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Final Scholarly Project: Evidence-Based Practice Guidelines for Perioperative Use of Dexmedetomidine in Pediatric Congenital Cardiac Surgery

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In Partial Fulfillment of the Requirements for the Degree

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We have no conflicts of interest to disclose.

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Abstract

Tachyarrhythmias are common postoperatively in the congenital cardiac surgery population. About 1% of the population is born with congenital heart disease (CHD), with 50% of patients undergoing surgery for CHD experiencing arrhythmias. Complications can arise from postoperative arrhythmias, including hemodynamic instability and myocardial depression, having catastrophic health repercussions. Despite the high prevalence and complications, there is no standard practice for postoperative tachyarrhythmia prevention in the chosen population, and prevention is at the provider's discretion. However, literature exploring the effects of dexmedetomidine notes promising results for using the drug for postoperative tachyarrhythmia prevention. The project aims to address the lack of evidence-based guidelines for tachyarrhythmia prevention in CHD cardiac surgery patients by implementing evidence-based practice guidelines for the intraoperative use of dexmedetomidine. The project utilizes quantitative data to evaluate and assess the effectiveness of the guideline in a level one pediatric trauma center. Following a review of literature, data collection, and data evaluation, the evidence-based guidelines for intraoperative use of dexmedetomidine are effective in reducing the incidence of postoperative tachyarrhythmias in congenital cardiac surgery patients, as well as a reduction in heart rate and invasive ventilation time. Utilizing the explored guidelines can lead to better patient outcomes, fewer complications, and a universal prevention protocol for anesthesia providers, providing consistently better results.

Keywords: tachyarrhythmia prevention, dexmedetomidine, invasive ventilation time, heart rate, congenital cardiac surgery, perioperative

Final Scholarly Project: Evidence-Based Practice Guidelines for Perioperative Use of Dexmedetomidine in Pediatric Congenital Cardiac Surgery

Introduction

Postoperative cardiothoracic complications play a significant factor in patient outcomes. Postoperative arrhythmias (POAs), a type of tachyarrhythmia, are associated with many outcomes, including increased length of stay, increased costs, and hemodynamic instability (Peretto et al., 2014). Although POAs are common in cardiac surgery patients, providers, such as the anesthesia team, lack guidelines for perioperative pharmacologic prevention.

POAs include bradyarrhythmias, ventricular arrhythmias, and atrial tachyarrhythmias. Postoperative atrial fibrillation (POAF) affects nearly 35% of post-cardiac surgery patients within the first two days post-surgery, with ventricular arrhythmias and bradyarrhythmias affecting patients to a lesser extent (Al-Ghamdi, 2017). Specifically, POAs are prevalent in those undergoing cardiac surgery for congenital heart disease (CHD), with a reported incidence of almost 50% (Talwar et al., 2015). With over 4,000 individuals undergoing surgery for CHD in the United States (U.S.) each year, POAs are common among the population (Pasquali et al., 2020). In children, these arrhythmias include focal ectopic atrial tachycardia (FEAT), intra-atrial reentry tachycardia, atrial fibrillation, and the most common, junctional ectopic tachycardia (JET) (Joye et al., 2023). Reports of JET exist following nearly all types of congenital cardiac surgery, with an incidence of up to 22%. Due to the commonality of POAs in cardiac surgery, providers often overlook the potential negative impacts, but evidence points to a continued rise in POAs (Al-Ghambi, 2017). With a lack of perioperative guidelines for arrhythmia prevention, the number of POAs will continue to rise.

Adverse effects accompany the high incidence of POAs in patients. POAs are a leading cause of morbidity and mortality in children and young adults undergoing congenital cardiac surgery (Joye et al., 2023). Additional impacts of POAs include increased costs, length of hospital stay, intensive care unit (ICU) time, and invasive ventilation time (Peretto et al., 2014; Wadile et al., 2023). Although all POAs associated with congenital cardiac surgery potentially cause instability, JET is the most dangerous due to the possibility of hemodynamic collapse associated with a loss of atrioventricular synchrony and increased myocardial depression associated with severe tachycardia (Al-Ghambi, 2017; Amrousy et al., 2016; Wadile et al., 2023). The hemodynamic instability leads JET to contribute up to 13.5% of surgical mortality in the population (Wadile et al., 2023). A continued lack of guidelines for tachyarrhythmia prevention leads to harmful effects for patients.

Background

Congenital Cardiac Surgery

CHD is a widely researched and discussed health condition. CHD is the most common congenital defect, affecting about 1% of live births (Baehner et al., 2020). There are a wide variety of CHDs, each developing during pregnancy and affecting heart development and function (Yale Medicine, 2023). Common CHDs include Atrial septal defect (ASD), Ventricular septal defect (VSD), Tetralogy of Fallot (TOF), Transposition of the Great Arteries (TGA), and Hypoplastic Left Heart Syndrome (HLHS). Congenital cardiac surgery holds long roots in medical history, starting in 1938. As a result of advancements in congenital cardiac surgery, affected children are surviving longer into adulthood than ever (Jacob et al., 2022). Despite the beneficial outcomes of congenital cardiac surgery, undesirable effects still need to be explored.

Many CHD surgeries result in tachyarrhythmias. Two of the most common CHD surgeries resulting in tachyarrhythmias include VSD and TOF repairs (El Amrousy et al., 2017). VSD repair is pertinent to look at when discussing CHD surgery, as it is the most performed pediatric cardiac surgery (Schipper et al., 2016). VSD repairs include closing the perforation between the left and right ventricles, often requiring coronary pulmonary bypass (CPB) (Mayo Clinic, 2022). TOF involves four related heart defects, including VSD, overriding aorta, pulmonary stenosis, and right ventricular hypertrophy (Cincinnati Children's, 2021). TOF repair focuses on using a synthetic patch between the ventricles to assist with blood flow to the aorta, but there are several approaches to TOF surgical interventions. After thorough research, initial surgery for TOF is the surgical intervention the most suited for the project due to its popularity, ability to cause postoperative tachyarrhythmias, and the vast amount of research associated with the chosen intervention.

Tachyarrhythmias

To understand the necessity of the project, knowledge surrounding tachyarrhythmias is essential. Hospitals need interventions to decrease tachyarrhythmias, with incidence as high as 47% and connections to hemodynamic downfall in cardiac surgery (Joye et al., 2022). Morbidity and mortality are two consequences of postoperative tachyarrhythmias in pediatric CHD surgical patients, further supporting the need for preventive measures.

Several kinds of tachyarrhythmias exist, each with a host of physiologic effects. Some of the most common tachyarrhythmias experienced postoperatively include FEAT, intra-atrial reentry tachycardia (IART), and JET (Joye et al., 2022). FEAT originates from a non-sinoatrial focus, causing rapid electrical discharges due to abnormal automaticity. IART is related to atrial geometric changes seen with certain CHD surgeries, leading to reentry tachycardia. JET often

follows surgical manipulation from congenital cardiac surgery, resulting in abnormal automaticity, although the exact mechanism is unknown. With all the tachyarrhythmias seen in the patient population, hemodynamic compromise is a concern, leading to worse patient outcomes.

Dexmedetomidine

Providers use dexmedetomidine in various ways in the operating room and ICU. Dexmedetomidine is an agonist for the alpha-2 receptors in the central nervous system, binding to the locus ceruleus of the brain, resulting in decreased noradrenergic output (Schwartz et al., 2016). As a result of the main mechanism of dexmedetomidine, the sinus and atrioventricular (AV) nodal functions are depressed, a basis for the prevention and treatment of arrhythmias (Rajput et al., 2014). Although the drug's current primary use is sedation, there are many other uses explored throughout literature. Newer indications optimize the drug's cardioprotective, antiarrhythmic, and anesthetic effects (Gautam et al., 2017). Dexmedetomidine is a multimodal drug that targets key effects of surgery for CHD.

One of dexmedetomidine's most recently explored effects is the drug's antiarrhythmic effects. Although the mechanism of the antiarrhythmic effects is not fully understood, there are pieces of the drug's functionality in research. Previous research suggests that dexmedetomidine regulates catecholamines through a negative feedback loop by activating presynaptic alpha-2 receptors, increasing the arrhythmogenic threshold (Bourgoin et al., 2023). Additionally, research indicates that the antiarrhythmic effects might relate to dexmedetomidine's enhancement of vagal activity. Lastly, current research indicates dexmedetomidine might directly act on calcium channel activation, decreasing spontaneous action potentials (Bourgoin et al., 2023). Regardless of the mechanism of action of the antiarrhythmic effects of

dexmedetomidine, the drug's use in the prevention of tachyarrhythmias postoperatively in pediatric patients undergoing congenital cardiac surgery needs exploration.

Significance of the Problem to Nurse Anesthesia

Certified Registered Nurse Anesthetists (CRNAs) are responsible for patient monitoring throughout the surgical process. A CRNA's responsibility to the patient begins preoperatively and extends postoperatively (American Association of Nurse Anesthesiology [AANA], 2020). CRNAs ensure patients are qualified to begin surgery, stay stable during surgery, and are well enough to progress into the care of the Post-Anesthesia Care Unit (PACU) or ICU, depending on the surgical circumstances. The continual involvement of CRNAs contributes to the importance of postoperative tachyarrhythmia prevention perioperatively.

A CRNA's scope of practice begins in the preoperative stage, staring with the preoperative assessment. An important factor, especially when assessing a pediatric patient before surgery for CHD, is arrhythmia involvement and risk (Tariq & Bora, 2023). Interdisciplinary communication between CRNAs and roles involving cardiology care is imperative to a holistic preoperative assessment. The risk of postoperative tachyarrhythmias differs depending on age, type of CHD, time patient will be on CPB, type of surgery, electrolyte imbalances, and anticipated inotropic support (Bourgoin et al., 2023; El Amrousy et al., 2017). Additionally, the CRNA must note arrhythmias and treatment in the patient's history, as those factors affect pharmacologic and other treatment options throughout the perioperative process (Chrysostomou et al., 2012). As mentioned, one of the expectations of CRNAs is to make decisions on the correct pharmacological interventions (AANA, 2020). The variety of patient factors discovered in the preoperative assessment drives pharmacological decisions.

The role of the CRNA in conjunction with arrhythmias carries over into the intraoperative period. According to Al-Ghambi (2017), anesthesia providers are the top contributors to perioperative prevention and treatment of all arrhythmias. Evidence-based avenues, such as Advanced Cardiac Life Support (ACLS), exist to treat arrhythmias. However, according to the AANA (2019), a standard for CRNAs is strict attention to the quality improvement process, which includes re-evaluating practice to improve patient outcomes. Intraoperative arrhythmia treatment is necessary, but prevention is a way for CRNAs to improve patient outcomes proactively. There is no gold standard to guide CRNAs in their pharmacological decision for arrhythmia prevention, and few attempted prevention methods were previously successful (El Amrousy, 2017). The CRNA is responsible for seeking the best possible prevention method for the CHD surgery population. Although the anesthesia provider aims to monitor and control arrhythmias, anesthetics cause arrhythmias. Specific anesthetic agents are arrhythmogenic, including induction agents, maintenance anesthetics, and pain management medications (Kwon & Kim, 2017). Due to the sedative and analgesic properties of dexmedetomidine and the CRNA's crucial role in arrhythmia treatment and prevention, the responsibility of the issue of postoperative arrhythmias and dexmedetomidine as a potential preventive measure falls under the anesthesia provider.

The CRNA's responsibility relating to arrhythmias continues throughout the postoperative period. CRNAs must complete a post-anesthesia evaluation that includes the normality of heart rhythm and rate (AANA, 2020). Patients are not only at risk for arrhythmias in the postoperative period but also for the adverse effects associated with arrhythmias. Anesthesia ensures the patient is well prepared for the post-surgical environment, including controlling arrhythmias (AANA, 2020). Adverse effects like increased ventilation time, length of hospital stay, ICU stay,

and inotrope requirements are associated with postoperative arrhythmias following congenital cardiac surgery (Wadile et al., 2023). With adequate arrhythmia management by CRNAs, patients might avoid associated adverse effects.

Problem Statement

The negative impacts of POAs support the need to find a prevention strategy in the perioperative phase before harm comes to the patient. The literature contains many recommendations for preventing POAs following congenital cardiac surgery. However, the incidence continues to rise with no effective guidelines for anesthesia providers, who contribute the most to the perioperative prevention of tachyarrhythmias (Al-Ghambi, 2017). The discovery and implementation of evidence-based guidelines relating to POA prevention in CHD surgical patients are imperative to improve patient outcomes and optimize hospital funding. The adverse effects of POA, such as increased costs, morbidity, mortality, length of stay, hemodynamic instability, and ventilator time, all contribute to the issue's importance.

PICO(T) Question

A literature review shows that POAs are high in post-congenital cardiac surgery patients. In the search to formulate guidelines for POA prevention, the scholarly project will address the following PICO(T) question: In pediatric patients undergoing congenital cardiac surgery for Tetralogy of Fallot (P), how does the implementation of evidence-based guidelines for perioperative use of dexmedetomidine (I) compared to traditional methods (C) affect tachyarrhythmia incidence, heart rate, and ventilation time (O) in the first 24 hours postoperatively (T)?

Project Objectives

Tachyarrhythmias are a complication seen with congenital cardiac surgery, leading to various adverse outcomes. Despite the many treatments for arrhythmia prevention, there is no gold standard, leaving anesthesia providers without guidelines to make appropriate decisions regarding preventing a harmful outcome (El Amrousy, 2017). Patients with CHD are at high risk for experiencing post-surgical arrhythmias, with literature suggesting incidence as high as 48% and a connection to certain CHD surgeries, like TOF, as previously noted (Ishaque et al., 2022). The high incidence and lack of guidelines brings tachyarrhythmia prevention methods forward as a primary concern.

With the undesirable effects of post-surgical tachyarrhythmias, such as increased costs, invasive ventilation time, length of hospital stay, and ICU stay, there is a need to find an ideal prevention method for the CHD surgery population. After reviewing the literature and assessing current prevention methods, the goal of the Final Scholarly Project (FSP) is to use current evidence and recommendations to formulate and implement guidelines regarding perioperative prevention of postoperative tachyarrhythmias, specifically with dexmedetomidine in the CHD surgery population, specifically initial TOF surgery. The project will investigate how using perioperative dexmedetomidine to prevent postoperative tachyarrhythmias affects tachyarrhythmia incidence, heart rate, and ventilatory time.

The objectives for the FSP are as follows:

1. Develop evidence-based practice (EBP) guidelines for perioperative use of dexmedetomidine for postoperative tachyarrhythmia prevention in patients undergoing surgery for CHD, specifically TOF.

2. Develop a comprehensive plan to implement the EBP guidelines described previously in the perioperative setting.
3. Develop a comprehensive plan to monitor/measure the effectiveness of the EBP guidelines.
4. Develop a comprehensive plan to monitor, measure, and adjust the perioperative prevention guideline if the outcomes, such as incidence of postoperative tachyarrhythmias and invasive ventilatory time, do not show improvement or maintenance of current statistics.

Literature Review

Databases

The author utilized Otterbein University's OneSearch database via the Courtright Memorial Library to find articles to review. OneSearch provides access to multiple databases, including Cumulative Index to Nursing and Allied Health Literature (CINAHL), PubMed, and Cochrane Library (Otterbein University, 2023). Using keywords, Boolean operators, and additional filters, OneSearch narrows results to those with the desired content. In addition to journal articles, OneSearch provides access to books and a multitude of multimedia sources, allowing the research team to access ample resources. With the previously described PICOT question in mind, the author analyzed each search result to determine the appropriateness for the current project.

Search Terms

The initial search utilized the Boolean operators and key terms as follows: "Dexmedetomidine AND perioperative AND arrhythmia prevention AND congenital cardiac surgery," yielding 636 results. Filtering the results to only peer-reviewed articles in a scholarly

journal narrowed the search further and yielded 423 results. Filtering the results to articles after 2011 and in the English language yielded 359 results. Lastly, the search required the key term "dexmedetomidine" to be included in the resulting articles, yielding 39 results.

Several of the 39 articles that resulted in the final search were not included for various reasons. Nine articles looked at other effects of dexmedetomidine not relevant to the project, such as prevention of kidney injury and postoperative sedation. Five articles were meta-analyses, which did not warrant inclusion due to the secondary nature of the articles. Seven articles did not include the population in question and were therefore not included. Lastly, ten articles were unrelated to the topic, deeming them irrelevant to the project. After reviewing the articles, nine articles were analyzed and synthesized for evidence relating to the project.

Literature Analysis

Outcomes

Following the literature review, the researcher chose outcomes to compare to "traditional methods". As described above, traditional methods refer to the prevention method of choice of the anesthesia provider, as there is not currently a standard practice for tachyarrhythmia prevention in children undergoing congenital cardiac surgery. The current prevention options are numerous, but after reviewing current literature and practice, dexmedetomidine is an emerging prevention strategy for tachyarrhythmias. The author discovered three consistent dependent variables in the literature affected by perioperative dexmedetomidine administration, including tachyarrhythmia incidence, heart rate, and invasive mechanical ventilation time. The project will delve into how the dependent variables discovered in the literature are affected by dexmedetomidine, potentially leading to a tachyarrhythmia prevention strategy.

Incidence of Postoperative Tachyarrhythmias

Postoperative tachyarrhythmia is a common complication in pediatric patients undergoing surgery for CHD. The incidence of some tachyarrhythmias**,** like JET, is as high as 30% (Bourgoin et al., 2023). Tachyarrhythmias following congenital cardiac surgery can potentially cause negative effects, like hemodynamic instability, leading to unfavorable outcomes for the child (Chrysostomou et al., 2011). Following extensive research, several articles detailed the importance of tachyarrhythmias as a postoperative risk for the CHD pediatric population, specifically surgery for TOF correction, and how implementation of dexmedetomidine affects postoperative tachyarrhythmia incidence.

The positive effects of perioperative dexmedetomidine are evident when reviewing the themes of the literature. The literature agrees that the incidence of postoperative tachyarrhythmias following congenital cardiac surgery is significantly decreased by the administration of dexmedetomidine perioperatively (Altun et al., 2021; Bourgoin et al., 2023; Chrysostomou et al., 2011; El Amrousy et al., 2017; Gautam et al., 2017; Kadam at al., 2015; Rajput et al., 2014; Schwartz et al., 2016; Wadile et al., 2023). Several articles recommended utilizing a loading dose, followed by a continuous infusion of dexmedetomidine in the perioperative period (Bourgoin et al., 2023; Chrysostomou et al., 2011; El Amrousy et al., 2017; Kadam et al., 2015; Rajput et al., 2014). However, other articles recommended a continuous dexmedetomidine infusion without the initial loading dose (Altun et al., 2021; Gautam et al., 2017; Schwartz et al., 2016; Wadile et al., 2023). Implementing an evidence-prevention method to decrease postoperative tachyarrhythmias is a positive outcome, leading to better satisfaction for patients, providers, and parents.

Heart Rate

Hemodynamic instability, including heart rate, leads to unfavorable outcomes for patients. Increased heart rate is especially harmful following CPB, leading to increased morbidity (Kadam et al., 2015). High heart rates following congenital cardiac surgery require urgent treatment, possibly spiraling into an emergent situation (Chrysostomou et al., 2011). Decreasing heart rate for patients following congenital heart surgery and maintaining hemodynamic stability is crucial to their post-surgical status.

The analyzed literature regarding the effects of perioperative dexmedetomidine on heart rate is unanimous. Perioperative administration of dexmedetomidine to children undergoing congenital cardiac surgery for initial correction of TOF significantly decreases heart rate (Altun et al., 2021; Chrysostomou et al., 2011; El Amrousy et al., 2017; Kadam et al., 2015; Rajput et al., 2014). Decreased heart rate is favorable for these patients; however, the studies consider dexmedetomidine's effects due to the drug’s alpha-2 agonist activity, including hypotension and bradycardia. In the studied population, bradycardia and hypotension from dexmedetomidine administration were no different than in the control group (Altun et al., 2021; Chrysostomou et al., 2011; El Amrousy et al., 2017; Rajput et al., 2014; Wadile et al., 2022). Additionally, the literature pointed out that dexmedetomidine provided a decreased heart rate without respiratory depression, which is imperative in patients when attempting to wean ventilatory support and improve respiratory status (Altun et al., 2022).

Ventilation Time

Due to the nature of congenital cardiac surgery, ICU admission is the standard of care for patients still undergoing mechanical ventilation. Hemodynamic stability, including the absence of tachyarrhythmias, is a fundamental need prior to planned extubation (Altun et al., 2021).

Prolonged mechanical ventilation leads to a host of negative pulmonary effects, including infection and atelectasis (Altun et al., 2021). Mechanical ventilation is limiting for the child following surgery and finding a way to shorten the ventilation time will benefit the child's recovery.

Following analysis and synthesis of the literature, the articles' conclusions regarding the perioperative use of dexmedetomidine for congenital cardiac surgery were similar across the board. Implementation of the independent factor, dexmedetomidine, decreases ventilation time in pediatric patients undergoing congenital cardiac surgery (Altun et al., 2021; Bourgoin et al., 2023; El Amrousy et al., 2017; Kadam et al., 2015; Rajput et al., 2014; Schwartz et al., 2016; Wadile et al., 2023). One article recommended including intraoperative dexmedetomidine administration into fast-track and ultra-fast track extubation protocols following congenital cardiac surgery (Altun et al., 2021). Patients receiving mechanical ventilation reside in the ICU, and many of the articles found that the inclusion of dexmedetomidine reduced the length of ICU stay following congenital cardiac surgery (Altun et al., 2021; El Amrousy et al., 2017; Rajput et al., 2014; Wadile et al., 2023). Decreasing mechanical ventilation time for patients benefits their long-term health and disposition from the ICU.

Summary of Literature Review

Congenital cardiac surgery in pediatric patients is proven to sustain life and improve outcomes for those affected. However, certain complications, such as postoperative tachyarrhythmias, increased heart rate, and increased mechanical ventilation, can complicate the postoperative course. Dexmedetomidine, a drug with an increasing number of beneficial uses in perioperative anesthesia and postoperative sedation, might improve patient outcomes. Providers can lower tachyarrhythmia incidence, heart rate, and ventilation time by implementing

perioperative dexmedetomidine in pediatric patients undergoing congenital cardiac surgery. Synthesis and analysis of the literature showed a significant difference with the implementation of dexmedetomidine, providing evidence in support of perioperative dexmedetomidine use in the chosen population.

To support the use of perioperative dexmedetomidine, the researcher included three randomized control trials (RCT), three prospective cohort studies, and three retrospective studies, with all articles supporting the conclusion. Many chosen studies contain robust sample sizes, with randomization and study type limitations. Despite the limitations, the studies are relevant to the population and include significant results relating to perioperative dexmedetomidine use. The evidence helped narrow the targeted population, focusing on pediatric patients undergoing congenital cardiac surgery for an initial intervention for TOF. The evidence concludes that implementing perioperative dexmedetomidine in the described population improves tachyarrhythmia incidence, heart rate, and ventilation time.

Study Design

Several models exist to ensure the effectiveness of EBP. The Johns Hopkins Evidence-Based Practice (JHEBP) Model for Nurses and Health Care Professionals provides the standardization needed for EBP success using three components: inquiry, practice, and learning (Dang et al., 2022). The JHEBP's assistance will propel the FSP forward. The author obtained permission to utilize the JHEBP model through electronic permission via the Johns Hopkins Health System on June 29, 2023, as seen in Appendix A. EBP is an important piece to creating change. EBP allows healthcare providers to discover and implement the best possible interventions in the scientific literature (Dang et al., 2022). EBP execution is best when using a model to ensure a standardized research approach, ensuring the initiative's success (Dang et al.,

2022). The JHEBP model is an exemplary example of a user-friendly model formulated to ensure the efficiency and reliability of changes in patient care (Johns Hopkins Medicine, 2022). Through inquiry, top evidence exploration, evidence translation into practice, and reflection, the JHEBP model creates a learner-focused EBP protocol (Dang et al., 2022).

The JHEBP model will provide a seamless, standardized model to assist with the FSP through the attention to detail and easy-to-use steps in the Practice Question, Evidence, and Translation (PET) process. Appendix B displays the JHEBP model's revised processes. The project will utilize quantitative and qualitative data to implement the perioperative use of dexmedetomidine for tachyarrhythmia prevention in congenital cardiac surgery patients and gain feedback on the guideline implementation.

Practice Question

The JHEBP model begins with scientific inquiry. Sparked by curiosity surrounding current practices and their connection with EBP, the initial step of the JHEBP model explores the practice question, current practice, relevance of the problem, and PICOT components (Dang et al., 2022). The literature review identified a need for standardized guidelines for postoperative tachyarrhythmia prevention, specifically in pediatric patients undergoing surgery for TOF. The following PICOT question, further developed from the initial question through the literature search, embodies the discovered problem: In pediatric patients undergoing congenital cardiac surgery for an initial TOF intervention (P), how does the implementation of evidence-based guidelines for perioperative use of dexmedetomidine (I) compared to traditional methods (C) affect tachyarrhythmia incidence, heart rate, and ventilation time (O) in the first 24 hours postoperatively (T)?

The first step involves identifying stakeholders and team formulation (Virginia Commonwealth University, 2018). The stakeholders and team will consist of anesthesia providers, surgeons, intensive care recovery nurses, preoperative staff, pharmacy, hospital administration, the parents of the pediatric patients, and the pediatric patients undergoing surgery for CHD. Project leadership is imperative to establish during the first step, which is the responsibility of the primary investigator (PI) or the project conductor. Team meetings consisting of the primary stakeholders must occur before, during, and after the project's initiation. Adequate meeting times include six months before initiation, one month, three months, and six months following implementation, and immediately following project conclusion. As previously discussed, the need for the project is imminent, which is imperative to share with the primary stakeholders mentioned.

Evidence

The next step in the PET process involves evaluating the evidence. Evidence evaluation involves searching databases, exploring resources, and sharing information (Virginia Commonwealth University, 2018). A systematic literature review fulfills the first step of the model and explores the multiple databases, each undergoing extensive evaluation by creating evidence tables, demonstrated in Appendix C. The reviewed evidence recommends the use of perioperative dexmedetomidine to prevent tachyarrhythmias. The stakeholders mentioned above will receive all recommendations to begin the next step in the PET process.

Translation

The final stage of the PET process focuses on translating the findings. Utilization of the Action Planning Tool is imperative in the translation process (Dang et al., 2022). The Action Planning Tool allows evidence-based research to be implemented into practice after meeting

specific criteria while exploring the research outcomes, strengths, and weaknesses to allow for revisions (Dang et al., 2022). Implementing perioperative dexmedetomidine is the highlight of the final PET stage, which will help validate the incorporation of the action into standardized practice. The JHEBP model provides support throughout the EBP research process. The standardized steps of the PET process allow researchers to focus on the most important factors in change implementation, resulting in effective and safe patient care. The FSP project will dive deep into the various steps of the JHEBP model to make meaningful and lasting changes to healthcare practice.

The chosen setting, a level-one pediatric trauma center in Columbus, Ohio, will need specific recommendations. Despite the chosen setting embodying research and evidence-based practice, change takes time and effort. Therefore, the start of the action plan will involve team meetings, as mentioned previously, to gain the support of key stakeholders. The support will assist in carrying out an action plan. Following the support of the stakeholders, the focus will be educating the CRNAs and anesthesiologists about the new guideline and the research behind implementation through a series of in-service meetings and email reminders regarding the new guideline.

Additionally, OR and PACU resources will help remind CRNAs of the guideline contents. The action plan will also ensure adequate availability of dexmedetomidine, the primary drug involved in the project, as drug access will make for a smoother transition into practice. Drug accessibility requires support from the pharmacy, making them another key stakeholder in the project.

Following the implementation of the action plan, follow-up is needed to determine if the implemented guideline provided a desirable effect. Quantitative data, discussed in more detail

below, is continuously collected before and during the project to allow for evaluation after the project. Project team members, including undergraduate and graduate students, will extract pre-implementation data for six months, the CRNAs will implement for six months or until CRNAs complete 25 cases with the new guideline, and the stakeholders will use the final six months to collect post-implementation data, meet to discuss revisions, and evaluate previously gathered data.

Quantitative Data

Quantitative data includes any measured, numerical information. Quantitative data assists with seeing the differences in outcomes before and after the implementation of the evidence-based intervention. Utilizing the electronic medical record (EMR) will help extract quantitative data on pediatric patients undergoing congenital cardiac surgery at the chosen facility, including heart rate and invasive ventilation time from the ICU. Continuous cardiac monitoring (CCM) data will accompany EMR data to provide more information regarding the same patient population, specifically tachyarrhythmia incidence in the ICU. Pre-implementation tachyarrhythmia incidence, heart rate, and invasive ventilation time data collected from the previous six months help to create a baseline. During implementation, the same data points and collection methods through the EMR and CCM will help gain insight into quantitative changes following guideline implementation. The data points will be analyzed to determine if there are positive, significant changes to the noted data points following guideline implementation with statistical analysis. Statistical analysis can also identify implementation failure and a need to revise the guidelines, which is important in determining what is best for clinical practice. After refinement, if the guideline is still offering patient improvements, the hospital might consider pursuing policy status for the guideline.

Methods

Implementation Plan

The previously described design will assist team leaders in guideline implementation following Institutional Review Board (IRB) and Quality Improvement (QI) Committee approval. The plan is in three phases to ensure simplicity. The phases include pre-implementation, implementation, and post-implementation.

Pre-Implementation

The development of the official guideline implemented into practice is composed in the pre-implementation phase based on the previously compiled evidence. Appendix D demonstrates the composed guideline. Following problem identification, question formation, and guideline composition, key stakeholders must meet to understand the importance of the problem. An initial meeting with the key stakeholders will help share vital information in the evidence-based research completed in the literature synthesis and analysis regarding postoperative tachyarrhythmia prevention in pediatric congenital cardiac surgery patients. The meeting, which will take place virtually toward the end of regular business hours, will allow key stakeholders to learn about the potential benefits of the new guideline and their role in making the project successful. Following approval, the next step is to ensure supplies are available to carry out implementation. The main supply for the project is dexmedetomidine, which falls under pharmacy and supply coordinators in hospital administration. Additional supplies include intravenous (IV) administration tubing and IV tubing filters necessary for administration in CHD.

As previously mentioned, data point collection will take place before implementation. For six months before the implementation phase, the Quality Improvement department will work

with volunteers like nursing students and medical students to extract the quantitative data previously described from the EMR and CCM databases. An email sent to surrounding nursing and medical schools already partaking in a clinical experience at the chosen hospital will provide information regarding the project and volunteer information, as seen in Appendix E. A statistician for the department will assist the team in calculating the average heart rate, tachyarrhythmia incidence, and invasive ventilation time in the first 24 hours postoperatively for any pediatric patient in the previous year that underwent an initial surgery for TOF. A spreadsheet will help organize the information and the calculated averages will help to determine project effectiveness in the post-implementation phase.

Implementation

Implementation begins with alerting the staff, including CRNAs, preoperative nurses, postoperative ICU nurses, and surgeons, about the new guideline. The PI will send an informative email detailing the new guideline, including supportive articles, to the above stakeholders. The email will also include details about postoperative tachyarrhythmias in pediatric congenital cardiac surgery patients, including negative impacts on the patients. An information sheet detailing dexmedetomidine's mechanism of action and other therapeutic uses included in the email will refresh the recipients on the drug they might not use daily. Lastly, the email will detail the lack of standard practice for tachyarrhythmia prevention in the chosen population and the evidence that dexmedetomidine is a strong choice. Posting the new guidelines in breakrooms, anesthesia rooms, preoperative bulletins, and ICU bulletins will help spread the information. A read receipt will be required for each recipient, monitored by individual supervisors.

Additionally, CRNAs and anesthesiologists must attend three 30-minute in-service meetings by the PI detailing the new guideline since they will be the most involved in drug administration. The three meetings will take place in weeks one, two, and three of the implementation phase, with the new guideline starting immediately following education completion in week four. The meetings will occur on days the operating rooms are operating under a later surgical start time, and anesthesia providers will be required to attend. The meetings will detail hospital-specific statistics, such as how many patients are affected negatively by postoperative tachyarrhythmias at the chosen facility with the previously collected data. The implementation portion of the project focuses on change theory, preparing the primary administrators for the change and reassuring them of the benefits.

Following education, the same team that collected pre-implementation data will continue to collect the same data points after guideline implementation in week four, lasting throughout the six-month implementation period or ending with 25 completed cases. The data points include heart rate, tachyarrhythmia incidence, and invasive ventilation time.

Post-implementation

Following implementation, statistical analysis will help to determine if any significant difference occurred through the implementation of the guideline. The same team will extract data from the intraoperative and postoperative medication administration flowsheets to ensure guideline adherence. After statistical analysis and survey collection, the stakeholders will hold a final meeting to discuss the findings. The quantitative data results will help determine the next steps, such as how to improve the guideline, guideline implementation, and patient outcomes. The final meeting should include CRNAs, surgeons, preoperative nurses, and postoperative ICU

nurses to ensure adequate multidisciplinary representation. The post-implementation phase should last six months.

Timeline

The timeline for the FSP is one and a half years, as seen in Appendix F. The pre-implementation phase will last a total of six months. During the six-month pre-implementation phase, the team needs to meet many milestones to continue with the project. The first milestone includes the stakeholder meeting, which will occur during regular business hours in the first week of the pre-implementation phase. The next step on the timeline is coordinating with pharmacy and the supply coordinators at the chosen facility to ensure supply availability. Pharmacy coordination will continue until supplies are secured, but not to exceed the six allotted months. Lastly, in the pre-implementation phase, data collection will occur to provide baseline data for the FSP. Recruitment for volunteer research assistants will start in the first week of the pre-implementation phase and continue throughout the project. Data collection will coincide with the other pre-implementation steps. Data collection will occur twice per week at the time discretion of the research volunteers until volunteers obtain the necessary information or until the six-month pre-implementation phase ends.

The implementation phase will occur over six months. As detailed above, the implementation phase starts with an initial email sent out in week one. The read receipt will need to be sent back to managers within two weeks of receiving the initial email. Additionally, posting the new guidelines in the previously described areas will take place in implementation week one. Next, the CRNAs and anesthesiologists will attend a mandatory 30-minute in-service meeting in weeks one, two, and three of the implementation phase. The meetings will occur on the surgery

late start day before the first case. Throughout the six months of the implementation phase, the research assistants will continue to collect data until there are 25 completed cases or at the end of the six allotted months.

The post-implementation phase will take six months. The first step of the post-implementation phase is data analysis. Depending on the wait on the statistician, the task might take several months. The goal is to complete the statistics within two months of implementation completion. Next, a final stakeholder meeting will occur following the statistical analysis completion. The goal is to complete the meeting early in the third month post-implementation. Completion of guideline changes is necessary by month six post-implementation.

Budget Plan

The budget for the project will come directly from applied grants. The Children's Heart Foundation provides a yearly opportunity to apply for up to $100,000 of funding for research projects involving improvements for patients with congenital heart defects, including quality improvement projects and projects surrounding pharmaceutical advancements (Children's Heart Foundation, 2023). The allotted funds from the grant will help to negate the costs described below.

The main budget concern for the project is CRNA and anesthesiologist salary. Since the hospital already pays the CRNAs and anesthesiologists, the three 30-minute in-service meetings are the main compensation timeframe. The supplies needed to adhere to the guideline include dexmedetomidine, IV tubing, and IV filters. After calculating the dexmedetomidine needed for the average patient weight in the chosen population based on the loading and continuous infusion dose, a single two milliliter (mL) vial will suffice, needing 25 vials total. CRNAs will need at least 25 IV tubing kits and filters to carry out the guideline. As mentioned, bulletins posted in the

breakrooms and unit information boards are crucial to spreading the new guideline information. Although printing through the PI's academic institution is free, cardstock paper is necessary to provide bulletins in three breakrooms and on three bulletins.

Aside from the costs broken down above, several aspects of the FSP accrue no costs. The meetings will take place on hospital property, where plenty of rooms are available for no cost. Student volunteers will facilitate all data extraction, eliminating the cost of paid research assistants. A statistician is employed by the chosen facility for approved projects, eliminating the cost of a separately paid statistician. Appendix G details the cost breakdown of the FSP with average supply costs and salaries.

Outcomes and Analysis

The team's first essential step is to analyze the outcomes and decide on the next steps. A final stakeholder meeting is built into the project timeline, allowing for ample time following the meeting for guideline revisions. As described previously, data is collected for the project from the EMR, CCM, and medication administration flowsheet at various times throughout the project, as outlined in the timeline. At the final stakeholder meeting, the statistician's analysis is the main topic of conversation and will drive the next steps in the project.

If outcomes are decreased by 25% after six months or 25 cases, no change will occur to the implemented guideline. A decrease in tachyarrhythmia incidence, heart rate, and invasive ventilation time are all beneficial outcomes for the hospital and patients, meaning that the evidence-based guideline improved patient lives. If the guideline is beneficial, further actions include spreading the guideline to other pediatric hospital systems, expanding the guideline to include more populations, and focusing on ensuring guideline compliance.

If outcomes are not decreased or worsen by 25% after six months or 25 cases, the main topic at the final stakeholder meeting will address adjustments to the guideline. An option for adjustment includes dropping the guideline from the hospital system if outcomes worsen. Another option is to re-visit the literature and refine the guideline by changing dosing, length of treatment, or time of administration. Lastly, if the lack of improvement is due to a medication administration compliance issue, the team must discuss ways of increasing compliance. Compliance can be increased by re-evaluating the training for the guideline or further emphasizing hospital values and staff's duties to the patients.

Limitations

The limitations of the project may include pushback from the anesthesia providers in altering their current anesthetic. Many anesthesia providers take on a preferred way to deliver anesthesia; therefore, adding an anesthetic component, despite being beneficial for the patient, might be met with noncompliance. Another limitation includes access to dexmedetomidine from the pharmacy, whether the limitation is from a financial or obtainability origin. Despite these limitations, the project utilizes drugs and systems already in place in many facilities, making it adaptable and easily performed.

Conclusions

Postoperative tachyarrhythmias are prevalent in the congenital cardiac surgery population and cause adverse outcomes for patients. Following a literature review, patients with TOF undergoing their initial surgical intervention were the most affected population, making them an ideal population for the project intervention. The literature review revealed promising results with dexmedetomidine, with reductions in tachyarrhythmia incidence, heart rate, and invasive ventilation, all beneficial outcomes for the chosen patient population. With the diligently crafted

implementation plan previously described, the existing anesthetic plan easily implements the proposed guideline for the chosen population. As evidenced by the review of literature and expected results, perioperative administration of dexmedetomidine in patients undergoing their initial surgical intervention for TOF leads to better patient outcomes, decreased tachyarrhythmias, decreased heart rate, and decreased invasive ventilation time. Despite the rising incidence of postoperative tachyarrhythmias, the proposed project outlines a guideline to reduce the frequency. Future implications of the findings include a standardized prevention technique for postoperative tachyarrhythmias in the noted population. Additionally, the future of dexmedetomidine, a current anesthetic adjunct, will expand to include a wide array of implications. However, future practitioners must overcome the barrier of tradition and the potential lack of pharmacy support to provide standardized prevention for pediatric patients undergoing surgery for TOF.

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Appendix A

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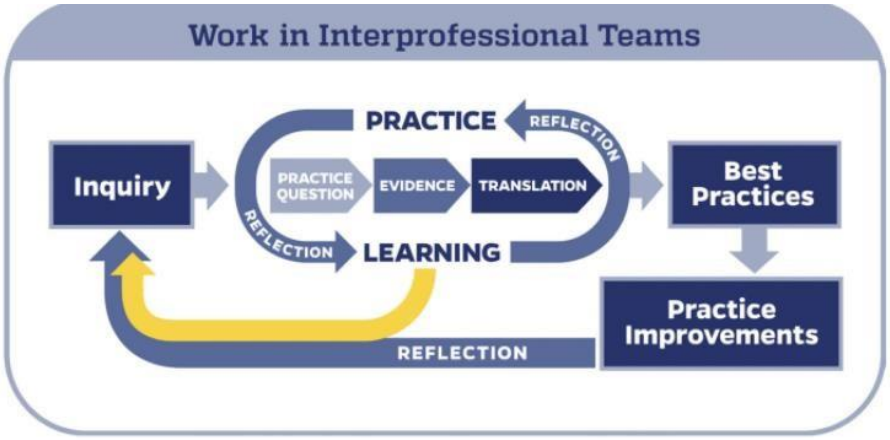
Appendix B

John Hopkins Evidence-Based Practice Model



Note: *Dang et al., 2023*

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Appendix C

Evidence Review

Evidence Review								
APA Citation: Bourgoin, P., Jegard, J., Joram, N., Fox, S., Biard, M., Fernandez, M., Baruteau, A. E., Dejoie, T., Ferdynus, C., & Chenouard, A. (2023). Effectiveness of intraoperative use of dexmedetomidine in reducing the incidence of tachyarrhythmia after congenital cardiac surgery in neonates and infants: A doubly robust method estimation analysis. *European Journal of Cardio-Thoracic Surgery, 63*(4), 1-9. https://doi.org/10.1093/ejcts/ezad076								
Conceptual Framework or Model	***Design or Method***	***Sample & Setting***	***Major Variables Studied & their Definitions, if any***	***Outcome Measurement(s)***	***Data Analysis***	***Findings***	***Level of Evidence***	***Quality of Evidence: Critical Worth to Practice***
Theoretical basis for the study: N/A	Retrospective analysis	**Number of Characteristics:** - Neonates and infants <12 months - Operated under CPB from 2017-2021 **Exclusion Criteria:** - Second surgery during same hospital stay - Patients for which sparce information about anesthesia protocols was available **Attrition:** - 617 surgeries	**Independent variables:** **IV1=** Administration of perioperative dexmedetomidine (DEX) (1 ug/kg over 15-minute loading dose then 1-1.4 ug/kg/h) **IV2=** Placebo, other anesthetic **Dependent variables:** - Onset of tachyarrhythmia during PICU stay - Arrhythmia requiring drug therapy/electrical cardioversion/defibrillation - Maximal serum lactate level - Renal dysfunction according to the Kidney Injury Diseases Improving Global Outcomes classification	**Scale(s) used:** **Reliability information (*alphas*, if any):** - Vaso inotropic score: Reliable and valid	**Statistical tests, if any:** **Qualitative analysis, if any:** - Logic regression: estimates the propensity of being exposed to DEX - Disease risk score through logistic regression (weight, class of cardiomyopathy, CPB time, aortic clamping time, and beta blocker prescription) - Exposed/non-exposed patients in	**Statistical findings, if any:** **Qualitative findings, if any:** - Probability of developing postoperative tachyarrhythmia 6.6% (95% confidence interval 0.032-0.099) with DEX and 14.5% (95% CI 0.098-0.193) with placebo - Doubly robust matched estimation showed mean reduction	Level 2	**Strengths:** - High number of patients - Significant results **Limitations:** - Results do not strictly differentiate between the intra/postoperative - Patients who were intubated for more than a few hours were probably sedated with other drugs - Additional bias due to practice variability may exist - Postoperative tachyarrhythmia

		- 593 retained - 216: Precedex - 377: No Precedex **Setting:** Nantes University Hospital, France	- Vaso inotropic score		a 1:1 ratio on both scores using a multivariate distance - Standardized mean differences: Patients' characteristics at baseline - Doubly robust matching estimator analysis: Effect in reducing postop tachyarrhythmia - Conditional binary logistic regression analysis: calculate odds ratio of developing postoperative tachyarrhythmia - All hypotheses tested at two-tailed alpha level of 5% - Comparisons used paired tests - SAS software	of 8.8% (-0.137 to -0.023)		incidence based on daily rounds - Difference in mean minimal core temperature in groups **Risk or harm if implemented:** - Bradycardia **Feasibility of use in the project practice area:** - Recommend

					version 9.4			

Annotated Bibliography statement: Bourgoin et al. (2023) conducted a retrospective cohort study including 514 infants less than 12 months of age who underwent cardiopulmonary bypass surgery to assess the antiarrhythmic effects of dexmedetomidine perioperatively to reduce postoperative tachycardia. Many included surgeries were for congenital heart disease (CHD). Group one received intravenous dexmedetomidine 1mcg/kg over 15 minutes, and group two received no dexmedetomidine, with both groups receiving a typical anesthetic. The study is a high level of evidence and revealed a significant reduction in postoperative tachyarrhythmias.

Thematic Analysis
Key Themes or FSP related significance:
1. Demonstrated benefits of using perioperative dexmedetomidine in pediatric patients undergoing surgery for CHD.
2. Revealed a significant reduction in postoperative tachyarrhythmias, including JET and supraventricular tachycardia.
3. Study suggests the safe use of dexmedetomidine with no noted infusion cessation, hemodynamic instability, or elevated lactated levels in the dexmedetomidine group.

Evidence Review

APA Citation: Chrysostomou, C., Sanchez-de-Toledo, J., Wearden, P., Jooste, E. H., Lichtenstein, S. E., Callahan, P. M., Suresh, T., O'Malley, E., Shiderly, D., Haney, J., Yoshida, M., Orr, R., Munoz, R., & Morell, V. O. (2011). Perioperative use of dexmedetomidine is associated with decreased incidence of ventricular and supraventricular tachyarrhythmias after congenital cardiac operations. *The Annals of Thoracic Surgery, 92*(3), 964-972. https://doi.org/10.1016/j.athoracsur.2011.04.099

Conceptual Framework or Model	***Design or Method***	***Sample & Setting***	***Major Variables Studied & their Definitions, if any***	***Outcome Measurement(s)***	***Data Analysis***	***Findings***	***Level of Evidence***	***Quality of Evidence: Critical Worth to Practice***
Theoretical basis for the study: N/A	Prospective cohort study	**Number of Characteristics:** - October 15, 2009 to June 30, 2010 - Pediatric patients undergoing cardiothoracic operations with CPB **Exclusion Criteria:**	**Independent variables: IV1=** Administration of intraoperative dexmedetomidine after anesthesia induction with loading dose (1ug/kg) and continued intraoperati	**Scale(s) used: Reliability information (*alphas*, if any):** N/A	**Statistical tests, if any: Qualitative analysis, if any:** - Calculated 52 patients would establish a power of 95% based on a two-tailed error of 0.05	**Statistical findings, if any: Qualitative findings, if any:** - Significantly higher incidence of tachyarrhythmias in the control group	Level 2	**Strengths:** - Significant results - Led to an increase in drug usage **Limitations:** - Non-randomized single institution methodology - Some arrhythmias not detected in the study - Only 72-hour observation period

		- Significant baseline neuro impairment that prohibited accurate titration of sedative and analgesic agents - Weight <2kg - Permanent pacemaker - Arrhythmias within last 6 months - Antiarrhythmic medications and B-blockers in last 72 hours - Use of amiodarone or DEX in last 30 days - Use of DEX for 12 hours or less after the end of CPB - Use of DEX for sedation in the control group above 1 ug/kg/d **Attrition:** - 32 pediatric patients in DEX group	vely and postoperatively (0.5 ug/kg) **IV2=** Placebo **Dependent variables:** - Vital signs - Duration of mechanical ventilation - Requirement of sedatives, analgesics, inotropic, and systemic vasodilator support - Use of antiarrhythmic meds - Immediately after and daily creatinine, potassium, magnesium, and ionized calcium - Q4 lactate and blood gases - Incidence of sinus tachycardia - Incidence of hypertension - Incidence of sinus bradycardia - Incidence of hypotension		- Difference between the treated and control arm: x^2 test - Comparison of demographics, operative details, postoperative medication use, and length of stay: x^2 test for categorical variables - Continuous variables: parametric independent-samples t test and nonparametric Mann-Whitney U test - Time varying vital signs: Repeated measures ANOVA with the Fisher least significant			**Risk or harm if implemented:** - No correlation between dexmedetomidine use and hypotension/bradycardia **Feasibility of use in the project practice area:** - Recommended

		- 20 patients in control group - 52 patients total **Setting:** Hospira Inc, Lake Forest, IL	- Incidence of arrhythmias (junctional ectopic tachycardia, atrial ectopic tachycardia, atrial flutter, afib, reentrant SVT, vtach, vfib)		differences post hoc analysis - All comparisons performed as two-sided tests with a significance level of 0.05 - SPSS 17.0 software			

Annotated Bibliography statement: Chrysostomou et al. (2011) performed a prospective cohort study with 32 pediatric patients undergoing cardiothoracic surgery to determine if perioperative dexmedetomidine use affects supraventricular and ventricular tachycardia incidence. In the experimental group, patients received dexmedetomidine 1 mcg/kg loading dose before incision and a dexmedetomidine 0.5 mcg/kg/hr infusion throughout surgery and into intensive care. The control group received no dexmedetomidine but the same anesthetic technique. The results showed a significantly decreased incidence of tachyarrhythmias in the group that received dexmedetomidine, significantly lower heart rate post-surgery, and lower antihypertensive use.

Thematic Analysis
Key Themes or FSP related significance:
1. Decreased incidence of tachyarrhythmias in the dexmedetomidine group and other beneficial outcomes.
2. No indication of dexmedetomidine lacking safety, including no significant difference in hypotension and bradycardia.
3. Article indicates specific use in the congenital cardiac surgery population.

Evidence Review

APA Citation: El Amrousy, D. M., Elshmaa, N. S., El-Kashlan, M., Hassan, S., Elsanosy, M., Hablas, N., Elrifaey, S., & El-Feky, W. (2017). Efficacy of prophylactic dexmedetomidine in preventing postoperative junctional ectopic tachycardia after pediatric cardiac surgery. *Journal of the American Heart Association, 6*(3), 1-5. https://doi.org/10.1161/JAHA.116.004780

Conceptual Framework or Model	***Design or Method***	***Sample & Setting***	***Major Variables Studied & their Definitions, if any***	***Outcome Measurement(s)***	***Data Analysis***	***Findings***	***Level of Evidence***	***Quality of Evidence: Critical Worth to Practice***
Theoretical basis for the	Prospective Control Study	**Number of Characteristics:**	**Independent variables: IV1=** Administrati	**Scale(s) used: Reliability informatio**	**Statistical tests, if any:**	**Statistical findings, if any:**	Level 2	**Strengths:**

study: N/A		- Children who underwent corrective surgery for congenital heart disease between March 2014 and April 2016 - Children aged less than 18 years **Exclusion Criteria:** - Known allergy to DEX - CHF - Renal impairment - liver diseases - Coagulation disorders - Permanent pacemaker - History of preoperative arrhythmias - History of antiarrhythmic medications and B-blockers within last 3 days **Attrition:** - 90 children - 60 received treatment - 30 received placebo	on of perioperative dexmedetomidine (0.5 ug/kg diluted in 100 mL NS over 20 minutes following by continuous infusion at 0.5 ug/kg/h) for 48 hours **IV2=** Placebo **Dependent variables:** - Incidence of postoperative JET - Bradycardia - Hypotension - Vasoactive inotropic score - ventilation time - pediatric care unit stay - Length of hospital stay - Perioperative mortality	**n (*alphas*, if any):** - Vasoactive inotropic score: Reliable and valid	**Qualitative analysis, if any:** - Analyzed by Mantel-Haenszel statistics in a random-effect model - Review Manager [RevMan] version 5.3 - Heart rate, systolic blood pressure effects: mean difference - Tachycardia, bradycardia, and atrial fibrillation: odds ratio (OR) at 95% confidence interval	**Qualitative findings, if any:** - JET incidence significantly reduced in the Dex group compared with placebo (P<0.0005) - Heart rate while coming off cardiopulmonary bypass significantly lower in the Dex group (P< 0.001) - Mean ventilation time, mean duration of intensive care stay, mean duration of hospital stay significantly shorter in the Dex group (P<0.001) - No significant difference in mortality, bradycardia, and hypotension		- Significant results **Limitations:** - Small number of patients - Atrial wire study unavailable **Risk or harm if implemented:** - Bradycardia - Decreased SBP **Feasibility of use in the project practice area:** - Recommend

		Setting: University Hospital						

Annotated Bibliography statement: El Amrousy et al. (2017) performed a prospective controlled study on 90 children who underwent surgery for congenital heart disease (CHD) to assess the use of dexmedetomidine in the prevention of junctional ectopic tachycardia (JET). Children who were less than 18 years old and undergoing surgery for CHD participated in the study. The study included two groups. Group one received dexmedetomidine 0.5 mcg/kg in 100 mL of normal saline intravenously over 20 minutes, with infusion completion 10 minutes before induction. Group one also received dexmedetomidine 0.5 mcg/kg/hr for 48 hours postoperatively. Group two received normal saline in the same amount intravenously. The intervention group experienced significantly lower heart rates coming off cardiopulmonary bypass, lower postoperative JET incidence, lower vasoactive inotropic score, reduced mean ventilation time, intensive care stay, and hospital stay. Limitations include the small number of participants and the lack of an atrial wire study.

Thematic Analysis
Key Themes or FSP related significance:
1. Level two evidence demonstrating the usefulness of dexmedetomidine in preventing JET in children undergoing surgery for CHD, as well as other significant, beneficial outcomes.
2. A lack of significant difference in bradycardia and hypotension, a main side effect of dexmedetomidine.
3. The control group demonstrated a higher incidence of adverse outcomes, including JET incidence.
4. Dexmedetomidine group experienced decreased mean ventilation time.

Evidence Review

APA Citation: Gautam, N. K., Turiy, Y., & Srinivasan, C. (2017). Preincision initiation of dexmedetomidine maximally reduces the risk of junctional ectopic tachycardia in children undergoing ventricular septal defect repairs. *Journal of Cardiothoracic and Vascular Anesthesia, 31*(6), 1960-1965. https://doi.org/10.1053/j.jvca.2017.04.010

Conceptual Framework or Model	***Design or Method***	***Sample & Setting***	***Major Variables Studied & their Definitions, if any***	***Outcome Measurement(s)***	***Data Analysis***	***Findings***	***Level of Evidence***	***Quality of Evidence: Critical Worth to Practice***
Theoretical basis for the study: n/a	Retrospective study	**Number of Characteristics:** - All patients with congenital heart disease whose repair involved trans-atrial VSD closure	**Independent variables: IV1=** Use of perioperative Dex before skin incision (1ug/kg/h) **IV2=** Use of perioperative Dex postoperatively (0.5 to 1 ug/kg/h)	**Scale(s) used: Reliability information (*alphas*, if any):** N/A	**Statistical tests, if any: Qualitative analysis, if any:** - Descriptive stats for continuous data displayed as median	**Statistical findings, if any: Qualitative findings, if any:** - Dex initiated intraop and continued postop had a greater	Level 3	**Strengths:** - Significant results - Adequate number of patients **Limitations:** - Retrospective and lacked

		- Underwent surgery from January 2010 and February 2013 **Exclusion Criteria:** - N/A **Attrition:** - 134 patients in final analysis - 99 exposed to Dex **Setting:** - N/A	**IV3=** No dexmedetomidine **Dependent variables:** - Incidence of JET		and range - Univariate analyses of all potential explanatory variables performed - Continuous explanatory variables: Mann-Whitney test - Univariate analysis of categorical variables: Fisher exact test - Multivariate analysis: logistic regression model - SAS 9.3	significant reduction in JET than those exposed only postop - Significant reduction in incidence of JET among groups with respect to the timing of DEX started before CPB versus after CPB		randomization and true control group - Data collection relief on proper documentation of postop course **Risk or harm if implemented:** - N/A **Feasibility of use in the project practice area:** - Recommend
Annotated Bibliography statement: Gautam et al. (2017) performed a retrospective cohort study using 134 participants from a surgical database of patients who underwent surgery for congenital heart disease to evaluate the efficacy and ideal timing of dexmedetomidine administration in prevention of junctional ectopic tachycardia (JET). The intraoperative group receiving dexmedetomidine started at 1mcg/kg/hr, the postoperative group receiving dexmedetomidine was titrated from 0.5 to 1 mcg/kg/hour, and the third group received no dexmedetomidine. The patients that received dexmedetomidine were less likely to develop postoperative JET, with intraoperative administration showing the most difference in JET incidence.								
Thematic Analysis **Key Themes or FSP related significance:** **1.** A significant decrease in JET was present in the group receiving dexmedetomidine.								

2. Further study information shows that intraoperative administration of dexmedetomidine may be the best time to administer the drug for JET prophylaxis.
3. Study pointed to better results with dexmedetomidine before cardiopulmonary bypass.

Evidence Review

APA Citation: Schwartz, L., Twite, M., Gulack, B., Hill, K., Sunghee, K., & Vener, D. (2016). The perioperative use of dexmedetomidine in pediatric patients with congenital heart disease: An analysis from the Congenital Cardiac Anesthesia Society-Society of Thoracic Surgeons Congenital Heart Disease Database. *Pediatric Anesthesiology: Original Clinical Research Report*, *123*(3), 715-721. https://doi.org/10.1213/ANE.0000000000001314

Conceptual Framework or Model	***Design or Method***	***Sample & Setting***	***Major Variables Studied & their Definitions, if any***	***Outcome Measurement(s)***	***Data Analysis***	***Findings***	***Level of Evidence***	***Quality of Evidence: Critical Worth to Practice***
Theoretical basis for the study: n/a	Retrospective cohort study	**Number of Characteristics:** - All index cardiopulmonary bypass operations entered in the CCAS-STS from 2010-2013 **Exclusion Criteria:** - Isolated patent ductus arteriosus closure in infants <2.5 kg - Organ procurement surgery - Patients >18 years of age - Missing anesthetic use of primary, intraoperative, or transfer medications - All patients with	**Independent variables: IV1=** Intraoperative Dex administration **IV2=** Control **Dependent variables:** - In-hospital mortality - Postop length of stay - Renal failure, neuro deficit, arrhythmia necessitating pacemaker, postop mechanical circulatory support, and unplanned	**Scale(s) used: Reliability information (*alphas*, if any):** N/A	**Statistical tests, if any: Qualitative analysis, if any:** - Categorical: Counts - Continuous: Median - Distribution of categorical and continuous data: standard hypothesis tests including X2 tests of association and Wilcoxon rank sum tests	**Statistical findings, if any: Qualitative findings, if any:** - Decreased mortality rate - Lower incidence of arrhythmia and postop neuro injury - Shorter duration of mechanical ventilation - Shorter length of stay	Level 3	**Strengths:** - Significant results - Large number of patients **Limitations:** - Retrospective in design - Voluntary and not a random sample - Did not consider dose or duration of drug administration - Could not analyzed data based on surgeons - Lacks audit or data verificatio

		missing STS-European Association for Cardio-Thoracic Surgery Society of Thoracic Surgeons Mortality Score - Participating centers with anesthesia data missing **Attrition:** - 23,011 eligible - 12,142 included **Setting:** - 37 centers to 29 centers	reoperation - Arrhythmia - Postop neuro deficit - Duration of mechanical ventilation		- SAS version 9.3			n for the anesthesia component **Risk or harm if implemented:** - Adverse effects of Dex (hypotension, bradycardia) **Feasibility of use in the project practice area:** - Recommend

Annotated Bibliography statement: Schwartz et al. (2016) performed a retrospective cohort study including 12,142 operations from a database to determine the utilization of dexmedetomidine amongst patients undergoing surgery for congenital heart disease (CHD). Qualifications did not specify specific dosages but included a group receiving perioperative dexmedetomidine and one not receiving perioperative dexmedetomidine. The patients in the dexmedetomidine group showed a decreased percentage of all complications compared to the dexmedetomidine group. Specific outcomes included a lower incidence of arrhythmias, postoperative neurologic injury, shorter mechanical ventilation time, and length of stay.

Thematic Analysis
Key Themes or FSP related significance:
1. Article showed dexmedetomidine group had decreased incidence of arrhythmias.
2. Article supports decreased complications in the dexmedetomidine group, including decreased mechanical ventilation time.
3. Including 12,142 operations, this large study found supportive evidence for using dexmedetomidine perioperatively.

Evidence Review

APA Citation: Shankar, V. K., Tailor, K. B., Kulkarni, S., Mohanty, S. R., Joshi, P. V., & Rao, S. G. (2015). Effect of dexmedetomidine on postoperative junctional ectopic tachycardia after complete surgical repair of tetralogy of Fallot: A prospective randomized controlled study. *Annals of Cardiac Anaesthesia, 18*(3), 323-328. https://doi.org/10.4103/0971-9784.159801

Conceptual Framework or Model	***Design or Method***	***Sample & Setting***	***Major Variables Studied & their Definitions, if any***	***Outcome Measurement(s)***	***Data Analysis***	***Findings***	***Level of Evidence***	***Quality of Evidence: Critical Worth to Practice***
Theoretical basis for the study: n/a	Randomized control trial	**Number of Characteristics:** - June 2010-June 2013 - All patients diagnosed with tetralogy of Fallot and needed complete intracardiac repair **Exclusion Criteria:** - Patients with preoperative arrhythmias - Patients coming in cyanotic spell and taken for emergency surgery - Patients who developed complete heart block post repair **Attrition:** - 94 patients - 47 received Dex - 47 did not receive Dex **Setting:** OR and PCICU	**Independent variables:** **IV1=** Dex started at 0.75 mcg/kg/h after loading dose of 1 mcg/kg over 15 min **IV2=** Fentanyl only **Dependent variables:** - Preoperative: gender distribution, mean age, mean weight, RV outflow tract gradient, preop HR, and preop use of propranolol - CPB time - Hematocrit - AXC time - HR coming of CPB	**Scale(s) used:** **Reliability information (*alphas*, if any):** - Vasoactive inotropic score: Reliable and valid	**Statistical tests, if any:** **Qualitative analysis, if any:** - All data expressed as mean and standard deviation - Categorical data: Pearson Chi-square t-test - Other data: Independent two sample t-test	**Statistical findings, if any:** **Qualitative findings, if any:** - Higher incidence of complicated patients in the Dex group - Lowest hematocrit during CPB was significantly lower in Dex group - Overall incidence of JET was significantly lower in the Dex group	Level 2	**Strengths:** - Significant results **Limitations:** - Small number of patients - Patients were infants and toddlers - Should have studied duration of JET along with incidence rather than just incidence - Duration of hospital stay should have been included **Risk or harm if implemented:** - Potentially lower hematocrit **Feasibility of use in the project practice area:** - Recommend

			- VIS - Cooling - Incidence of JET - Duration of ICU stay - Mortality					

Annotated Bibliography statement: Shankar et al. performed a quasi-randomized trial including 94 patients to evaluate dexmedetomidine's effect on postoperative junctional ectopic tachycardia (JET), duration of ventilation time and length of intensive care stay. Group one received a dexmedetomidine 1mcg/kg loading dose and an infusion at 0.75 mcg/kg/hr. The control group received no dexmedetomidine. Results showed a decreased incidence of JET and heart rate coming off cardiopulmonary bypass. Limitations of the study include a small number of patients, a population focused on younger children, and a lack of certain variables pertinent to the study, like duration of JET and hospital stay.

Thematic Analysis
Key Themes or FSP related significance:
1. Results show a decreased incidence of JET in the dexmedetomidine group.
2. Results show a lower heart rate while coming off cardiopulmonary bypass.
3. Study sets up the potential for other, larger studies to weigh in on ventilatory time and intensive care stay.

Evidence Review

APA Citation: Wadile, S., Sivakumar, K., Murmu, U. C., Ganesan, S., Dhandayuthapani, G. G., Agarwal, R., Sheriff, E. A., & Varghese, R. (2023). Randomized controlled trial to evaluate the effect of prophylactic amiodarone versus dexmedetomidine on reducing the incidence of postoperative junctional ectopic tachycardia after pediatric open heart surgery. *Annals of Pediatric Cardiology*, *16*(1), 4-10. https://doi.org/10.4103/apc.apc_150_22

Conceptual Framework or Model	***Design or Method***	***Sample & Setting***	***Major Variables Studied & their Definitions, if any***	***Outcome Measurement(s)***	***Data Analysis***	***Findings***	***Level of Evidence***	***Quality of Evidence: Critical Worth to Practice***
Theoretical basis for the study: n/a	Randomized control trial	**Number of Characteristics:** - Consecutive patients under 12 years who underwent CPB **Exclusion Criteria:**	**Independent variables: IV1=** Amiodarone at anesthesia induction with no bolus at 5-10 mcg/kg/min	**Scale(s) used: Reliability information (*alphas*, if any):** - Vasoactive inotropic score: Reliable and valid	**Statistical tests, if any: Qualitative analysis, if any:** - SPSS version 16.0 - Descriptive	**Statistical findings, if any: Qualitative findings, if any:** - Age, sex, body weight, and presence of malnutrition no	Level 2	**Strengths:** - Adequate number of patients - Significant results **Limitations:**

		- Surgeries with low risk of JET like atrial septal defect closure or Glenn shunt - Pre-existing LV dysfunction - Pre-existing arrhythmias **Attrition:** - 225 patients **Setting:** University Hospital	**IV2=** Dex at anesthesia induction at 0.2-0.5 mcg/kg/h **IV3=** Routine postoperative care **Dependent variables:** - Incidence of JET - Operative: duration of CPB and aortic cross clamp - Postop: serum electrolyte levels, inotrope use, duration of ventilation, ICU stay, and hospitalization		analysis: frequencies, proportions, mean, standard deviation, median, and range - Normality of continuous variables - Categorical variables: Chi square and Fischer's exact - Continuous variables: independent t-test, ANOVA test, Mann-Whitney U test, and Kruskal-Walls test	significance with JET - Longer CPB time and ACC time associated with JET - Hypokalemia and hypomagnesemia associated with JET - Patients with JET had longer ventilation time, ICU stay, and hospitalizations - Incidence of JET significantly lower in both interventions - Ventilation time, duration of ICU stay, and hospital stay significantly lower in Dex and amiodarone groups - Amiodarone had a higher incidence of bradycardia and hypotension (not statistically significant)		- Single center study - Alternate sampling method used - Composite VIS score instead of individual inotrope hourly dosage **Risk or harm if implemented:** - N/A **Feasibility of use in the project practice area:** - Recommend both amiodarone and dex
Annotated Bibliography statement: Wadile et al. (2023) performed a randomized controlled trial to compare the prophylactic effects of amiodarone and dexmedetomidine to prevent postoperative junctional ectopic tachycardia (JET). The study included 225 participants, with 70 patients in each group. Group A received								

amiodarone at 5-10 mcg/kg/min, group B started at 0.2-0.5 mcg/kg/hr, and group C experienced routine care only. The incidence of JET was significantly lower in the dexmedetomidine group than the control, despite the amiodarone group showing the most decrease in JET incidence. The results showed a decreased incidence of ventilation duration, ICU stay, hospital stay, and vasoactive inotropic score in the intervention groups.
Thematic Analysis **Key Themes or FSP related significance:** **1.** A decreased incidence of JET was noted between the control group and interventions group, with amiodarone showing the most difference **2.** Adverse effects from JET were significantly decreased in the intervention groups **3.** There was not a significant increase in adverse effects like bradycardia and hypotension, deeming both agents safe

Appendix D

Perioperative Use of Dexmedetomidine

Perioperative Use of Dexmedetomidine in Congenital Cardiac Surgery Patients (2023)	
Developed Date: 9/01/2023	**Effective Date:**
Developed By: Kayla Thomsen	**Reviewed Date:**
Reviewed By: Dr. Kacy Ballard	**Approved By:** Dr. Kacy Ballard

STATEMENT OF PURPOSE:

The purpose of this guideline is to provide evidence-based practice recommendations regarding perioperative use of dexmedetomidine in pediatric congenital cardiac surgery for postoperative tachyarrhythmia prevention. Postoperative tachyarrhythmias is a common occurrence in the patient population and can result in many adverse effects. The use of perioperative dexmedetomidine for prevention of postoperative tachyarrhythmias decreases tachyarrhythmia incidence, heart rate, and invasive ventilation time.

POLICY:

These guidelines are for all CRNAs administering anesthesia to a patient undergoing pediatric congenital cardiac surgery for TOF repair in the absence of bradycardia with first surgical intervention. Clinical judgment needs to be used when necessary to prevent patient harm. However, compliance is necessary and will be audited.

GUIDELINES:

- Administer dexmedetomidine bolus, 1 mcg/kg over 15 minutes in the absence of bradycardia prior to cardiac bypass initiation.
- Initiate dexmedetomidine infusion at 0.5 mcg/kg/h and continue into the postoperative period.
- Discontinue dexmedetomidine infusion 24 hours after post-surgical ICU admission, at the discretion of the primary physician, or if any of the below incidents take place.
    - Severe, prolonged hypotension
    - Prolonged bradycardia
    - Failure to return to neurological baseline post-surgery

Appendix E

Example Email to Students

To whom it may concern:

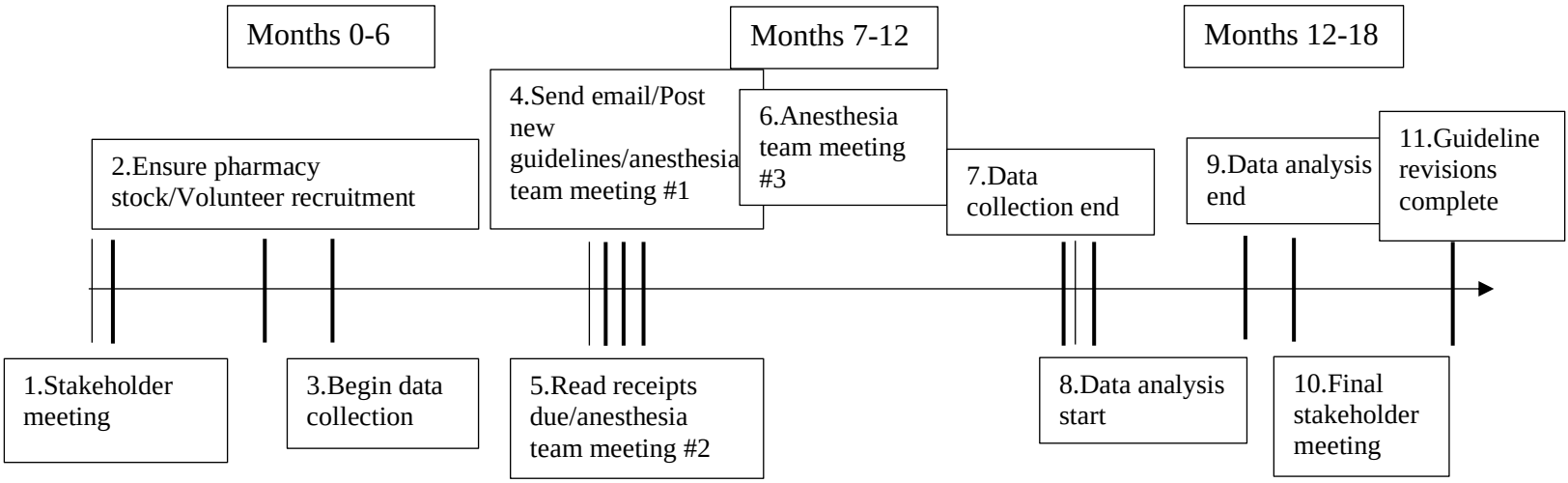
I am currently conducting a Final Scholarly Project for completion of a doctoral degree and am looking for research volunteers. Volunteers must be current nursing or medical students who have rotated through the chosen hospital in a clinical rotation. Duties include data extraction from the electronic medical record (EMR) and continuous cardiac monitoring (CCM) records. Below is a synopsis of the project. Please feel free to contact the primary investigator with any questions or interest.

The project is looking at integrating perioperative dexmedetomidine for postoperative tachyarrhythmia prevention in pediatric congenital cardiac surgery, focusing on Tetralogy of Fallot. The project will span one and a half years.

Thank you,
Kayla Thomsen, BSN, RN, SRNA (PI)
Email: thomsen2@otterbein.edu
Phone: 740-405-8189

Appendix F

Timeline



Appendix G

Budget Plan

Product	Monetary value	Amount
CRNA hourly salary	$98.93 per hour (U.S. Bureau of Labor Statistics, 2022b)	1.5 training hours x 50 180 additional hours for CRNA scholar involvement
Anesthesiologist hourly salary	$145.66 per hour (U.S. Bureau of Labor Statistics, 2022a)	1.5 training hours x 20
2 mL Dexmedetomidine 100 mcg/1 mL vial	$45.00 (National Library of Medicine, 2014)	25 vials
IV tubing	$1.39 per tubing (Mountainside Medical Equipment, 2023)	25 tubings
IV filters	$310.45 per case (Medical Product Sales, 2023)	1 case
White cardstock paper	$5.00 per 25 sheets (Amazon, 2023)	25 sheets
Total cost	$31,039.33	
Total grant money	Up to $100,000.00 (Children's Heart Foundation, 2023)	
Out-of-pocket expenses	$0.00	