Perioperative Glucose Management for Diabetic Patients Undergoing Orthopedic Surgery

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DNP Scholarly Project

Diabetes Mellitus (DM) is diagnosed in 285 million adults worldwide. By 2030 this number is expected to increase to 439 million adults (Wukich, 2015). In the United States diabetes is diagnosed in 23.6 million people with 1.6 million new diagnoses every year (Moghissi et al., 2009). According to the American Diabetes Association (n.d.) 618,156 people in Maryland are diagnosed with diabetes. Diabetes results in many complications such as microvascular and macrovascular disease, hypertension, coronary artery disease, stroke, neuropathy, peripheral artery disease and end stage renal disease (Wukich, 2015).

Hyperglycemic diabetic patients undergoing orthopedic surgery are at an increased risk for surgical site infections, prosthetic joint infections, longer inpatient length of stay, decreased likelihood of being discharged home and increased risk of morbidity and mortality (Thompson, Stearns, Apsey, Schlinkert & Cook, 2016). In patients undergoing orthopedic surgery, hyperglycemia from their diabetes can negatively impact bones, soft tissue, ligament and tendon healing, increase the risk for prosthetic joint infections and cause pulmonary embolism (Wukich, 2015).

According to Kwon et al., (2013), perioperative glucose monitoring is often overlooked. Of 18,278 admitted surgical patients, only 7,653 had their glucose recorded on the day of surgery. In a study by Gandhi et al. (2007), every increase in blood glucose by 20mg/dL greater than 100mg/dL intraoperatively was related to a 34% increase in postoperative complications. On the other hand it is also important to prevent hypoglycemia. Patients with poorly controlled glucose levels can experience hypoglycemia at normoglycemic levels. It is imperative to determine baseline glucose levels and prevent dramatic drops in their blood glucose. Hypoglycemia during general anesthesia is of major concern because of undetectable symptoms. If prolonged, hypoglycemia can damage brain function (Joshi et al., 2010).

A recent intervention to address the risks of hyperglycemia among surgical patients is perioperative glucose management and insulin administration. Glucose management should maintain a specific range of blood glucose that prevents hyperglycemia and hypoglycemia (Joshi et al., 2010). According to Alexanian, Mcdonnell and Akhtar (2010), intravenous (IV) insulin infusion can be used because it is quicker acting, has a short half-life and can rapidly correct hyperglycemia. However, subcutaneous insulin is also preferred in some situations as it provides similar control over blood glucose as IV insulin. Studies found that patients that received rapid-acting subcutaneous insulin every 1 to 2 hours compared to IV insulin had similar blood glucose levels when re-checked. Subcutaneous insulin administration is also found to be less labor-intensive and more cost effective. Additionally, use of rapid-acting subcutaneous insulin can decrease the amount of time a patient is observed in the postoperative period (Joshi et al., 2010).

In the perioperative area at an academic facility in the mid-Atlantic region, management of hyperglycemic diabetic patients has become a problem of interest. A clinical practice guideline has not yet been established at this facility for the treatment of hyperglycemic patients. Development of a guideline is imperative as complications resulting from hyperglycemic diabetic patients may contribute to the surgical complications.

The purpose of this Doctor of Nursing Practice (DNP) Scholarly Project is to develop and evaluate an evidence-based clinical practice guideline (CPG) for glucose management among adult hyperglycemic diabetic patients undergoing orthopedic surgery. It is anticipated that the development of a clinical practice guideline for the care of orthopedic surgical patients with diabetes will improve communication among anesthesia providers and lead to more standardized

care. Outcomes include optimizing blood glucose management perioperatively and maintaining consistency among providers in using the clinical practice guideline.

Theoretical Framework

The theoretical framework to be used for this DNP project is "A model for change to evidence-based practice" by Rosswurm and Larrabee (1999). The model addresses various stages of evidence-based practice (EBP), and guides the process of assessing the need for change to integrating the evidence-based protocol. The steps of the model include six steps. The first step is assessing the need for change in practice. The second step is linking the problem with interventions and outcomes. The third step is synthesizing the best evidence. The fourth step is designing a change in practice. The fifth step is implementing and evaluating the practice change. Lastly, sixth step is, integrating and maintaining the practice change.

The steps in this model will be followed to develop a CPG regarding perioperative glucose management. In the first step, a need for change in practice is recognized because a CPG for perioperative glucose management at this facility has not been established. In the second step, a glucose level >180mg/dL is problematic and requires correction with an IV insulin infusion scale to obtain an outcome of a glycemic level of 120-180mg/dL (Alexanian et al. 2010). In the third step, studies were analyzed to determine if a change in practice is supported. Existing evidence found that a perioperative glucose management range and guideline should be implemented to prevent hyperglycemia perioperatively. In the fourth step, key stakeholders will be contacted to engage them in the development of the CPG. The studies will be discussed with the stakeholders. Once stakeholders establish buy-in, the CPG draft will be reviewed and feedback will be noted. Additional staff will be engaged. Feedback from stakeholders and staff will yield adjustments to the guideline. Approval of the CPG by stakeholders and staff permits

engagement of additional staff and a change in practice will be designed. In the fifth step, key stakeholders will monitor and reinforce the use of the CPG. Data will be collected and analyzed regarding the outcomes of the patients. Staff and peers will endorse the use of the CPG for change in practice. Feedback from stakeholders and staff will be analyzed. Lastly, in the sixth step, the practice of monitoring blood glucose perioperatively will be integrated into the standard of practice and maintained.

Literature Review

Due to the increasing number of diabetic patients who present for surgery, there is a growing need for the intraoperative management and monitoring of blood glucose values. In the following literature review, significant evidence related to intraoperative glycemic control will be presented. Initially, two studies examining the outcomes of various blood glucose ranges will be analyzed. Next, two additional studies exploring the outcomes related to the use of intravenous (IV) insulin maintaining certain glycemic ranges will be reviewed. After that, an intraoperative glycemic guideline currently utilized in practice will be evaluated. Lastly, a synthesis of the studies will be discussed.

Various studies continue to debate on whether a target glycemic range or glycemic control (liberal, moderate, or tight) is more beneficial for patients during the intraoperative phase, due to a wide spectrum of inconsistent results. Lazar et al. (2011) conducted a randomized controlled trial (RCT) with patients (n=82) who were undergoing coronary artery bypass graft (CABG) surgery in an academic medical center. The purpose was to compare the influence of maintaining a tight (90-120 mg/dL) versus a moderate (120-180 mg/dL) glucose level and the impact on morbidity and mortality. The researchers reported that 75% of patients in the tightly controlled group had episodes of hypoglycemia compared to 10% of patients in the moderate

group. They recommended that patients' blood glucose be maintained at 120-180mg/dL intraoperatively.

Sathya, Davis, Taveira, Whitlatch and Wu (2013) also recommended a more moderate control of blood glucose. They carried out a meta-analysis comparing various levels of blood glucose management; strict (100-150mg/dL), moderate (150-200mg/dL) and liberal (>200mg/dL). Results of this study found that when glucose levels were between 150-200mg/dL, patient outcomes demonstrated a reduction in postoperative mortality and stroke when compared to patient's with blood glucose levels maintained >200mg/dL.

Joshi et al. (2010) also studied intraoperative blood glucose levels. They conducted a systematic review to develop an intraoperative practice guideline regarding the management of perioperative glycemic levels in surgical patients. The reviewers concluded that intraoperative blood glucose levels be maintained <180mg/dL, which is comparable to the recommendations of Lazar et al. (2011). They also recommended that blood glucose levels that are chronically elevated should not be decreased acutely in the perioperative period. They concluded that patients with chronically elevated blood glucose levels should be kept closer to their preoperative baseline values intraoperatively due to their compromised threshold for hypoglycemia.

Use of IV insulin intraoperatively has also been deliberated amongst research studies. Gandhi et al. (2007) conducted a RCT at a tertiary care center with patients undergoing surgery (n=400) to examine the use of IV insulin infusions. Patients were placed in the tight insulin therapy group (80-100mg/dL) versus the liberal treatment group (>200mg/dL). Patients that were given IV insulin to maintain a blood glucose range of 80-100mg/dL had an increased incidence of death, stroke, and heart block requiring a pacemaker.

Alexanian et al. (2011) also addressed intraoperative insulin therapy as part of a CPG for a perioperative glycemic control program at Boston Medical Center. The use of IV insulin was promoted to maintain blood glucose target range between 120-180mg/dL. The guidelines were strengthened by incorporating a 3 month pilot of the protocol in one OR area prior to implementation. The guidelines recommend that an IV insulin infusion be implemented when patients blood glucose is >180mg/dL.

Methods

Design and Setting

The design of this project is development of a clinical practice guideline (CPG). The setting that this CPG will take place is on a perioperative unit in an academic facility in the mid-Atlantic region of the United States. Due to the fact that there is more than one sample in this project, identification of each sample will be discussed under each of the stages of the project associated with that sample.

Sample and Procedures

Stage 1. In stage 1 the sample will include three DNP student project leaders and an anesthesiologist (*n*=4). This team will develop the CPG. During the first month the following meetings will take place weekly. In the first week the evidence based research and CPG will be presented to the team. During the second week the team will be presented with the AGREE II Instrument by the project leaders and asked to use the instrument to evaluate the CPG before the next meeting. In the third week the team will review results of the AGREE II Instrument and appropriate changes will be made to the CPG. During the fourth week a draft of the CPG will be handed to the team and a final discussion will be held regarding feedback for the CPG.

Stage 2. In stage 2 the sample will include Anesthesiologists and Certified Registered Nurse Anesthetists (CRNAs). Approximately 20 healthcare providers will be voluntarily included in this sample. One meeting will be held during this second month with the sample. During the meeting the sample will be presented with the CPG
And the Practitioner Feedback Questionnaire (PFQ), will be handed out. Following the meeting, the staff will have a two-week interval to complete the PFQ.

Stage 3. In stage 3 the sample will include the chief anesthesiologist. During this third month two meetings will be held. These meetings will be held two weeks apart in order to allot enough time for the chief anesthesiologist to construct feedback on the CPG. The timeline for this project can be found in Appendix D.

Data Collection and Analyzation

Data Collection

The AGREE II Tool will be used to collect data on the CPG by the development team (AGREE Next Steps Consortium, 2009). The purpose of this tool is to assess the quality of the guideline, provide a strategy for developing the guideline, and inform the user of the information to be included in the guideline and how it should be reported. The AGREE II Tool is scored using a 7-point Likert scale. The scale ranges from strongly disagree (score of 1) to strongly agree (Score of 7). It contains 6 domains with a total of 23 questions. The data for this tool will be collected by paper and pencil. According to the National Collaborating Centre for Methods and Tools [NCCMT] (2011). The tool used construct validity, and reliability of the tool was reported with a Cronbach alpha score ranging from 0.64 to 0.89, as a measure of internal consistency (NCCMT, 2011).

The Practitioner's Feedback Questionnaire (PFQ) will also be used to collect data on the CPG from the anesthesia providers. The purpose of the PFQ is to gather data from practitioners about their opinions on the CPG. The PFQ consists of 23 questions and is scored using a 3 – point Likert Scale that ranges from strongly agree (3) to neither agree nor disagree (2) to strongly disagree (1). Questions that are in support of the CPG are considered positive items and will be scored according to the above scoring system. Questions that are not in support of the CPG (items #10, 13, 14 & 15) are considered negative items and will be reverse scored. The data for this tool will be collected by paper and pencil. Content validity was reported and a reliability measure demonstrating internal consistency was reported with Cronbach alpha coefficients for the factors ranging from 0.75 to 0.85. (Brouwers, Graham, Hanna, Cameron & Browman, 2004).

Data Analysis

Scores for each, in order to run the data analysis the data will be inputted into excel for analyzation. Qualitative data obtained from the comments section of each domain will be analyzed for common themes and patterns in Microsoft Word.

Data Analysis of the PFQ will be completed by calculating the mean of each question and dividing by the total number of questions. This number will then be multiplied by 100 to convert it into a percentage. Using excel, data will be calculated into a univariate frequency table. The table will display the frequency of each score of three to the survey questions.

Measures To Protect Human Rights

The measures being taken to protect human subjects include not collecting any identifiers with the AGREE II and PFQ in order to protect the subject anonymity. Participation by all subjects will be voluntary. Data from the PFQs will be collected via a locked secure box.

The data will then be stored in a locked file cabinet in a locked office. Data for data analysis will then be transferred to a password protected computer and transferred to excel. Permission will be requested from the IRB. A proposal will be submitted to the University of Maryland Baltimore (UMB) Institutional Review Board (IRB) for a Non Human Subjects Research (NHSR) determination. A proposal will also be submitted to the IRB of the organization at which the project will be implemented.

Results

The CPG was finalized using results collected from the PFQ and the AGREE II Tool (see Appendix E and G) 19 anesthesia providers were provided with the PFQ of which all returned the survey completed. On the PFQ six items received a 100% positive response. This included, staff agreeing with the need for the guideline, staff agreeing with the methodology of the evidence to support the guideline, correct analysis of the evidence by the CPG team, the recommendations being suitable and acceptable for the patients at this facility and the providers agreeing that they would apply the guideline to their patients. Two items on the survey received a 95% and included that the draft recommendations were clear and have an approach to improve current usual practice. 89% of the staff agreed with the recommendations and the rationale for the guideline. In addition they agreed that the literature search was relevant and complete, and they would feel comfortable if patients received care with the recommendations and would use the guideline if it were approved. 79% of the anesthesia providers stated that the guideline has more benefits than risk ratio, that they are likely to be supported by colleagues when using the guideline and that the guideline should be approved as a practice guideline, but also that the guideline would take work and reorganization. 74% of the providers stated that the expected effects on patient outcomes would be obvious. 50% of the staff was unsure if the

recommendations were too rigid. Providers were evenly split 50/50 between agree and disagree that applying the guideline will be challenging. Finally 50% neither agreed nor disagreed that guideline recommendations are too expensive to apply.

Discussion

Of the items discussed above, items that received low percentage scores less than 85% are explained. Providers reported a low percentage score of 79%, that benefits of this guideline outweigh the risk. Five out of 19 providers disagreed with this item on the PFQ, stating that the benefits of the guideline would not outweigh the risk. Postoperative outcomes for diabetic patients are not readily available and distinct, giving reason for why providers disagreed with this item and are hesitant with the benefits that the guideline can bring. Hypoglycemia is also a risk that is associated with this guideline and a concern to anesthesia providers explaining the incorporation of a hypoglycemia protocol in this guideline. Providers also reported not being supported by their colleagues if this guideline were to be implemented. Five providers out of 19 (79%) stated their colleagues would not support them if this guideline were to be implemented; however, from this data it can be established that the majority of the providers believe they would have support if this guideline were to be implemented. Not receiving support from the majority of the providers decreases compliance and implementation. Resolution to this discrepancy amongst those five providers can be mended with communication amongst staff members. Providers scored the lowest (74%) on agreeing that expected effects on patient outcomes would be obvious. Monitoring for patient outcomes from perioperative glucose management is not readily obvious and can take prolonged periods of time for the results to be compiled. This can understandably cause hesitancy with providers if they do not experience and observe the improved outcomes firsthand. Half of the providers thought the recommendations

were too rigid, however, perioperative glucose management requires rigidity in order to prevent episodes of hypoglycemia and further glucose related complications. Half of the providers also agreed that implementing the guideline will be challenging. This can be appreciated by the difference between provider experiences and professional backgrounds. Providers that have experience in prior institutions with using perioperative insulin guidelines understand the benefits of this guideline, the process for implementation and maintenance of the patient. Understandably so, those who have not had prior exposure to perioperative glucose management guidelines will be more uncomfortable with its use. Having providers with a variety of experiences will help with the implementation of this guideline and being mentors for those who have not used something similar to it.

Limitations

Limitations of this project included a small sample size, lack of an endocrinologist, adherence of the protocol, acceptance to change, resources such as glucometers being readily available, and insulin being accessible from pharmacy. A small sample size of 19 anesthesia providers was approached with a presentation of this guideline. Though the anesthesia group at this hospital consists of 19 providers, other perioperative staff could have also been included; however, timing of the presentation, organization of all staff in one room and time restraints made this not feasible and therefore the sample size was kept small and the guideline was presented to only anesthesia providers. Input from an endocrinologist would have assisted in developing the intricacies of the guideline; however, due to the time restraints an endocrinologist could not be contacted. Due to the small anesthesia group, resistance to the guideline from one provider who may have an immense influence on the group can generate resistance from other providers. From the PFQ it was reported by the majority of the providers that they would

implement the guideline; however, once implemented, its acceptance and adherence may be difficult if influential staff members disapprove of its complexities. Resources such as glucometers need to be readily available in the preoperative area, the operating rooms and the postoperative unit. If resources are difficult to find then use of the guideline will be rejected rapidly. Currently there is one glucometer in the preoperative area and the postoperative unit. There are no glucometers in the operating rooms. This creates a limitation to the implementation of this guideline. Pharmacy also needs to be involved in providing insulin. Insulin needs to be available in anesthesia carts and accessible to anesthesia providers without them needing to wait for it or obtain it themselves. If the insulin is not readily available it can cause a limitation to the implementation of this guideline because providers will find its execution burdensome.

Plans For Translation

In order to translate the current guideline into practice, education will need to be provided to perioperative nurses, pharmacy will need to ensure that insulin is readily available, biomedical engineering will need to provide more glucometers and anesthesia providers with prior experience with similar glucose management guidelines will need to step up as pioneers for excellence. Education of perioperative nurses is essential as they are part of the process in helping transition the patient through each stage of the operative phase. Their assistance and diligence is crucial during times when the anesthesia provider may be busy with other responsibilities. Pharmacy will need to be on board with implementation of the guideline as they play an important role in supplying the insulin. A quick reaction from pharmacy in supplying an insulin drip, providing anesthesia providers with education on the different insulin regimens and supplying the anesthesia carts with insulin vials will be beneficial in making the implementation of this guideline smooth. Obtaining more glucometers allows for all providers to have adequate

resources to check blood sugars in a timely manner and prevent hindrance due to lack of resources. Lastly, anesthesia providers that have prior experience with analogous glucose management guidelines will need to step up as super users and assist their fellow anesthesia providers with the particularities of the guideline.

Conclusion

Perioperative glucose management is imperative in preventing postoperative complications among diabetic patients undergoing orthopedic surgery. Anesthesia providers and perioperative nurses are crucial members in the implementation and adherence of this guideline. Their vigilance and diligence in caring for diabetic patients' undergoing orthopedic surgeries is essential in keeping these patients safe and increasing the benefits associated with this guideline. From the data collected from the PFQ it can be concluded that anesthesia providers find the guideline to be useful but the benefits and expected effects on patient outcomes to be difficult to observe. The goal of this project included identifying an area of improvement at a community teaching hospital, developing a CPG based on evidence-based research, presenting the CPG to the anesthesia department, gathering feedback from anesthesia providers using the PFQ and finalizing a CPG to be distributed to the anesthesia department for further implementation. Implementation of the guideline will require unification from many different disciplines in the hospital; however, once complexities are configured diabetic patients can be optimized for their surgeries. Use of this guideline is hypothesized to standardize care by anesthesia providers when providing glucose management for diabetic patients undergoing orthopedic surgery, optimize diabetic patient care when admitted on the day of surgery with uncontrolled blood glucose levels and decrease postoperative complications among diabetic patients with uncontrolled blood glucose levels.

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Table 1

Evidence Rating Table

Author, year	Study objective/intervention or exposures compared	Design	Sample (n)	Outcomes studied (how measured)	Results	*Level and Quality Rating
Alexanian, McDonnell, & Akhtar (2011)	Compares the strategies used at Boston Medical Center vs. Yale New Haven in management of hyperglycemic diabetic surgical patients.	Practice-guideline	N/A	Before the protocol was implemented hospital-wide a 3-month pilot program was performed	Use IV insulin instead of subcutaneous due to the quick action and short half-life. IV insulin it is preferred for rapid correction. Subcutaneous insulin can take several hours to have peak effect and be metabolized which limits how many times we can redose the patient. Boston Medical Center: Glucose range: 120-180mg/dL If blood glucose is <180mg/dL the patient can go to surgery. Blood glucose levels 181-300mg/dL illustrate the need for the patient to be started on an IV insulin infusion by RN in preop. The patient should also receive a 5% dextrose infusion to reduce hypoglycemia. A blood glucose >300mg/dL	1B

					needs a metabolic evaluation A blood glucose >500mg/dL indicates that surgery should be postponed Yale New Haven: IV insulin is not started in preoperative area. If glucose >200mg/dL subcutaneous Aspart insulin is administered For a glucose >400mg/dL , the anesthesiologist is informed and elective surgery is discouraged For an intraoperative glucose >180mg/dL, an IV insulin infusion should be initiated with glucose monitoring q1hr with goal 120-180mg/dL	
Gandhi et al. (2007)	To explore the outcomes of patients whose blood glucose was maintained normoglycemic intraoperatively with an IV insulin infusion	Randomized controlled trial open-label, controlled trial with blinded assessment	Patients were randomly assigned to either group: Intensive insulin therapy group, given IV insulin infusion if blood glucose >100mg/dL to maintain intraoperative level between 80-100mg/dL, (n=199)	Blood glucose was measured preoperatively every 30minutes, then every 1-2 hours in the postoperative period. Intraoperative blood glucose levels were measured based	Patients in the intensive insulin therapy group received an IV insulin infusion to maintain their blood glucose at normoglycemic levels (100mg/dL). This group showed no reduction in short-term mortality, morbidity or length of stay in the intensive care unit (ICU) or hospital When patients with diabetes	2B

			(n=37 diabetic patients) Or Conventional treatment group where patients did not get insulin during surgery unless their glucose level was >200mg/dL (N=201) (n=36 diabetic patients) In the conventional group: Glucose between 200-250mg/dL patients received 4 units of insulin every hour until glucose was <200mg/dL For intraoperative glucose levels >250mg/dL, patients were placed on an IV insulin infusion until the glucose was less than 150mg/dL	on the providers' discretion. Accu-check (glucometer) was used for measurement of blood glucose.	who were also in the intensive insulin infusion group were analyzed separately their outcomes also did not improve	
Joshi et al.	Development of	Systematic	1 systematic review	Not stated	In patients with well-	1A

(2010)	perioperative glycemic control guidelines based on a systematic review of ambulatory surgical patients.	review	and 9 trials including 5 RCTs		controlled diabetes, Intraoperative blood glucose levels should be maintained <180mg/dL. In patients with poorly controlled glycemic levels their blood glucose levels should be maintained around their preoperative baseline values rather than normalizing them. Patients with chronically elevated blood glucose levels should not be decreased to normoglycemic levels because of their differing hypoglycemic threshold It is better to administer subcutaneous insulin because it provides similarities in glycemic control with the IV regular insulin infusion. However, multiple doses given one right after another should be avoided to prevent a “stacking” effect that can eventually cause hypoglycemia. Therefore, additional subcutaneous doses should not be given until the	

					peak effect of the previous dose has passed or the blood glucose is being closely monitored.	
Lazar et al. (2011)	To decide which blood glucose range; 90-120mg/dL or 120-180mg/dL results in better clinical outcomes and less morbidity in diabetic patients undergoing CABG surgery	Randomized controlled trial	82 diabetic patients undergoing CABG who were randomized into two groups The Moderate glycemic control group 120-180 mg/dL (n=42) and Aggressive group 90-120 mg/dL (n=40)	Serum glucose was measured every 30 minutes in the operating room and each hour in the ICU. Blood glucose measurements were obtained by blood draws from arterial catheters and were measured with the use of point-of-care analyzers	75% of patients in the aggressive glucose control group had episodes of hypoglycemia compared to 10% of patients in the moderate group. Controlling patient's glucose in the aggressive group did not have any effect on the patients morbidity or mortality; however, if the patients developed hypoglycemia it did increase their risk of mortality. The study recommends maintaining a moderate targeted blood glucose level of 120-179mg/dL because this way blood glucose is controlled and hypoglycemia is avoided.	2B
Sathya, Davis, Taveira, Whitlatch, & Wu	To conduct a meta-analysis comparing strict (100-150mg/dL), moderate (150-	Meta-analysis	2 retrospective analysis (5710 patients) 1 non-randomized	Primary outcome postoperative mortality. Secondary	Patients whose glucose was kept between 150-200mg/dL had a significant reduction in mortality compared to those whose blood sugar was kept	1B

(2013)	200mg/dL) and liberal (>200mg/dL) glucose levels to postoperative outcomes in patients with diabetes.		prospective study (200 patients) 3 randomized trials (423 patients) 5out of the 6 studies included patients with diabetes	outcomes were postoperative incidence of atrial fibrillation, infection or stroke.	between 100-150mg/dL Some studies showed less incidence of stroke for those in moderate vs. liberal group. Some showed no significant difference. No relationship between incidence of atrial fibrillation and glucose range. No relationship between glucose and wound infection. Those whose blood glucose was maintained in the strict group had more incidence of hypoglycemia. Most studies suggest a blood glucose <180mg/dL; however, this study suggests a blood glucose <200mg/dL Patients with diabetes, it is best to keep their glucose <200mg/dL	

Table 2

Evidence Review Appraisal for Quality

Author, year	Study objective/intervention or exposures compared	Strengths	Weaknesses	Quality Rating
Alexanian. McDonnell, & Akhtar (2011)	Compares the strategies used at Boston Medical Center vs. Yale New Haven in management of hyperglycemic diabetic surgical patient.	• clinical practice guideline • 3 month pilot of the protocol was performed in one OR area prior to being used hospital wide • Tested in diabetic patients	• Used for inpatients	B
Gandhi et al. (2007)	A study that explored the outcomes of patients whose blood glucose was maintained normoglycemic intraoperatively with IV insulin infusion	• Randomized controlled trial with blinded assessment • did pilot trial with 20 patients 2 weeks prior to implementation • power analysis calculated. Needed 177 patients in each group to have 90% power (2-sided alpha level of 0.05) • patients treated with strict glycemic control postoperatively to make sure the difference in outcome was from the intraoperative glycemic control • Baseline characteristics were not statistically significantly between the 2 study groups	• Only implemented at 1 center • Need larger diabetic population • Could not blind the intensive insulin treatment • Tested in patients going for cardiac surgery	B

Joshi et al. (2010)	Development of perioperative glycemic control guidelines based on a systematic review in ambulatory surgical patients.	• systematic review of literature • study protocol stated clearly • Operational definition for hypoglycemia	• No operational definition for hyperglycemia • Threat to external validity due to not being able to generalize this protocol	A
Lazar et al. (2011)	To decide which blood glucose range; 90-120mg/dL or 120-180mg/dL results in better clinical outcomes and less morbidity in diabetic patients undergoing CABG surgery	• Random assignment • Variables measured are clearly stated • Sample size adequate to detect statistical differences in serum glucose	• Clinicians were not blinded to the treatment groups • Threat to external validity- results derived from a single center • Small sample size • Threat to external validity: Patients undergoing CABG surgery so unable to generalize to other surgeries.	B
Sathya, Davis, Taveira,Whitlatch, & Wu (2013)	To conduct a meta-analysis comparing strict (100-150mg/dL), moderate (150-200mg/dL) and liberal (>200mg/dL) glucose levels to postoperative outcomes in patients with diabetes.	• Meta-analysis • good sample size for the studies included in the meta-analysis • inclusion criteria clearly stated • operationalized definition for strict, moderate and liberal glucose target • 3/6 studies were randomized trials • 5/6 studies included diabetic patients	• 2 of the studies in the meta-analysis were retrospective	B

Table 3

Summary Evidence Rating Table

Evidence Based Practice Question (PICO): In adult diabetic surgical patients undergoing orthopedic surgery how should hyperglycemia be treated intraoperatively?			
Level of Evidence	Number of Studies	Summary of Findings	Overall Quality (you may expand further)
1	3	All three concluded that a moderate glycemic control strategy be used. Study by Sathya recommended glucose range of 150-200mg/dL, Alexanian recommended 120-180mg/dL and Joshi recommended <180mg/dL. Alexanian et al. (2011) also recommended that IV insulin be used in the perioperative period for critically ill patients and >300mg/dL should be evaluated in the preoperative area to evaluate for ketoacidosis. Or postpone non-urgent/emergency surgery if glucose is >400mg/dL and postpone non-urgent if >500mg/dL Joshi et al. (2010) recommended the administration of subcutaneous insulin, using the "rule of 1500" or "rule of 1800" to calculate the insulin dose, giving adequate intraop crystalloid 20-40mL/kg and PONV prophylaxis	B: reasonably consistent results, sufficient sample, some control, with fairly definitive conclusions, reasonably consistent recommendations based on fairly comprehensive literature review that includes some reference to scientific evidence.

2	2	Both RCTs found that when glucose levels were decreased to normoglycemic levels it did not have any added benefit for the patients. Both RCTs used insulin infusions to decrease the glucose levels. Patients' risk of short-term death, morbidity or length of stay in the ICU or hospital did not decrease.	B: reasonably consistent results in both studies; sufficient sample size in Gandhi et al. (2007) study; however, insufficient sample size in the Lazar et al. (2011) study. Some control, fairly definitive conclusions, consistent recommendations based on moderately comprehensive literature review that includes reference to scientific evidence.

Appendix A

Time Line

Submit proposal to committee members by April, 2016

Present proposal to committee members on May, 2016

Submit project proposal to UMB and hospital Institutional Review Board by May, 2016

Implement project from September, 2016 to December, 2016

Analyze, synthesize and evaluate data by March, 2017

Submit final scholarly project manuscript to committee for review by March 2017

Present final scholarly project report to Committee by April, 2017

Appendix B

Practitioner Feedback Questionnaire

1. Are you responsible for the care of patients for whom this draft guideline report is relevant? This may include the referral, diagnosis, treatment, or follow-up of patients.	Yes ☐	No ☐	Unsure ☐
If you answered "*No*" or "*Unsure*", there is no need to answer or return this questionnaire. If you answered "*Yes*", please answer the questions below and return to [enter expected destination of surveys].			
	Strongly agree	Neither agree or disagree	Strongly disagree
2. The rationale for developing a guideline is clear.	☐	☐	☐
3. There is a need for a guideline on this topic.	☐	☐	☐
4. The literature search is relevant and complete (e.g., no key evidence was missed nor any included that should not have been) in this draft guideline.	☐	☐	☐
5. I agree with the methodology used to summarize the evidence included in this draft guideline.	☐	☐	☐
6. The results of the evidence described in this draft guideline are interpreted according to my understanding of the evidence.	☐	☐	☐
7. The draft recommendations in this report are clear.	☐	☐	☐
8. I agree with the draft recommendations as stated.	☐	☐	☐
9. The draft recommendations are suitable for the patients for whom they are intended.	☐	☐	☐
10. The draft recommendations are too rigid to apply to individual patients.	☐	☐	☐
11. When applied, the draft recommendations will produce more benefits for patients than harms.	☐	☐	☐
12. The draft guideline presents options that will be acceptable to patients.	☐	☐	☐
13. To apply the draft recommendations will require reorganization of services/care in my practice setting.	☐	☐	☐
14. To apply the draft guideline recommendations will be technically challenging.	☐	☐	☐
15. The draft guideline recommendations are too expensive to apply.	☐	☐	☐
16. The draft guideline recommendations are likely to be supported by a majority of my colleagues.	☐	☐	☐
17. If I follow the draft guideline recommendations, the expected effects on patient outcomes will be obvious.	☐	☐	☐
18. The draft guideline recommendations reflect a more effective approach for improving patient outcomes than is current usual practice. (If they are the same as current	☐	☐	☐

practice, please tick NA). *NA* ☐			
19. When applied, the draft guideline recommendations will result in better use of resources than current usual practice. (If they are the same as current practice, please tick NA). *NA* ☐	☐	☐	☐
20. I would feel comfortable if my patients received the care recommended in the draft guideline.	☐	☐	☐
21. This draft guideline should be approved as a practice guideline.	☐	☐	☐
22. If this draft guideline were to be approved as a practice guideline, I would use it in my own practice.	☐	☐	☐
23. If this draft guideline were to be approved as a practice guideline, I would apply the recommendations to my patients.	☐	☐	☐

Adapted from: Brouwers, M.C., Graham, I.D., Hanna, S.E., Cameron, D.A., & Browman, G.P. (2004). Clinicians' assessments of practice guideline in oncology: The CAPGO survey. *International Journal of Technology Assessment in Health Care, 20*(4), 421-6.

Appendix C

Clinical Practice Guideline for Perioperative Glucose Management for Diabetic Patients Undergoing Orthopedic Surgery

A. **Overview**: Diabetes Mellitus (DM) is diagnosed in 285 million adults worldwide. By 2030 this number is expected to increase to 439 million adults (Wukich, 2015). In the United States diabetes is diagnosed in 23.6 million people with 1.6 million new diagnoses every year (Moghissi et al., 2009). According to the American Diabetes Association (2014) 618,156 people in Maryland are diagnosed with diabetes. Diabetes results in many complications such as microvascular and macrovascular disease, hypertension, coronary artery disease, stroke, neuropathy, peripheral artery disease and end stage renal disease (Wukich, 2015).

B. **Background**: Hyperglycemic diabetic patients undergoing orthopedic surgery are at an increased risk for surgical site infections, prosthetic joint infections, longer inpatient length of stay, decreased likelihood of being discharged home and increased risk of morbidity and mortality (Thompson, Stearns, Apsey, Schlinkert & Cook, 2016). In patients undergoing orthopedic surgery, hyperglycemia from their diabetes can negatively impact bones, soft tissue, ligament and tendon healing, increase the risk for prosthetic joint infections and cause pulmonary embolism (Wukich, 2015).

C. **Objective**: The objective of this CPG is to standardize perioperative glucose treatment amongst providers and maintain optimal glycemic control in patients throughout the perioperative period. The CPG will provide evidence-based recommendations for the management of blood glucose levels in the preoperative, intraoperative and postoperative

periods. It will include guidelines for perioperative insulin treatment, a threshold blood glucose level for treatment with insulin, threshold blood glucose level for metabolic evaluation, and a recommended blood glucose level for cancellation of non-urgent surgery.

D. **Population**: Adult diabetic patients (Insulin and Non-Insulin Dependent) patients undergoing orthopedic Surgery

E. **Population Excluded**: Patients <18 years old, emergency surgery/trauma patients

F. **Health Care Setting**: Full-service community hospital in the mid-Atlantic region; perioperative area including pre-op/holding unit, intraoperative (operating rooms), and Postoperative Anesthesia Care Units (PACU)

G. **Target Users:** This CPG is intended for use of all anesthesia providers including anesthesiologists, CRNAs, and perioperative nurses

H. **Search Strategies**: A comprehensive search of the literature was conducted using CINAHL and PubMed. Search was limited to studies in English language and inclusion of human subjects. Two CPGs, one systematic review, two randomized controlled trials (RCTs) and one meta-analysis were used for the development of this CPG. The Melnyk Fineout-Overholt rating and evidence-grading tool was used for analysis of the studies.

I. **Inclusion Criteria for evidence**: Systematic reviews, Meta-analysis, RCTs, research within the past 5 years, diabetic patients, adult patients, patients undergoing orthopedic surgery. Presence of glycemic measurements and ranges, inclusion of two glucose range targets for comparison with statement of postoperative outcomes.

J. **Exclusion criteria for evidence**: Non-orthopedic surgical patients, Pediatric patients

K. **Strengths**: Two clinical practice guidelines, one systematic review, two RCTs, one meta-analysis. Testing among diabetic patients, random assignment in one study with variables clearly stated and adequate sample size to detect statistical difference in serum glucose. Of the RCTs included both included pilot trials, one included a power analysis and one included a large sample size.

L. **Limitations**: Threat to external validity in one study because unable to generalize the protocol. In another study clinicians were not blinded to the treatment groups. Two of the studies included in the meta-analysis were retrospective.

M. **Consensus Techniques**: Group consensus will be used to finalize recommendations for the development of the CPG, agreed upon by including experts of the team.

N. **Procedure for updating the guideline**: Guideline will be updated every three years with the most recent literature.

O. **Facilitators and Barriers**: In order to identify facilitators and barriers to implementing the CPG, feedback from key stakeholders, perioperative staff, and administration will be sought throughout the three stages of data collection. Furthermore, a pilot program will be instituted for 3 months before widespread implementation to so that any unforeseen challenges or barriers that may arise during testing may be revealed. Strategies for facilitating implementation include making sure the CPG is well organized, easy to follow, and readily available. In-services will be conducted to ensure verbal understanding of the CPG from the staff. Anticipated barriers may include the risk of hypoglycemia and the skills/comfort of practitioners on recognizing and treating severe hypoglycemia. In order to prevent this barrier, the CPG will include hypoglycemic treatment strategies.

P. **How the Recommendations Can Be Put Into Practice**: The CPG will be in the form of a clinical algorithm. The instructions for recommendations will be clear and divided out between preoperative, intraoperative, and postoperative recommendations. In-services will be provided where copies of the CPG will be disseminated. Once a pilot program will be implemented over a three month period, results from a pilot test will be summarized and a paper handout will be passed out to the perioperative staff. Patient leaflets regarding education on controlling blood glucose levels in the perioperative period will be disseminated to patients during pre-op testing appointments.

Q. **Resource Implications**: The costs of implementing this CPG is expected to be minimal. The clinical skills required to implement the recommendations are within the standard practice of care provided by the perioperative staff. Consideration to the cost of equipment includes cost of supplying glucometers across the perioperative area and the pharmacological costs of subcutaneous insulin and intravenous insulin infusions. Other anticipated costs may include the costs of training/educating staff.

R. **Auditing Criteria**: In order to assess the adherence to the recommendations outlined in the clinical practice guideline, auditing criteria will include the following:

1. The perioperative blood glucose level should be maintained 120-180mg/dL
2. If the preoperative blood glucose level was >180mg/dL, an insulin infusion was initiated
3. Elective cases were cancelled if preoperative blood glucose levels were >400-500mg/dL
4. Intraoperative blood glucose levels were checked every hour
5. Blood sugars were checked upon arrival to PACU

S. This CPG was developed without funding.

T. The group members have declared they have no competing interests.

References

American Diabetes Association. (2014). Statistics About Diabetes. Retrieved from http://www.diabetes.org/diabetes-basics/statistics/

Moghissi, E.S., Korytkowski, M.T., DiNardo, M., Einhorn, D., Hellman, R., Hirsch, I.B., … Umpierrez, G.E. (2009). American association of clinical endocrinologists and American diabetes association consensus statement on inpatient glycemic control. Diabetes Care 32(6). doi: 10.2337/dc09-9029

Thompson, B.M., Stearns, J.D., Apsen, H.A., Schlinket, R.T. & Cook, C.B. (2016). Perioperative management of patients with diabetes and hyperglycemia undergoing elective surgery. Current Diabetes Report, 16(1). doi: 10.1007/s11892-015-0700-8

Wukich, D. K. (2015). Diabetes and its negative impact on outcomes in orthopaedic surgery. World Journal of Orthopedics, 6(3), 331-339. doi:10.5312/wjo.v6.i3.331

Preoperative Recommendations:

- Schedule diabetic patients early in the day[3].
- Check point of care blood glucose (POC BG) on all patients with diabetes upon arrival to the Pre-op area.
- Optimal Preoperative BG range: 120-180 mg/dL[3].
- If initial POC BG is out of optimal BG range, follow CPG algorithm
- Initiate q2hr POC BG if initial POC BG is 120-180 mg/dL
- Initiate q1hr POC BG if initial POC BG is <120 or >180mg/dL
- Elective cases should be postponed in patients with fasting BG>400-500mg/dL or in patients with significant complications of hyperglycemia such as severe dehydration, ketoacidosis, and hyperosmolar non-ketotic states [1,3]. Postponing elective cases is always up to the discretion of the provider, taking into account the patient's stability, necessity of the procedure and acceptable risk [1,3].

Table 1

Pre-Operative Diabetic Medication Guidelines [1,2,3]

Type of Insulin	Day & Evening Before Surgery	Morning of Surgery
Oral Agents	Continue all oral agents. *If the patient has renal dysfunction or is likely to receive IV contrast, you may discontinue metformin 24-48 hours prior to surgery.	Hold.
Short-Acting Insulin (Aspart, Lispro, Apidra, Regular, Novolog, Humalog)	Continue.	Hold.
Intermediate-Acting Insulin (NPH)	Maintain usual meal plan & insulin dose. If taken in the evening, take 75% of dose.	Give 50% of the usual dose.
Long-Acting Insulin (Lantus, glargine, detemir)	Maintain usual meal plan and insulin dose. If taken at night and the patient has a history of nocturnal or morning hypoglycemia, reduce nighttime dose by 25%.	Take 75% of the usual dose.
Insulin Pump	Maintain usual meal plan & basal rate.	Maintain basal rate.

Intraoperative Recommendations:

- Patient is within optimal range if blood glucose levels are maintained between 120-180 mg/dL [1,3]
- Initiate q2hr POC BG if initial POC BG is 120-180 mg/dL
- Initiate q1hr POC BG if initial POC BG is <120 or >180mg/dL
- If POC BG >180mg/dL follow subcutaneous sliding scale for treatment
- If BG < 70mg/dL stop administration of insulin immediately and follow hypoglycemia protocol

Postoperative Recommendations:

- Maintain target perioperative glucose range 120-180mg/dL[1,2,3]
- Check BG once patient arrives in PACU.[1,3]
- Continue q2hr POC BG if initial PACU BG is 120-180 mg/dL
- Initiate q1hr POC BG if initial PACU BG is <120 or >180mg/dL
- For BG>180mg/dL follow subcutaneous sliding scale for treatment or maintain insulin gtt if already running[1]
- If BG remains within 120-180mg/dL for 4 hours, decrease frequency of checks from 1 hour to every 2 hours[3]
- Maintain vigilance in the postoperative period for the risk of hypoglycemic symptoms such as sweating, palpitations, confusion, and loss of consciousness[2]
- Use maintenance IV fluids without dextrose unless the patient is on an insulin drip.[3]
- Stabilized blood glucose levels and tolerance of oral intake permits the resumption of previous anti-diabetic therapy[1,]
- If patient on IV insulin consult endocrinology or hospitalist for postoperative consultation and continue follow-up in appropriate nursing unit that can manage patients on IV insulin infusion.

Hypoglycemia Recommendations[3]:

- If blood glucose <80mg/dL give 100mL D10W IV or 25-50mL (1/2-1 amp) D50
    - Check blood glucose in 15-30min
- Blood glucose 80-100mg/dL begin D5W at 40mL/hr or D10W at 20mL/hr
    - Check blood glucose in 1 hour
- If intraoperative blood glucose decreases < 120 mg/dL initiate D5W at 40mL/hr or D10W at 20mL/hr[3]
    - Check blood glucose every hour[3]

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Clinical Practice Guideline Algorithm

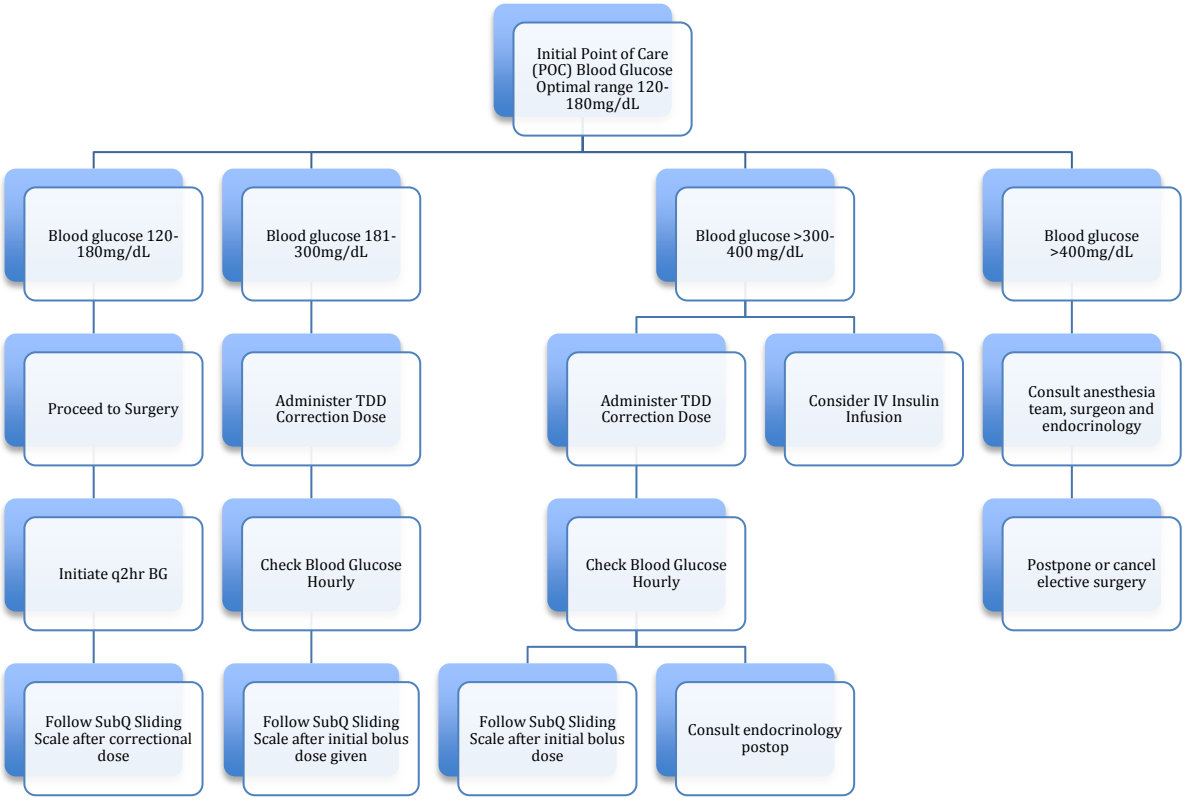

Table 1. *Total Daily Dose (TDD) Calculation*

Patients on basal-bolus dose or PreMixed Insulin at home	**Patients on basal insulin only with or without oral hypoglycemic**

• Calculate TDD using insulin doses from home
  ○ Basal dose (Bolus x 3*[# of meals]*) = TDD
  ○ Take TDD and look at chart. Match TDD with initial POC BG to get treatment dose
	• Calculate TDD using weight
	  ○ 0.3-0.5 units/kg for patients with type 2 diabetes under acceptable control = TDD
	  ○ Take TDD and look at chart. Match TDD with initial POC BG to get treatment dose.

Table 2

Correction Dose Guideline[3]

Weight Class I (<175 lbs/80 kg)	Weight Class II (175-220 lbs/81-99 kg)		Weight Class III (>220 lbs/100 kg)
BG (mg/dl)	Insulin Units (subcut)	Insulin Units (subcut)	Insulin Units (subcut)
<150	0 unit	1 unit	2 units
150-180	1 unit	2 units	4 units
181-200	2 units	4 units	6 units
>200	Begin insulin infusion	Begin insulin infusion	Begin insulin infusion

Table 3

Subcutaneous Insulin Sliding Scale[3]

POC BG mg/dL	15units or less TDD	16-30 units TDD	31-50 units TDD	51-75 units TDD	76-100 units TDD	>100 units TDD
180-200	0	1	1	1	2	2
201-255	1	1	2	3	4	5
226-250	1	2	3	4	6	7
250-275	2	2	4	6	8	10
276-300	2	3	5	7	10	12
>300	3	3	6	8	12	15

Table 4

IV Insulin Initiation[3]

IV Insulin Initiation Dose		
Blood glucose (mg/dL)	Regular Insulin (bolus)	Regular Insulin (infusion per hour)
151-200	No Bolus	2 units IV
201-250	3 units IV	2units IV
251-300	6 units IV	3 units IV
301-350	9 units IV	3 units IV
>350	10 units IV	4 units IV

Table 5

IV Insulin Sliding Scale[3]

Previous Blood Glucose (mg/dl)

Current Blood Glucose (mg/dL)	<60	60-80	81-100	101-150	151-200	201-250	251-300	301-400	>400
<60	Hold drip and give 1 amp 50% glucose and check BG every 30 minutes until >100mg/dL								
60-80	Hold drip and check BG every 30 minutes until >100mg/dL								
81-100	↓ rate by 1unit	No change	↓ rate by 0.5 units	↓ rate by 0.5 units	↓ rate by 2 units	↓ rate by 2 units	↓ rate by 2 units	↓ rate by 2 units	↓ rate by 2 units
101-150	No Change					↓ rate by 2 units	↓ rate by 2 units	↓ rate by 2 units	↓ rate by 2 units
151-200	↑ rate by 1 unit	↑ rate by 1 unit	↑ rate by 0.5 units	↑ rate by 0.5 units	↑ rate by 1 unit	No Change	↓ rate by 2 units	↓ rate by 2 units	↓ rate by 2 units
201-250	↑ rate	↑ rate by 2	↑ rate	↑ rate	↑ rate	↑ rate by	↑ rate	↑ rate	No Change

	by 2 units	units	by 2 units	by 2 units	by 1 unit	1 unit	by 1 unit	by 1 unit	
251-300	↑rate by 2.5 units	↑rate by 2.5 units	↑rate by 2.5 units	↑ rate by 1.5 units	↑ rate by 1 unit	↑ rate by 1 unit	↑ rate by 1.5 units	↑ rate by 2 units	No Change
301-400	↑ rate by 3 units/hr								
>400	↑ rate by 4 units/hr								

Appendix E

AGREE II Tool Appraisal Scoring

Table 1

Domain 1: Scope & Practice

	Item 1	Item 2	Item 3	Total
Appraiser 4	7	7	7	21
Appraiser 3	7	6	7	20
Appraiser 2	6	5	7	18
Appraiser 1	7	6	7	20
Total	27	24	28	79

Maximum possible score= 7(strongly agree) x 3(items) x 4(appraisers)= 84
Minimum possible score= 1(strongly disagree) x 3(items) x 4 (appraisers)=12

The scaled domain score will be:
Obtained score-Minimum Possible score
Maximum possible score-Minimum possible score
79-12/84-12 x 100

(67/72) x 100
(0.93)x100= 93%

Table 2

Domain 2. Stakeholder Involvement

	Item 4	Item 5	Item 6	Total
Appraiser 4	6	6	7	19
Appraiser 3	7	7	7	21
Appraiser 2	7	2	7	16
Appraiser 1	7	2	7	16
Total	27	17	28	72

Maximum possible score= 7(strongly agree) x 3(items) x 4(appraisers)= 84
Minimum possible score= 1(strongly disagree) x 3(items) x 4 (appraisers)=12

(72-12)/(84-12)
(60/72) x100
(0.83) x100= 83%

Table 3

Domain 3. Rigour of Development

	Item 7	Item 8	Item 9	Item 10	Item 11	Item 12	Item 13	Item 14	Total
Appraiser 4	7	6	6	6	7	6	6	5	49
Appraiser 3	7	3	3	6	7	7	4	2	39
Appraiser 2	5	5	7	6	7	7	6	3	46
Appraiser 1	7	7	5	7	6	6	2	4	44
Total	26	21	21	25	27	26	18	14	178

Maximum possible score= 7(strongly agree) x 8(items) x 4(appraisers)= 224
Minimum possible score= 1(strongly disagree) x 8(items) x 4 (appraisers)=32

(178-32)/(224-32)
(146/192) x100
(0.76) x100= 76%

Table 4

Domain 4. Clarity of Presentation

	Item 15	Item 16	Item 17	Total
Appraiser 4	7	7	7	21
Appraiser 3	7	7	7	21
Appraiser 2	7	7	6	20
Appraiser 1	6	7	7	20
Total	27	28	27	82

Maximum possible score= 7(strongly agree) x 3(items) x 4(appraisers)= 84
Minimum possible score= 1(strongly disagree) x 3(items) x 4 (appraisers)=12

(82-12)/(84-12)
(70/72) x100
(0.97) x100= 97%

Table 5

Domain 5. Applicability

	Item 18	Item 19	Item 20	Item 21	Total
Appraiser 4	5	7	6	6	24
Appraiser 3	4	7	5	5	21
Appraiser 2	7	7	6	7	27
Appraiser 1	5	3	6	4	18
Total	21	24	23	22	90

Maximum possible score= 7(strongly agree) x 4(items) x 4(appraisers)= 112
Minimum possible score= 1(strongly disagree) x 4(items) x 4 (appraisers)=16

90-16/112-16
(74/96)x100
0.77x100=77%

Table 6

Domain 6: Editorial Independence

	Item 22	Item 23	Total
Appraiser 4	7	7	17
Appraiser 3	6	7	13
Appraiser 2	7	7	14
Appraiser 1	7	7	14
Total	27	28	58

Maximum possible score= 7(strongly agree) x 2(items) x 4(appraisers)= 56
Minimum possible score= 1(strongly disagree) x 2(items) x 4 (appraisers)=8
55-8/56-8
(47/48) x100
0.98x100= 98%

Table 7

Overall Assessment

	OA1
Appraiser 4	6
Appraiser 3	5
Appraiser 2	6
Appraiser 1	6
Total	23

Appendix F

Practitioner Feedback Survey Results

Table 1

Practitioner Feedback Survey

Item #	PFS 1	PFS 2	PFS 3	PFS 4	PFS 5	PFS 6	PFS 7	PFS 8	PFS 9	PFS 10	PFS 11	PFS 12	PFS 13	PFS 14	PFS 15	PFS 16	PFS 17	PFS 18	PFS 19	Mode
2	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2	3	3
5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
7	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3
8	3	2	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
9	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
10	3	2	2	2	1	2	2	3	3	1	3	3	2	3	1	3	2	2	2	2
11	3	3	3	3	3	2	3	3	3	3	3	3	1	3	3	3	2	2	3	3
12	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
13	3	3	3	2	2	3	3	3	3	3	3	3	3	3	1	3	2	3	3	3
14	3	2	2	1	2	3	1	3	3	2	3	2	3	3	1	3	1	3	1	3
15	2	2	2	1	1	2	1	3	2	1	2	2	3	3	1	3	1	2	1	2
16	2	2	3	3	3	3	3	1	3	3	3	3	3	3	3	3	3	2	3	3
17	3	2	3	2	3	3	3	3	3	2	3	3	3	3	3	3	2	2	3	3
18	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
19	3	3	3	2	3	2	3	3	3	3	3	3	3	3	3	3	2	3	3	3
20	3	3	3	3	3	2	3	3	3	3	3	3	1	3	3	3	3	3	3	3
21	3	2	3	2	3	3	2	3	3	3	3	3	3	3	3	3	3	3	2	3
22	3	3	3	2	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3
23	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

*PFS = Practitioner Feedback Survey
Strongly Agree = 3
Neither Agree or Disagree = 2
Strongly Disagree = 1

Appendix G

Percentage Response Per Survey

Table 2

Practitioner Feedback Questionnaire Percentage (%) Response Per Survey

Item #	Strongly Agree (%)	Neither Agree or Disagree (%)	Strongly Disagree (%)
2	89	11	0
3	100	0	0
4	89	11	0
5	100	0	0
6	100	0	0
7	95	5	0
8	89	11	0
9	100	0	0
10	37	47	16
11	79	16	5
12	100	0	0
13	79	16	5
14	47	26	26
15	21	42	37
16	79	16	5
17	74	26	0
18	95	5	0
19	84	16	0
20	89	5	5
21	79	21	0
22	89	11	0
23	100	0	0