). Cochrane resources including the Cochrane Library, clinical trials registry, and Effective Practice and Organisation of Care (EPOC) registry were also searched (Allanson et al., 2017; Cassidy et al., 2021; Chan et al., 2017).

Each article was individually assessed for bias by project team members. Allanson et al. (2017) found 39% of RCTs were high risk of bias, 26% were low risk of bias, and the remaining 35% had an unclear risk of bias. Analysis bias and attrition bias were the most frequent types of bias reported. Cassidy et al. (2021) found low risk of bias in their allocation concealment, baseline outcome measurements, baseline characteristics, and other sources of bias (78-90% of RCTs). The highest risk of bias was detected when incomplete outcome data and contamination
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL was present (27% and 17% respectively). The Assessment and Multiple Systematic Reviews (AMSTAR) tool was used to determine the quality of each review resulting in low risk of bias within the RCTs (Cassidy et al., 2021; Chan et al., 2017). Chan et al. (2017) scored 23 SRs as good-quality, 16 SRs as fair-quality, and 7 SRs as poor-quality. Chan et al. (2017) did not discuss bias in specific SRs. The research used a two-person independent review process for each article/review improving validity. The literature lacks quantitative evidence of the magnitude of benefit of using educational strategies or audit and feedback to improve successful implementation. The literature failed to assess publication bias within the reviews. Another weakness was the inability to complete a meta-analysis of quantitative outcomes due to heterogeneity of the data reported (Allanson et al., 2017; Cassidy et al., 2021). Quality of implementation reporting was highly variable, limiting the analysis in each review.

**Patient Population and/or System Needs**

The population included all anesthesia providers (anesthesiologists, anesthesiology fellows, anesthesiology residents, CRNAs and SRNAs) at BJH involved with blood glucose monitoring and management. The other population was PWD who are undergoing a procedure requiring anesthesia services. A patient under anesthesia is unable to detect if their glucose levels are too low or too high, making it critical for anesthesia providers to closely monitor glucose levels and signs of glycemic derangement. Inconsistent provider practices with glucose monitoring intraoperatively in PWD undergoing surgical procedures was identified. In addition, the most recent data looking at adherence to blood glucose monitoring were not comprehensive thus, an analysis of the institution’s adherence to the current blood glucose guideline was inadequate.

**Evidence of Literature for DNP Project**
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL

Review of the current literature demonstrated adverse outcomes of abnormal glucose levels, including perioperatively. There is limited, variable quality evidence of best practices for monitoring blood glucose and treating abnormal glucose levels (Franco et al., 2019). The center of diabetes management and the focus of CPG in PWD is glucose control (Franco et al., 2019). Understanding the effects of abnormal glucose levels on clinical outcomes and the importance of protocol implementation strategies can increase provider knowledge and improve patient outcomes. The literature suggests that identification of barriers to adherence and educational programs focusing on current practice guidelines can be effective in increasing knowledge of protocols and ultimately lead to improved glucose control during the perioperative period. The adverse outcomes of abnormal glucose levels identified in the literature made it imperative to identify barriers and solutions to improve provider adherence to institutional guidelines.

Conceptual/Theoretical Framework or Evidence Based Practice Model

This Doctor of Nursing Practice (DNP) project was a quality improvement (QI) project focusing on the improvement of processes and outcomes in the intraoperative setting regarding blood glucose monitoring in PWD. It focused on the “processes of care, the patients, the care team, and the use of data to drive change” (Moran et al., 2020, p.138). The six aims outlined by the IOM report Crossing the Quality Chasm were implemented including safe, effective, patient-centered, timely, efficient, and equitable. Evidence supports implementing educational programs with audit and feedback strategies for successful implementation of CPG. Barrier identification is also identified as a method of improving CPG uptake. This guided the framework for the QI project. Individual adherence barriers specific to the project setting were identified and an educational program was created. The educational program includes materials and a presentation tailored to the identified barriers. With the education complete, the audit and feedback strategy was fulfilled.
Feedback was collected from participants via a provider survey assessing the attitudes toward the glucose guideline as well as the education provided. A comparison in provider adherence to the glucose guideline prior to and following the education was completed.

**Theoretical Framework**

The Donabedian Model proposes that three components: structure, process, and outcome are linked and determine results (Boston University School of Public Health, 2016). See Appendix C. The structure implies the technique in which care is delivered including facilities, equipment, and staff. This project was conducted in the operating rooms at BJH named POD one through five. Project structure included surveys and implementation of education for the anesthesia providers. The process component involves all the interactions that occur between patients and providers such as treatments, preventative care, and education. Outcomes include the effects of healthcare implementations, satisfaction, and improved knowledge (Boston University School of Public Health, 2016). The project process was data collection via retrospective chart review, a pre-implementation barrier and attitudes survey, education on identified barriers, and post-implementation data collection via the same pre-implementation survey and three additional chart reviews. Outcomes included barrier identification, education implementation, identification of attitudes toward the glucose monitoring guideline, and increased rate of adherence to the guideline.

**Methodology**

In an effort for this QI project to evaluate and improve adherence to intraoperative glucose monitoring at BJH, baseline patient data, provider attitudes and barriers towards the blood glucose guideline were collected, organized, and analyzed to see where the education implementation focus should start.
Project Design

The Six Sigma model focusing on identifying and eliminating defects in a process to reduce variability and improve outcomes was used to guide this project (Moran et al., 2020). The Six Sigma model "uses the DMAIC strategy—Define (define the opportunity for improvement, the project goals, and the key stakeholders), Measure (determine what to measure and collect the data), Analyze (analyze the data to determine the root cause), Improve (implement a solution and continue to collect data to evaluate the outcome), and Control (develop and initiate a monitoring plan)" (Moran et al., 2020, p. 142). This project evaluated provider adherence and barriers impeding adherence to the current intraoperative glucose monitoring guideline. It provided tailored education and assessed attitudes with the goal of improving adherence rate. A validated survey tool was selected and adapted for the project identifying institutionally specific barriers to intraoperative glucose monitoring guideline adherence. A project-specific survey of provider attitudes towards the guideline was administered prior to and following the education intervention. The perceived adherence barriers and provider attitudes were comprised of the qualitative findings and the supplied survey responses were presented quantitatively as frequencies and percentages. The data collected on barriers were analyzed then used to create an educational intervention specific to areas identified for improvement. The educational intervention was implemented then adherence rates were evaluated at two-, four-, and six-weeks post-education to determine if any change occurred. Monitoring post-educational intervention adherence and attitudes was part of the audit and feedback strategy.

Health Promotion/Disease Prevention

Evaluating and improving provider adherence to blood glucose monitoring intraoperatively aims to reduce perioperative adverse outcomes. This improves the health of PWD undergoing anesthesia at BJH during the perioperative period. Mitigation of risk for PWD
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL is crucial during the perioperative period for optimizing post-operative outcomes. This project also validated current practices used to measure institutional standards of care for PWD during the intraoperative phase. This was accomplished by pulling retrospective EHR (electronic health record) data via Tableau, organizing into Excel worksheets, and analyzing the data via IBM Statistical Package for the Social Sciences (SPSS). This project can be used for the pre- and post-operative phases of care in future QI projects.

**Stakeholders**

There were multiple stakeholders for this project as glucose control in the perioperative service involves many providers across several phases of care (Wolfe, 2018). Stakeholders included individuals that were either involved or affected by healthcare decisions, policies, and programs related to glycemic control in the perioperative services (Petkovic et al., 2020). Stakeholders for this project were the providers of intraoperative anesthesia services. Their role included providing feedback on current glucose monitoring and the current guideline, helping identify barriers, and implementing new changes. The anesthesia providers were the active participants using the guideline and documenting in patient records. An important stakeholder that was also affected by the project was PWD presenting for surgery. They benefited from the improved data validation, increased education in the perioperative department, and an improved glucose control guideline. Another stakeholder was those responsible for quality metrics and analysis at the institution. This project involved data validation which includes extracting information from the electronic medical records and confirming accuracy of the data. The data was subsequently analyzed for adherence with the perioperative glycemic management guideline. Administrative and clinician leaders have a stake in knowing that the data they use for decision making reflect the actual quality of care being
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL delivered. Finally, the WUSTL Anesthesia department, BJH, and Goldfarb School of Nursing (GSON) were stakeholders and advisors to the project.

Resources

The overall cost for the proposed DNP quality improvement project was minimal. Three categories were included in the breakdown cost: personnel, materials, and technology. See Appendix D for a detailed description. Personnel time included forty-five minutes of salary pay from the anesthesiologists, anesthesia residents and fellows, CRNAs, and SRNAs. Fifteen minutes of their time was for the presented PDF PowerPoint education. In addition, 15 minutes for each survey completion pre and post education. The education and survey completion occurred during scheduled working hours where overtime was not needed to complete the tasks. Personnel costs were paid for by the Washington University in St. Louis Department of Anesthesiology. The time of the DNP project members was also considered for the time and effort into the project. Materials for the project were minimal to none. The project did not anticipate the need for printed material unless a paper copy is requested by personnel. The presentation, education material, collection, and analysis of data was conducted and distributed electronically. The technology cost for the project included Microsoft PowerPoint and Excel, Qualtrics survey software, SPSS version 27, EHR, and Microsoft Teams. Microsoft was provided for free for those with a Microsoft 365 email which included the staff at BJH within the WUSTL Anesthesia Department. In addition, Microsoft Teams was included in the plan. The Qualtrics software used to conduct the survey was free to use. The IBM SPSS Statistics version 27 software was a required program to buy for previous course work allowing for no additional cost for the project. The EHR has already been purchased and in use by BJH and WUSTL Anesthesia and did not require additional cost for the project.
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL

The projected benefits of the DNP project include improved adherence to the intraoperative glucose monitoring guideline at BJH in effort to keep PWD euglycemic during the intraoperative period to avoid associated complications with dysglycemia. In addition, the benefits included collecting reliable baseline data on guideline adherence, identifying the perceived difficulty of following the guideline and identifying the top five barriers to guideline adherence.

Project Site

The project setting took place at BJH in St. Louis, MO in the perioperative service department, with the staff of BJH and WUSTL. BJH is a level one, tertiary care center consisting of currently 1,400 beds (Washington University of Physicians, n.d.). There are five operating rooms labeled “PODS”. POD one, typically consists of gynecology, urology, bariatric and general surgeries. POD two usually consists of trauma, critical care, and orthopedic cases. POD three typically consists of thoracic and vascular surgeries. POD four usually consists of general outpatient surgeries and ophthalmology cases. POD five typically consists of general surgery, neurosurgery, and ear, nose and throat (ENT) cases.

Population

The population included all anesthesia providers (anesthesiologists, anesthesia fellows, residents, CRNAs and SRNAs) at BJH involved with adult blood glucose monitoring and management for PWD. The exclusion criteria were anesthesia providers of pediatrics services, only those who were both adults and pediatrics or adults only were included. The other population at stake was PWD who underwent a procedure lasting greater than 60 minutes that required anesthesia services. This was collected to determine adherence rates to the blood glucose monitoring guideline. This population included patients of ages 18 years and older of all
genders, races, and ethnicities. Exclusion criteria included patients under the age of 18 years, patients without the diagnosis of type 1 or type 2 diabetes, surgical duration less than or equal to 60 minutes, and intraoperative patients not receiving anesthesia services.

Ethical Considerations

The Washington University in St. Louis Institutional Review Board (IRB) approval was obtained and the project was determined to be a QI project. A letter of support from Ivan Kangrga, MD, PhD, was obtained prior to the implementation phase. Ivan Kangrga, MD, PhD is the Vice Chair for Health System Liaison and Director of Quality and Safety for Perioperative Services at BJH. Prior to the distribution of surveys and education to all anesthesia providers via email, approval was obtained from INQUIR. INQUIR is a collaboration between BJH Research Division and the Washington University Department of Anesthesia of Clinical and Translation Research. Ethical considerations for this project entail the privacy and security of data as it was collected from EHR and stored into Microsoft Excel spreadsheets in a secure cloud-based file storage system, WUSTL BOX. In addition, de-identification of patient data occurred on spreadsheets or other software it was extracted or obtained from. Health Insurance Portability and Accountability Act (HIPAA) compliance was established during the project at all levels of implementation.

Recruitment/Sampling Strategy

An anonymous electronic provider survey created using Qualtrics (https://www.qualtrics.com) was sent out to all WUSTL anesthesia providers. This was sent out via a group email list from the WUSTL Anesthesia Department compiling the current anesthesia staff and students. The estimated numbers of anesthesia providers the email was sent out to was six hundred.
A pre-intervention baseline data collection consisted of a 30-day retrospective chart review via an extract that identified PWD undergoing surgery via multiple avenues. During a 30-day period, August 6, 2022, to September 6, 2022, 636 PWD underwent surgery at BJH. Out of those PWD who underwent surgery, 476 of those cases were over one hour implying the current intraoperative glucose monitoring guideline be followed. This number was used in Raosoft (http://www.raosoft.com/samplesize.html) to identify a sample size of 213 patient charts needed for a 95% confidence interval with a 5% margin of error. Every other patient chart was included until a total of 218 charts were reached on the pre-education data collection. For each post-education data collection at the two-, four-, and six-week time intervals, every other patient chart was included for each collection point for a total of 296 charts post-education review.

**Measurement Instruments**

In order to measure the outcomes of this DNP Project the following instruments were used: Tableau, the EHR, provider Likert-type survey, and Microsoft Excel program.

**Tableau and Electronic Health Record**

Tableau is a visual analytics platform capable of extracting selected data and generating individualized reports. Tableau extracts data from the EHR via Epic, the EHR system used at the institution. Tableau was used retrospectively to screen for PWD identified in EPIC who underwent surgery during the designated collection period. The patients’ diagnoses were identified as T1DM or T2DM.

Tableau was used to collect pre- and post-education data on PWD undergoing surgery during the intended project time. Data was taken from PWD in POD one through five in Barnes Jewish Hospital operating rooms pre-education and at the designated post-education intervals.
This included nominal data of patient demographics: age (not grouped), gender (male, female, or non-binary), diabetes diagnosis (type one versus type two), and American Society of Anesthesiology (ASA) score. Clinical variables collected included type of surgery (cardiothoracic, minimally invasive, neurology, orthopedics, OBGYN, otolaryngoscopy, plastics, transplant, urology, vascular, colorectal, oral/maxillofacial, ophthalmology, hepatobiliary, acute critical care services, oncology, general surgery), length of surgery (> 1 hour), intraoperative time, patient class (inpatient or outpatient) and location (POD number). Intraoperative time was determined by calculating the difference in documented time in the OR and documented time out of the OR. The intraoperative intervals at which the blood glucose was checked was included.

The outcomes were placed into two groups. They were placed into “meets standard”, “does not meet standard”. While baseline data were collected, the provider survey was emailed out to all anesthesia providers. The data collected were placed in a Microsoft Excel spreadsheet (see Appendix F).

This Tableau tool used for data collection was validated by manual chart review to ensure no blood glucose values were missed. Five randomly selected patient charts selected from the baseline report generated by Tableau were reviewed by two members of the DNP project. Glucose values were compared for in the intraoperative anesthesia report, the results review tab, glucose summary review tab, and the labs tab under chart review in EPIC.

Provider Survey

A survey was used before and after education to identify anesthesia provider demographics, perceived adherence and barriers to guideline adherence, and attitudes toward the guideline (See Appendix E). The survey assessed anesthesia provider demographics including age group, gender, race, provider role at BJH (CRNA, SRNA, anesthesiologist, fellow or
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL
resident), range groups of years in practice in current role, range groups of years working for
WUSTL Anesthesia Department, and the areas worked by providers. Perception of adherence to
the blood glucose guideline and attitudes toward the guideline were assessed using two and five
Likert-type scale items, respectively, barriers to adherence using six Likert-type scale items and
two text boxes, and further comments or concerns using a text box measured ordinal data.

The survey used by Qumseya et al. (2021) to evaluate physician compliance to CPGs was
used as a guide for this survey and to increase construct validity. In the survey by Qumseya et
al. (2021) a small expert panel of physicians provided feedback on what to include and exclude
from the survey content. A larger group of physicians were then asked to fill out the survey and
along with a debriefing survey on the content, ease, and suggestions for improvement. This
project’s survey was created using Qualtrics (https://qualtrics.com) online. This survey includes
more demographic information than the Qumseya et al. (2021) survey. The survey was reviewed
by a total of five providers: three anesthesia providers, one pharmacist, and one educator to
increase content validity prior to being distributed. Reliability of the survey was strengthened
using a test and retest method with three anesthesia providers to determine the consistency of the
results between multiple tests (Moss, n.d.).

Once published, the survey was administered via business email addresses of a compiled
list of anesthesia providers in the WUSTL network. Through Qualtrics, the survey was available
on mobile devices as well as tablets and computers for convenience. Using the review of
literature and the survey responses, tailored education was formulated. Informatics informed the
measurement instruments for this DNP project by literature review, use of the EHR, Qualtrics
survey software and Microsoft Excel program.

Data Collection Procedure
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL

Pre-intervention baseline data collection consisted of a retrospective chart review via an extract that identified PWD undergoing surgery via multiple avenues. Through Tableau all patient demographics were collected. Point of care (POC) glucose samples, arterial blood gas (ABG) analysis, basic metabolic panel (BMP) values, and comprehensive metabolic panel (CMP) values were included as acceptable glucose monitoring. The data collection took place at BJH in operating rooms POD one through five. These data were collected, compiled, and secured into a Microsoft Excel spreadsheet in a cloud-based storage system by two DNP project leaders. See Appendix F for the spreadsheet example. Patient records were compiled chronologically by surgery date and time into the Excel spreadsheet.

An anonymous electronic provider survey was sent out to all anesthesia providers (anesthesiologists, CRNAs, SRNAs, anesthesiology residents and fellows) regarding survey items related to blood glucose monitoring and attitudes to the blood glucose guideline in the operating room. This was sent out via a group email list from the WUSTL Anesthesia Department compiling the current anesthesia staff and students. The initial survey was available for a two-week period with an email reminder sent out at the one-week mark. A provider response rate of 20% was the goal. These survey items aimed to identify barriers perceived by the participating staff. Trends in barriers specific to the institution were determined by comparing similar responses on the survey. Responses were collected electronically and transcribed to the spreadsheet (See Appendix D). The survey items were identified in the spreadsheet as A1-2 for the adherence items, G1-5 for the guideline items, B1-7 for the guideline barrier related items, and BG1-4 for the specific glucose monitoring barrier related items. Once the results from the surveys were received, they were reviewed by the team members on the project. The free text items were reviewed individually by two DNP project leaders for trends.
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL

Data was collected in an inclusive manner to be mindful of cultural considerations by remaining anonymous, having multiple racial and gender options to include all backgrounds.

**Data Points**

An education component tailored to the identified barriers was presented in a PDF PowerPoint and distributed via email. This education was presented to anesthesia providers by two DNP project leaders. Education in the form of a PDF version was sent out to the same pre-education anesthesia staff through the WUSTL email group, thus providing education to all anesthesia staff. The final education component included a roving in-service of the education targeted at providers in the OR setting caring for PWD. Roving in-service education of the PDF PowerPoint consisted of two days by two team members. Education adherence was monitored through a list of providers that were educated during the in-service education and via a Qualtrics survey with one question if providers completed the education. A Qualtrics hyperlink was provided at the end of the education PowerPoint for providers to complete indicating if they completed the education PowerPoint. The question in the hyperlink stated “Did you complete the PowerPoint education?” Three answer choices were presented including “yes”, “no”, and “partial.” Three post education chart reviews were conducted on the second, fourth, and sixth week following the implementation of the education, identifying if improvement in blood glucose monitoring occurred in the intraoperative period. Post-education chart review consisted of all patients identified with DM and not those only specifically cared for by anesthesia providers that attended the education presentation. The first chart review consisted of weeks 1-2 following post education allowing time for providers to adjust to the new information. The second chart review consisted of weeks 3-4 and the third chart review were weeks 5-6 post education. This was measured by a percentage from baseline data of glucose collection
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL intraoperatively. The same provider survey was emailed assessing the attitudes toward the glucose guideline post-education at the beginning of the second post-education week. The post-education provider survey remained open for a four-week period closing at the end of the sixth week. An email reminder was sent out at the beginning of the fifth post-education week. The Six Sigma model DMAIC steps: define, measure, analyze, improve and control, was the guidance during this period of the project to identify, and eliminate imperfections to the current blood glucose process. Informatics informed the data collection design and procedure for this DNP project by the collection of data through the EHR, Qualtrics survey, and use of Microsoft Excel software.

Data Analysis

Descriptive and inferential statistics was used to analyze the data. Demographic data were described using frequency and percentages. The nominal demographic data of the two independent groups, pre-education and post-education, were compared using Chi-square. The adherence outcome was analyzed and reported as percentages at each pre- and post-education timepoint. A line graph illustrates change in adherence over time. The ordinal survey items were analyzed using Mann Whitney-U. The SPSS software, Version 27, was used to analyze the data. Alpha was set at .05.

Procedures for Project Implementation

A carefully considered plan was developed for this QI project to be successful during the implementation process. The overall goal of the project, the expected benefits, and the objectives were developed to lead to the desired outcome of increased provider adherence to the current intraoperative glucose guideline. First, a provider survey was developed to identify the demographics of anesthesia providers and the perceived barriers to the intraoperative glucose
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL monitoring guideline. The survey used by Qumseya et al. (2021) to evaluate physician compliance to CPGs was used as a guide for developing this survey. The anonymous electronic provider survey was sent out to all anesthesia providers via a group email list from the WUSTL Anesthesia Department compiling the current anesthesia staff and students. The email contained a copy of the current intraoperative guideline for reference, a brief introduction, background on the QI project, title, and a hyperlink or QR code to the survey. The survey remained open for two weeks with a reminder survey emailed a week after the initial delivery.

After analysis of the provider survey results and education PowerPoint was created addressing the top three identified barriers. The top three barriers identified were remembering to monitor blood glucose, lack of access to supplies, and time constraints. The PDF PowerPoint education included the significance of monitoring blood glucose intraoperatively, how to access the intraoperative glycemic management appendix, the top three barriers identified in the survey, and proposed solutions to each barrier. This education was sent out in a PDF version to all anesthesia providers via the same group email list used for the provider survey. Two days of in-service roving education was completed by two DNP team leaders. This consisted of the team leaders presenting the education PowerPoint to anesthesia staff during working hours and answering questions regarding the education. An estimate of thirty-seven providers were educated including the in-service roving education and the providers who answered the Qualtrics survey indicating if they completed the education. Thirty providers were educated in person and seven answered “yes” they completed the education on the Qualtrics survey. Two weeks following the distribution of the PDF PowerPoint education an email was sent out along with the post-education provider survey hyperlink. The post-education provider survey remained open for a total of four weeks following education distribution with a reminder email sent out on the fifth
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL post education week.

Evaluation and Outcomes

Results

The initial provider survey that was developed to identify the demographics of anesthesia providers and the perceived barriers to the intraoperative glucose monitoring guideline was sent out via a WUSTL email distribution list and remained open for a total of two weeks. A reminder email was sent out one week following distribution. It was estimated by the Executive Assistant to the Chair Department of Anesthesiology the total number of providers in the email distribution list was six hundred. The survey received forty-six providers fully answering the survey and five providers partially answering the survey. Including the fully and partially answered surveys, the survey response rate was 8.5%. The survey identified the demographics of the anesthesia providers and the perceived barriers to the intraoperative blood glucose guideline. See Table 1 for provider demographics and Table 2 for perceived barriers.

Table 1

Provider Demographics

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Pre-education (n)</th>
<th>Pre-education (%)</th>
<th>Post-education (n)</th>
<th>Post-education (%)</th>
<th>Chi square</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-35</td>
<td>24</td>
<td>47.1</td>
<td>13</td>
<td>52.0</td>
<td>1.205a</td>
<td>.877</td>
</tr>
<tr>
<td>36-45</td>
<td>16</td>
<td>31.4</td>
<td>6</td>
<td>24.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46-55</td>
<td>6</td>
<td>11.8</td>
<td>3</td>
<td>12.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>56-65</td>
<td>4</td>
<td>7.8</td>
<td>3</td>
<td>12.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;65</td>
<td>1</td>
<td>2.0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>American Indian or Alaska</td>
<td>2</td>
<td>4.1</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>native</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>3</td>
<td>6.1</td>
<td>2</td>
<td>8.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>1</td>
<td>2.0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White or Caucasian</td>
<td>38</td>
<td>77.6</td>
<td>22</td>
<td>88.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Native Hawaiian or Other</td>
<td>4</td>
<td>8.2</td>
<td>1</td>
<td>4.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>22</td>
<td>44.9</td>
<td>10</td>
<td>40.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>27</td>
<td>55.1</td>
<td>13</td>
<td>52.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provider role</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anesthesiologist</td>
<td>14</td>
<td>27.5</td>
<td>6</td>
<td>24.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>attending</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The top three barriers identified in the provider survey were remembering to monitor blood glucose, lack of access to supplies, and time constraints. Twenty-two providers (47.82%) selected agree or strongly agree for remembering to monitor blood glucose as a top barrier. Twenty-one providers (45.66%) selected agree or strongly agree for lack of access to supplies as a top barrier. Twenty-one providers (45.65%) selected agree or strongly agree for time constraints as a top barrier. Thirty-seven (80.43%) providers disagreed or strongly disagreed that monitoring glucose levels was not necessary as a barrier. Forty-five providers (88.24%) either selected often or always for rating their adherence to monitoring Q1 or Q2 hour glucose levels.
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL

intraoperatively for patients with T1DM or T2DM. Forty-one providers (87.23%) either agreed or strongly agreed that they were adequately trained in applying the guideline into their daily practice the intraoperative guideline.

Table 2
Provider Survey Results

<table>
<thead>
<tr>
<th>Survey Item</th>
<th>Pre-education (n)</th>
<th>Post-education (n)</th>
<th>Mann Whitney U</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q8 part 1: Following the guideline in general</td>
<td>51</td>
<td>24</td>
<td>440.500</td>
<td>.013</td>
</tr>
<tr>
<td>Q8 part 2: Monitoring Q1 or Q2 hour glucose levels intraoperatively for patients with type 1 or type 2 diabetes</td>
<td>51</td>
<td>23</td>
<td>492.000</td>
<td>.221</td>
</tr>
<tr>
<td>Q9 part 1: I am adequately trained in applying the guideline in my daily practice</td>
<td>47</td>
<td>21</td>
<td>446.000</td>
<td>.484</td>
</tr>
<tr>
<td>Q9 part 2: I have easy access to the guideline within my practice</td>
<td>47</td>
<td>21</td>
<td>415.500</td>
<td>.245</td>
</tr>
<tr>
<td>Q9 part 3: The guideline is evidence-based</td>
<td>46</td>
<td>21</td>
<td>432.500</td>
<td>.468</td>
</tr>
<tr>
<td>Q9 part 4: The guideline is easy to read and understand</td>
<td>47</td>
<td>21</td>
<td>461.000</td>
<td>.653</td>
</tr>
<tr>
<td>Q9 part 5: I have accessed the guideline in the last 30 days</td>
<td>46</td>
<td>21</td>
<td>386.000</td>
<td>.162</td>
</tr>
<tr>
<td>Q10 part 1: Difficulty accessing</td>
<td>46</td>
<td>20</td>
<td>438.500</td>
<td>.756</td>
</tr>
<tr>
<td>Q10 part 2: Length of guideline documents</td>
<td>46</td>
<td>20</td>
<td>441.000</td>
<td>.782</td>
</tr>
<tr>
<td>Q10 part 3: Complexity of guideline</td>
<td>46</td>
<td>20</td>
<td>379.500</td>
<td>.245</td>
</tr>
<tr>
<td>Q10 part 4: Lack of familiarity to the current guideline</td>
<td>46</td>
<td>20</td>
<td>388.500</td>
<td>.279</td>
</tr>
<tr>
<td>Q10 part 5: Time constraints due to clinical responsibilities</td>
<td>46</td>
<td>20</td>
<td>426.500</td>
<td>.627</td>
</tr>
<tr>
<td>Q10 part 6: Conditional or weak recommendations of the guideline</td>
<td>46</td>
<td>20</td>
<td>360.000</td>
<td>.141</td>
</tr>
<tr>
<td>Q10 part 7: Concerns that guideline is not able to be individualized</td>
<td>46</td>
<td>20</td>
<td>359.500</td>
<td>.146</td>
</tr>
<tr>
<td>Q11 part 1: Lack of access to supplies (e.g., glucometers)</td>
<td>46</td>
<td>20</td>
<td>421.000</td>
<td>.568</td>
</tr>
<tr>
<td>Q11 part 2: Time constraints due to clinical responsibilities</td>
<td>46</td>
<td>20</td>
<td>432.000</td>
<td>.679</td>
</tr>
<tr>
<td>Q11 part 3: Remembering to monitor glucose levels</td>
<td>46</td>
<td>20</td>
<td>429.000</td>
<td>.648</td>
</tr>
<tr>
<td>Q11 part 4: Feeling to monitor glucose levels is not necessary</td>
<td>46</td>
<td>20</td>
<td>376.500</td>
<td>.201</td>
</tr>
</tbody>
</table>

Note. See Appendix E for detailed survey items.

The pre-intervention baseline data collection consisted of a 30-day retrospective chart review via an extract that identified PWD undergoing surgery at BJH. During a 30-day period, August 6, 2022, to September 6, 2022, 636 PWD underwent surgery at BJH. Out of those PWD who underwent surgery, 476 of those cases were over one hour implying the current intraoperative glucose monitoring guideline be followed. Every other chart was included for a total sample of 218 charts. See Table 3 for the demographics of the patients. A frequency percentage was conducted in SPSS of adherent and non-adherent resulting in 27.1% of providers non-adherent and 72.9% as adherent. See Table 4. Providers were considered adherent and non-adherent by taking the total time in the operating room (OR) and dividing by 120 minutes for
type 2 diabetic patients or dividing by 60 minutes for type 1 diabetics. If providers completed the expected number of blood glucose checks in the OR time, then they were considered adherent. If there was less than the expected number of blood glucose checks completed in the OR time, they were considered non-adherent.

Table 3

Patient Demographics

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Pre-Education (n)</th>
<th>Pre-Education (%)</th>
<th>2-week post-Education (n)</th>
<th>2-week post-Education (%)</th>
<th>4-week post-Education (n)</th>
<th>4-week post-Education (%)</th>
<th>6-week post-Education (n)</th>
<th>6-week post-Education (%)</th>
<th>Chi square</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>25</td>
<td>1.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>6.943</td>
<td>0.998</td>
</tr>
<tr>
<td>&lt;25</td>
<td>1</td>
<td>0.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-35</td>
<td>2</td>
<td>0.9</td>
<td>2.0</td>
<td>2.0</td>
<td>1.9</td>
<td>1.9</td>
<td>1.9</td>
<td>1.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36-45</td>
<td>18</td>
<td>8.3</td>
<td>8.1</td>
<td>7.7</td>
<td>6.7</td>
<td>9.7</td>
<td>9.7</td>
<td>9.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46-55</td>
<td>28</td>
<td>12.8</td>
<td>12.1</td>
<td>16.4</td>
<td>13.4</td>
<td>14.0</td>
<td>14.0</td>
<td>14.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>56-65</td>
<td>57</td>
<td>26.1</td>
<td>27.3</td>
<td>33.1</td>
<td>31.7</td>
<td>26.2</td>
<td>28.0</td>
<td>28.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>66-75</td>
<td>71</td>
<td>32.6</td>
<td>34.3</td>
<td>32.8</td>
<td>30.8</td>
<td>28.0</td>
<td>30.1</td>
<td>30.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>76-85</td>
<td>39</td>
<td>17.9</td>
<td>15.2</td>
<td>12.1</td>
<td>11.5</td>
<td>15.6</td>
<td>16.1</td>
<td>16.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>=85</td>
<td>2</td>
<td>0.9</td>
<td>1.0</td>
<td>2.0</td>
<td>1.9</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>107</td>
<td>49.8</td>
<td>53.5</td>
<td>52.0</td>
<td>50.0</td>
<td>40.0</td>
<td>43.0</td>
<td>2.221</td>
<td>0.528</td>
</tr>
<tr>
<td>Female</td>
<td>108</td>
<td>50.2</td>
<td>46.5</td>
<td>52.0</td>
<td>50.0</td>
<td>53.0</td>
<td>57.0</td>
<td>57.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASA class</td>
<td>I</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8.527</td>
<td>0.743</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>39</td>
<td>17.9</td>
<td>16.2</td>
<td>24.0</td>
<td>23.1</td>
<td>17.3</td>
<td>18.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>145</td>
<td>66.5</td>
<td>69.7</td>
<td>69.6</td>
<td>66.3</td>
<td>61.3</td>
<td>65.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IV</td>
<td>30</td>
<td>13.8</td>
<td>14.1</td>
<td>11.0</td>
<td>10.6</td>
<td>14.1</td>
<td>15.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V</td>
<td>1</td>
<td>0.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not listed</td>
<td>3</td>
<td>1.4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM diagnosis</td>
<td>T1DM</td>
<td>6</td>
<td>2.8</td>
<td>2.0</td>
<td>6</td>
<td>5.8</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>T2DM</td>
<td>212</td>
<td>97.2</td>
<td>98.0</td>
<td>98.0</td>
<td>94.2</td>
<td>93.0</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class</td>
<td>Outpatient</td>
<td>100</td>
<td>45.9</td>
<td>41.4</td>
<td>48.0</td>
<td>46.2</td>
<td>34.0</td>
<td>35.7</td>
<td>6.430</td>
<td>0.092</td>
</tr>
<tr>
<td></td>
<td>Inpatient</td>
<td>116</td>
<td>53.2</td>
<td>57.5</td>
<td>55.0</td>
<td>52.9</td>
<td>66.0</td>
<td>58.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Emergent</td>
<td>2</td>
<td>0.9</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>39.0</td>
<td>41.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POD</td>
<td>POD 1</td>
<td>47</td>
<td>21.6</td>
<td>17.2</td>
<td>14.0</td>
<td>13.5</td>
<td>20.0</td>
<td>21.5</td>
<td>11.373</td>
<td>0.497</td>
</tr>
<tr>
<td></td>
<td>POD 2</td>
<td>29</td>
<td>13.3</td>
<td>21.2</td>
<td>18.0</td>
<td>17.3</td>
<td>18.0</td>
<td>19.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>POD 3</td>
<td>53</td>
<td>24.3</td>
<td>26.3</td>
<td>23.0</td>
<td>22.1</td>
<td>19.0</td>
<td>20.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>POD 4</td>
<td>45</td>
<td>20.6</td>
<td>15.2</td>
<td>25.0</td>
<td>24.0</td>
<td>13.0</td>
<td>14.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>POD 5</td>
<td>44</td>
<td>20.2</td>
<td>20.2</td>
<td>24.0</td>
<td>23.1</td>
<td>23.0</td>
<td>24.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case Service</td>
<td>ACCS</td>
<td>6</td>
<td>2.8</td>
<td>6.1</td>
<td>7</td>
<td>6.7</td>
<td>6.5</td>
<td>6.5</td>
<td>48.472</td>
<td>0.867</td>
</tr>
<tr>
<td></td>
<td>Cardiothoracic</td>
<td>18</td>
<td>8.3</td>
<td>9.1</td>
<td>6</td>
<td>5.8</td>
<td>5.4</td>
<td>5.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Colorectal</td>
<td>3</td>
<td>1.4</td>
<td>2.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hepatobiliary</td>
<td>6</td>
<td>2.8</td>
<td>2.0</td>
<td>1</td>
<td>1.0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimally invasive</td>
<td>13</td>
<td>6.0</td>
<td>1.0</td>
<td>3</td>
<td>2.9</td>
<td>3.0</td>
<td>3.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Neurosurgery</td>
<td>19</td>
<td>8.7</td>
<td>5.1</td>
<td>9</td>
<td>8.7</td>
<td>11</td>
<td>11.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OB/GYN</td>
<td>18</td>
<td>8.3</td>
<td>8.1</td>
<td>9</td>
<td>8.7</td>
<td>7</td>
<td>7.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oncology</td>
<td>7</td>
<td>3.2</td>
<td>4.0</td>
<td>2</td>
<td>1.9</td>
<td>5</td>
<td>5.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ophthalmology</td>
<td>15</td>
<td>6.9</td>
<td>2.0</td>
<td>6</td>
<td>5.8</td>
<td>8</td>
<td>8.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oral/Maxillofacial</td>
<td>1</td>
<td>0.5</td>
<td>5.1</td>
<td>6</td>
<td>5.8</td>
<td>2</td>
<td>2.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Orthopaedics</td>
<td>32</td>
<td>14.7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Otolaryngology</td>
<td>11</td>
<td>5.0</td>
<td>12.1</td>
<td>13</td>
<td>12.5</td>
<td>15</td>
<td>16.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pain management</td>
<td>1</td>
<td>0.5</td>
<td>10.1</td>
<td>12.0</td>
<td>11.5</td>
<td>7</td>
<td>7.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plastics</td>
<td>13</td>
<td>6.0</td>
<td>1.0</td>
<td>1</td>
<td>1.0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The first post-education retrospective chart review consisted of weeks 1-2 following post education distribution. Data was pulled via the same extract that identified PWD undergoing surgery at BJH as the baseline data. During this period, October 5th, 2022, to October 18th, 2022, 315 PWD underwent surgery at BJH. Out of those PWD who underwent surgery, 197 of those cases were over one hour implying the current intraoperative glucose monitoring guideline be followed. Every other chart was included for a total sample of 99 charts. See Table 3 for the demographics of the patients. A frequency percentage was conducted in SPSS of adherent and non-adherent resulting in 33.3% of providers non-adherent and 66.7% as adherent. See Table 4.

The second post-education retrospective chart review consisted of weeks 3-4 following post education distribution. Data was pulled via the same extract that identified PWD undergoing surgery at BJH as the baseline data. During this period, October 19th, 2022, to November 1st, 2022, 322 PWD underwent surgery at BJH. Out of those PWD who underwent surgery, 208 of those cases were over one hour implying the current intraoperative glucose monitoring guideline be followed. Every other chart was included for a total sample of 104 charts. See Table 3 for the demographics of the patients. A frequency percentage was conducted in SPSS of adherent and non-adherent resulting in 3.8% of providers non-adherent and 96.2% as adherent. See Table 4.

The third post-education retrospective chart review consisted of weeks 5-6 following post education distribution. Data was pulled via the same extract that identified PWD undergoing surgery at BJH as the baseline data. During this period, November 2nd, 2022, to November 15th, 2022, 301 PWD underwent surgery at BJH. Out of those PWD who underwent surgery, 185 of those cases were over one hour implying the current intraoperative glucose monitoring guideline

<table>
<thead>
<tr>
<th>Provider/foot/ankle</th>
<th>2</th>
<th>0.9</th>
<th>4</th>
<th>4.0</th>
<th>7</th>
<th>6.7</th>
<th>4</th>
<th>4.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transplant</td>
<td>12</td>
<td>5.5</td>
<td>2</td>
<td>2.0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2.2</td>
</tr>
<tr>
<td>Urology</td>
<td>18</td>
<td>8.3</td>
<td>5</td>
<td>5.1</td>
<td>5</td>
<td>4.8</td>
<td>3</td>
<td>3.2</td>
</tr>
<tr>
<td>Vascular</td>
<td>23</td>
<td>10.6</td>
<td>8</td>
<td>8.1</td>
<td>6</td>
<td>5.8</td>
<td>4</td>
<td>4.3</td>
</tr>
</tbody>
</table>

PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL

be followed. Every other chart was included for a total sample of 93 charts. See Table 3 for the
demographics of the patients. A frequency percentage was conducted in SPSS of adherent and
non-adherent resulting in 32.3% of providers non-adherent and 67.7% as adherent. See Table 4.
See Figure 1 for a line graph of the provider adherence over time.

Table 4

Provider Adherence

<table>
<thead>
<tr>
<th>Adherence</th>
<th>Pre-Education (frequency)</th>
<th>Pre-Education (%)</th>
<th>2-week post-Education (frequency)</th>
<th>2-week post-Education (%)</th>
<th>4-week post-Education (frequency)</th>
<th>4-week post-Education (%)</th>
<th>6-week post-Education (frequency)</th>
<th>6-week post-Education (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does not meet standard</td>
<td>59</td>
<td>27.1</td>
<td>33</td>
<td>33.3</td>
<td>4</td>
<td>3.8</td>
<td>30</td>
<td>32.3</td>
</tr>
<tr>
<td>Meets standard</td>
<td>159</td>
<td>72.9</td>
<td>66</td>
<td>66.7</td>
<td>100</td>
<td>96.2</td>
<td>63</td>
<td>67.7</td>
</tr>
</tbody>
</table>

Figure 1

Provider Adherence

Identical to the initial provider survey, a post-education provider survey identifying the
demographics of anesthesia providers and the perceived barriers to the intraoperative glucose
monitoring guideline was sent out via a WUSTL email two weeks after the education distribution
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL

and remained open for a total of four weeks. A reminder email was sent out three weeks following distribution. The estimate of the total number of providers in the email distribution list was six hundred and included the same individuals as the initial provider survey. The survey received twenty-two providers fully answering the survey and five providers partially answering the survey. Including the fully and partially answered surveys, the survey response rate was 4.5%. The survey identified the demographics of the anesthesia providers and the perceived barriers to the intraoperative blood glucose guideline. See Table 1 and Table 2.

The top three barriers identified in the post-education survey were the same as the initial provider survey: remembering to monitor blood glucose, lack of access to supplies, and time constraints. Fourteen providers (70%) selected agree or strongly agree for remembering to monitor blood glucose as a top barrier. Ten providers (50%) selected agree or strongly agree for lack of access to supplies as a top barrier. Eleven providers (55%) selected agree or strongly agree for time constraints as a top barrier. Twenty-two providers (100%) disagreed or strongly disagreed that monitoring glucose levels was not necessary as a barrier. Twenty-one providers (95.65%) either selected often or always for rating their adherence to monitoring Q1 or Q2 hour glucose levels intraoperatively for patients with T1DM or T2DM. Twenty-two providers (100%) either agreed or strongly agreed that they were adequately trained in applying the guideline into their daily practice the intraoperative guideline.

Discussion of Findings/Outcomes

There was no statistically significant difference between the pre- and post-education chart reviews for the patient demographic variables as all $p$-values were $> .05$. The provider adherence was near base line at two weeks post-education, improved at four weeks, but returned to near baseline at six weeks post-education. A successful improvement in adherence rate was seen
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL during the four-week post-education during the time of roving in-service education was being conducted. This suggests that roving education may be an effective method for delivery of educational content. There is no statistically significant difference between the pre- and post-education provider groups for the demographic variables measured (all $p$-values were > .05). The same top barriers were identified in the pre- and post-education provider surveys: remembering to monitor blood glucose, lack of access to supplies, and time constraints. In question 8, part 1, “Following the guideline in general” there was a statistically significant difference pre-education compared to post-education ($p < .05$). See Table 2. In the pre-education survey, 44 providers (88.24%) stated they either often or always followed the guideline in general and (11.76%) stated they sometimes followed the guideline in general. In the post-education survey, 23 providers (100%) stated they either often or always followed the guideline in general. Both pre- and post-survey response rates were low. The email distribution list for the surveys included the pediatric providers who were not expected to respond due to differing glucose monitoring guidelines.

**Strengths and Limitations of Findings**

A strength of this DNP project is testing between the pre-, and post-education provider and patient demographics resulting in no statistically significant differences between the groups. A total of 218 pre-education charts and 296 post-education charts were analyzed for a 95% confidence interval with a 5% margin of error. Having comparable patient and provider groups and an adequate sample of chart reviews reduces confounding of the adherence outcome. To decrease the risk of bias, clear procedures were followed for pre- and post-data collection, and surgical cases were randomly sampled.

A limitation to this DNP project was the low provider response rate on pre- and post-education surveys, despite being comparable groups. Additionally, the post-education response
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL
rate was approximately half the pre-education rate. The project was limited to the intraoperative
phase and did not include recovery/PACU glucose checks in adherence rates. Another limitation
is the uncertainty of the exact number of people who completed the education. Some providers
may have completed the education but did not click on the hyperlink of the Qualitrics survey to
answer if they did. Finally, the project outcomes were measured over a limited period of time
and did not measure long-term adherence.

Evaluation of the Process

During the process of finding evidence-based research it was challenging locating recent
articles on the association with poorly controlled glucose levels and adverse clinical outcomes.
The articles that were located were of lesser quality or published greater than five years ago. In
addition, there is a gap in research focusing on the optimal interval of glucose monitoring during
the intraoperative period.

The survey response rate was low both pre-education at 8.5% and post-education at 4.5%.
This low response rate contribution could be due to the multiple emails providers receive on a
daily basis. An alternative delivery method, such as in-person surveying, may have yielded more
responses. A shorter survey with fewer questions could have yielded a higher response rate as
providers may have felt it would take less time. A few reminder emails of the survey were sent
out a week or two after the original email. These reminders may have added to email burden for
potential respondents.

This project also validated current practices used to measure institutional standards of
care for PWD during the intraoperative phase. This was accomplished by pulling retrospective
EHR data via Tableau, organizing into Excel worksheets, and analyzing the data via SPSS.

The education material development and distribution went well. The in person roving
education impacted more providers than sending out the information via email. Providers were accepting and thankful for the education material presented.

**System and Practice Impact**

**Implications for Organizational and Systems Change**

This DNP project provides a starting point for improvement of provider adherence to intraoperative glucose monitoring. It provided a baseline provider adherence rate to the intraoperative glycemic management appendix 6 currently utilized at BJH. A successful improvement in adherence rate was seen during the four-week post-education during the time that roving in-service education was being conducted. Team members of the DNP project met with the Anesthesia EPIC Operations Team to implement the development of electronic reminders for intraoperative charting. This change to the EPIC EHR will begin with reminders built into the current reminders tab where providers can initiate them intraoperatively for PWD. A tab labeled ‘T1DM and T2DM’ will be added for providers to select. Throughout the case, reminders would continue to appear Q1 or Q2 hours based on their diabetic status. Further trialing needs to be done to see if the other proposed solutions can be achieved. The second proposed solution was adding a question relating to DM in the current workflow of the anesthesia checklist. A provider would then have to identify if the patient is T1DM or T2DM or not diabetic at all. From that answer automatic reminders would appear at intervals of Q1 or Q2 hours depending on the patient’s DM status. Throughout the case reminders would continue to appear based on their diabetic status and the time of the last glucose check. The third proposed solution was to have an automatic glucose check appear reminder based off the time of the preoperative glucose check. If the patient is T1DM, the reminder would automatically appear one hour after the preoperative check. If the patient is T2DM, the reminder would automatically
appear two hours after the preoperative check. Throughout the case reminders would continue to
appear based on their diabetic status and the time of the last glucose check. This EPIC change
improvement could benefit all throughout the WASHU facilities.

Recommendations for Nursing Practice

A significant fluctuation in glucose levels is seen in patients undergoing surgery and
anesthesia due to fasting, adjusting the dosing of antidiabetic medications preoperatively,
surgical stress, and anesthetic agents (Galway et al., 2021; Kaur & Joyner, 2019). The body’s
natural stress response to surgery contributes to hyperglycemia through the development of
insulin resistance and through the production of glucose (Wolfe, 2018). This makes the
maintenance of glycemic control more difficult. Anesthesia providers including
anesthesiologists, anesthesiology fellows, anesthesiology residents, CRNAs, and SRNAs are
responsible for glucose monitoring and management of patients under anesthesia. Providers need
to be diligent on checking the intraoperative blood glucose levels to treat hypoglycemia and
hyperglycemia when it first appears. At BJH the suggested time frame to check blood glucose
levels in the Perioperative Glycemic Management of the Adult Surgical Patient-
Perioperative/Surgery/Anesthesiology Guideline is every hour for T1DM and bi-hourly for
T2DM. It is essential to keep patients euglycemic during the intraoperative period to avoid the
associated complications with dysglycemia that can affect the length of the patients’ recovery
ultimately affecting multiple levels of nursing care.

Sustainability

In order to sustain this DNP project, providers need to prioritize glucose control
intraoperatively. The number one barrier identified during the survey was remembering to
monitoring intraoperative glucose levels. Providers should utilize the reminders tab that will be
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL set up in EPIC if they are forgetting to monitor intraoperative glucose levels. Providers can use the other examples that were provided in the education material such as setting an alarm or timer on a smart phone or smart watch, setting a timer on the anesthesia machine, or setting a timer on the Phillips monitor. The third EPIC proposal as listed above would benefit providers the most as the intraoperative glucose monitoring reminders would automatically appear and not require providers to remember to select a reminder tab.

**Summary and Conclusion**

**Project Summary**

The purpose, aim, and objectives of the DNP project were met in regards to implementing an educational initiative to all anesthesia providers tailored the identified barriers to glucose monitoring at Q1 and Q2- hour intervals for patients with T1DM and T2DM, respectively per institutional guidelines adherence. The effect of the educational intervention was measured by comparing baseline adherence with post-intervention adherence rates. An improvement was seen at the four-week interval during the roving in-service education. It is expected for adherence rates to continue to improve as additional EPIC changes are implemented in the upcoming months. In addition, the goals of identifying the top three barriers to the intraoperative guideline and providing a baseline adherence rate were achieved. This project can be used for the pre- and post-operative phases of care in future QI projects.

**Plan for Dissemination**

The plan for dissemination of the DNP Project includes a PowerPoint presentation that describes the purpose, planning, implementation, and evaluation components of this project. Two team members will be presenting a poster presentation at a regional meeting in the Spring of 2023. In addition, an oral presentation will be presented to stakeholders and the organization
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL leadership via Microsoft Teams meeting.
Providing adherence to an intraoperative glucose monitoring protocol

References


American Diabetes Association. [ADA], (n.d.). *Blood sugar testing and control.*
https://diabetes.org/healthy-living/medication-treatments/blood-glucose-testing-and-control


https://sphweb.bumc.bu.edu

https://doi.org/10.1097/sla.0000000000005246
PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL


PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL


PROVIDER ADHERENCE TO AN INTRAOPERATIVE GLUCOSE MONITORING PROTOCOL


Appendix B

1. My current employment is:
   - Academic
   - Hospital employed
   - Multi-specialty group
   - Private or Solo practice

2. I have been in practice for:
   - 0-1 years
   - 1-3 years
   - 3-5 years
   - 5-10 years
   - >10 years

3. I have been involved in clinical guideline development?
   - True
   - False

4. During my training, I feel that I am/was adequately trained accessing and applying guidelines in my daily practice
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree

5. I would rate my adherence to clinical practice guidelines as:
   - Very high
   - High
   - Average
   - Low
   - Very low

6. With regards to guidelines within my specialty, I feel that:
   a. I have sufficient input on the content of guidelines
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   b. I understand the process of guidelines development
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   c. I have easy access to guidelines within my practice
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   d. Current guidelines are evidence-based
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   e. Guideline documents are easy to read and understand
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   f. My knowledge of clinical practice guidelines is up-to-date
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   g. Guidelines may already be out of date by the time of publication
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   h. Other:

7. In my opinion, the following factors are barriers to using clinical practice guidelines?
   a. Lack of access/difficulty in access to guidelines
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   b. Length or complexity of guidelines documents
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   c. Time constraints due to clinical responsibilities
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   d. Lack of physician involvement in guideline development
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   e. Conflicting guidelines on the same topic
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   f. High number of conditional or weak recommendations
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   g. Concerns that guidelines do not apply to a single patient
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   h. Patient refusal to comply with guidelines
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   i. Physician apathy to abide by guidelines
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   j. Lack of insurance coverage to certain guidelines
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   k. Lack of consideration of cost of some recommendations
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree

8. In my opinion, the following factors can help increase awareness of and adherence to clinical practice guidelines?
   a. Improved focus on guidelines during training
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   b. Access to relevant guidelines at the point of care (EMR)
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   c. Linking payment incentives to guideline adherence
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   d. Having more input on topic and content on guidelines
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
   e. More transparency on physician commercial affiliation
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree

Appendix C

Donabedian Model

Figure 1: The Donabedian model for quality of care

- **STRUCTURE**: Physical and organisational characteristics where healthcare occurs
- **PROCESS**: Focus on the care delivered to patients e.g. services, diagnostics or treatments
- **OUTCOME**: Effect of healthcare on the status of patients and populations

*Note.* Figure found on https://healthcaremarketreview.com/avedis-donabedian-and-the-birth-of-healthcare-quality-assurance/
Appendix D

### Table 1.

#### Budget Table

<table>
<thead>
<tr>
<th>Nature of Expenditure/Item</th>
<th>Cost per Unit</th>
<th># Units</th>
<th>Total Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direct Costs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personnel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anesthesiologists</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missouri average</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hourly rate $152&lt;sup&gt;1&lt;/sup&gt;</td>
<td>1.5 hour</td>
<td></td>
<td>$228</td>
</tr>
<tr>
<td>CRNA Missouri average</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hourly rate $80&lt;sup&gt;4&lt;/sup&gt;</td>
<td>1.5 hour</td>
<td></td>
<td>$120</td>
</tr>
<tr>
<td>Anesthesiologists</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resident Missouri</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hourly rate $21&lt;sup&gt;5&lt;/sup&gt;</td>
<td>1.5 hour</td>
<td></td>
<td>$31.5</td>
</tr>
<tr>
<td>Anesthesiologists</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fellow hourly rate&lt;sup&gt;2&lt;/sup&gt;</td>
<td>1.5 hour</td>
<td></td>
<td>$156</td>
</tr>
<tr>
<td>SRNAs no hourly rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time of DNP members</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>300</td>
<td>$0</td>
</tr>
<tr>
<td><strong>Materials and Supplies</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper handouts&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Print as requested</td>
<td></td>
<td>0.1 cent per sheet</td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardware/Software</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microsoft (PowerPoint &amp;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excel)</td>
<td>1</td>
<td></td>
<td>$0</td>
</tr>
<tr>
<td>Qualtrics Software</td>
<td>1</td>
<td></td>
<td>$0</td>
</tr>
<tr>
<td>SPSS version 27</td>
<td>1</td>
<td></td>
<td>$50</td>
</tr>
<tr>
<td>EHR</td>
<td>1</td>
<td></td>
<td>$0</td>
</tr>
<tr>
<td>Microsoft Teams</td>
<td>1</td>
<td></td>
<td>$0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td>$585.50</td>
</tr>
</tbody>
</table>

**Note.**

<sup>1</sup> Errera, R. (2019, August 20). Printing costs: How to accurately calculate your printing cost per page. Toner Buzz. [https://www.tonerbuzz.com/blog/printing-costs-how-to-accurately-calculate-your-printing-cost-per-page/#:~:text=A%20standard%20cost%20of%20printing,cents%20per%20sheet%20or%20higher](https://www.tonerbuzz.com/blog/printing-costs-how-to-accurately-calculate-your-printing-cost-per-page/#:~:text=A%20standard%20cost%20of%20printing,cents%20per%20sheet%20or%20higher).


<sup>5</sup> ZipRecruiter. (n.d.). Medical residency salary in Missouri. [https://www.ziprecruiter.com/Salaries/Medical-Residency-Salary--in-Missouri#:::text=As%20of%20May%202015%2C%20the%20starting%20salary%20for%20an%20in%20Missouri%20medical%20residency%20is%20approximately%20%24243.25%20per%20month.](https://www.ziprecruiter.com/Salaries/Medical-Residency-Salary--in-Missouri#:::text=As%20of%20May%202015%2C%20the%20starting%20salary%20for%20an%20in%20Missouri%20medical%20residency%20is%20approximately%20%24243.25%20per%20month.).
## Appendix E

### Provider Survey

**What is your age?**

<table>
<thead>
<tr>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-35</td>
</tr>
<tr>
<td>36-45</td>
</tr>
<tr>
<td>46-55</td>
</tr>
<tr>
<td>56-65</td>
</tr>
<tr>
<td>over 65</td>
</tr>
</tbody>
</table>

**Race**

<table>
<thead>
<tr>
<th>Race</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Indian or Alaska Native</td>
</tr>
<tr>
<td>Asian</td>
</tr>
<tr>
<td>African American</td>
</tr>
<tr>
<td>Native Hawaiian or Other Pacific Islander</td>
</tr>
<tr>
<td>White or Caucasian</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>-----------------------------------</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Non-binary / third gender</td>
</tr>
</tbody>
</table>

What is your role at Barnes Jewish Hospital/Washington University School of Medicine (WUSM) in St. Louis Department of Anesthesiology?

<table>
<thead>
<tr>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anesthesiologist Attending</td>
</tr>
<tr>
<td>Anesthesiology Resident</td>
</tr>
<tr>
<td>Anesthesiology Fellow</td>
</tr>
<tr>
<td>Certified Registered Nurse Anesthetist</td>
</tr>
<tr>
<td>Student Registered Nurse Anesthetist</td>
</tr>
</tbody>
</table>
How many years have you been affiliated with the WUSM Department of Anesthesiology in this role?

- I am currently still in training (1-2 year SRNA or resident)
- I am currently still in training (3+ year SRNA or resident)
- 5 years or less
- 6-10 years
- 11-15 years
- 16-20 years
- 20+ years

How many years have you been in practice in your current role?

- I am currently still in training (SRNA or resident)
- 5 years or less
- 6-10 years
- 11-15 years
- 16-20 years
- 20+ years
Which area(s) do you work in most frequently? (Select all that apply.)

<table>
<thead>
<tr>
<th>Pod 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pod 2</td>
</tr>
<tr>
<td>Pod 3/CPC</td>
</tr>
<tr>
<td>Pod 4</td>
</tr>
<tr>
<td>Pod 5</td>
</tr>
<tr>
<td>Currently in training and rotating through all areas</td>
</tr>
</tbody>
</table>
The remaining questions will focus on specific aspects and appendices of the EJC HEALTHCARE - System Guideline for Perioperative Glycemic Management of the Adult Surgical Patient - Perioperative/Surgery/Anesthesiology Guideline. When indicated the specific appendix will be referred to in the question group stem.

With regard to the guideline, Intraoperative Glycemic Management (Appendix 6), I would rate my adherence to..

<table>
<thead>
<tr>
<th>Following the guideline in general</th>
<th>Never</th>
<th>Seldom</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring Q1 or Q2 hour glucose levels intraoperatively for patients with type 1 or type 2 diabetes</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Initiating an insulin infusion intraoperatively</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Initiating an insulin infusion using the ANE Adult Perioperative Insulin Orders set</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
With regard to the Intraoperative Glycemic Management (Appendix 6), and Guideline for the Perioperative use of Continuous Intravenous Insulin Infusion in Patients with Diabetes or Equivalent (Appendix 7) I feel that:

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am adequately trained in applying the guideline in my daily practice</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I have easy access to the guideline within my practice</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The guideline is evidence-based</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The guideline is easy to read and understand</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I have accessed the guideline in the last 30 days</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am comfortable initiating an insulin infusion intraoperatively</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am comfortable titrating and managing an insulin infusion intraoperatively (Appendix 7 only)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
In my opinion, the following factors are barriers to using the Intraoperative Glycemic Management (Appendix 6) and Guideline for the Perioperative use of Continuous Intravenous Insulin Infusion in Patients with Diabetes or Equivalent (Appendix 7):

<table>
<thead>
<tr>
<th>Factor</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty accessing</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Length of guideline documents</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Complexity of guideline</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Lack of familiarity to the current guideline</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Time constraints due to clinical responsibilities</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Conditional or weak recommendations of the guideline</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Concerns that guideline is not able to be individualized</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
In my opinion, the following factors are barriers to monitoring Q1/Q2 hour blood glucose levels per the guideline intraoperatively:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of access to supplies (e.g., glucometers)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Time constraints due to clinical responsibilities</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Remembering to monitor glucose levels</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Feeling to monitor glucose levels is not necessary</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
In my opinion, the following factors are barriers to initiating an insulin infusion per guideline intraoperatively (Appendix 5, Appendix 6 & Appendix 7):

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of access to supplies (glucometers, medications, IV tubing)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placing an order in EPIC to order and document insulin infusion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgeon not wanting patient to be on an insulin infusion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concern for the PACU's ability to manage an insulin infusion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concern with delayed discharge following outpatient surgery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinician judgment/not wanting to initiate an infusion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other barriers to guideline adherence:

The most significant barrier is:

Other comments/concerns:
## Appendix F

### Patient Data Collection Spreadsheet

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Patient #</td>
<td>Age</td>
<td>Gender</td>
<td>ASA score</td>
<td>T1DM, T2DM</td>
<td>POO</td>
<td>Type of Surgery</td>
<td>Time in OR</td>
<td>Time out of OR</td>
<td>Length of Surgery</td>
<td>Inpatient vs outpatient</td>
<td>Compliant</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>3</td>
<td>C</td>
<td>1</td>
<td>T2DM</td>
<td>POO</td>
<td>Type of Surgery</td>
<td>Time in OR</td>
<td>Time out of OR</td>
<td>Length of Surgery</td>
<td>Inpatient vs outpatient</td>
<td>Compliant</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Provider Survey Data Collection Spreadsheet

<table>
<thead>
<tr>
<th>Survey F</th>
<th>Age</th>
<th>Gender</th>
<th>ASA score</th>
<th>Type of Procedure</th>
<th>POO</th>
<th>Time in OR</th>
<th>Time out of OR</th>
<th>Length of Procedure</th>
<th>Inpatient vs outpatient</th>
<th>Compliant</th>
<th>Not Compliant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>