DNP Scholarly Project Final Approvals

The DNP student Sarah Bitterson **and the Scholarly Project** Intraoperative Hypothermia Prevention and Temperature Guideline Education in Anesthesia Providers **meet all the requirements for the degree of Doctor of Nursing Practice at University of Saint Francis-Fort Wayne, IN.**

Date of Final Approval: 6/18/21

DNP Student Signature: _____

DNP Faculty Advisor Signature: _____

Graduate Nursing Program Director Signature: _____

NAP Program Director Signature: _____

Copies to: Student File, Graduate office and attached to the Final Project Manuscript.

Intraoperative Hypothermia Prevention and Temperature Guideline Education in Anesthesia Providers

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NURS 785: DNP Project III

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Abstract

Background: Basic standard of care monitors and vital signs include pulse oximetry, heart rate, respiratory rate, blood pressure, and body temperature. When looking specifically at these vital signs, temperature encompasses one of the most diverse criteria for the anesthesia provider to monitor. **Methodology:** The purpose of this Doctoral Nursing Practice (DNP) project was to provide education and increased knowledge regarding intraoperative hypothermia prevention and temperature guideline education in anesthesia providers. Does the utilization of an intraoperative hypothermia education and a Pre and Post-Test model program, with a specific temperature guideline, increase knowledge base and awareness in anesthesia providers, as evidenced by a decreased prevalence for hypothermia in adult patients having general anesthesia? **Findings:** The educational intervention was implemented at Elkhart General Hospital (EGH) in Elkhart, Indiana. A Pre-Test, educational PowerPoint Presentation, Post-Test, and Likert Scale Post Survey via Microsoft Forms were utilized throughout the implementation. The average Pre-Test score was 62% (6.2/10 points). The average Post-Test score was 80.7% (8.07/10 points). The percent change between the Pre-Test score and Post-Test score was an increase of 18.7%. **Implications:** Nurse anesthesia providers need education on the prevention of hypothermia and temperature management guidelines. Future recommendations include updated knowledge and education related to hypothermia prevention in future practices of care.

DNP Scholarly Project Final Approval Form

University of Saint Francis
Institutional Review Board
Human Subjects Review Committee/ACUC/IBC
Institutional Review Board Approval Form

Protocol Number: 16000262490-HSRC

Review by (underline one): HSRC ACUC IBC

Date Reviewed: 10/12/2020
Principal Investigator: Sarah Brotherson
Faculty Advisor: Dr. Susan Lown
Protocol Title: Intraoperative hypothermia prevention and temperature guideline education in anesthesia providers
Study Site(s): Elkhart General Hospital

Type of Proposal:
- Original research
- Replication or extension of previous research
- Quality Improvement/Evidence-Based Practice Project

Items submitted for review:
- ☒CITI Certificate
- ☒Initial protocol
- ☒Abstract
- ☒Informed Consent Form (if applicable)
- ☒Approval letter from outside institution
- ☒Other – explain: pre/post surveys, educational intervention, post-intervention survey

Type of Review:
- ☒Full Review
- ☐Expedited Review
- ☐Exempt Review

Approval:
- ☒Approval granted on 10/12/2020
- ☐Approval granted on _____ for a period of one year.
- ☐Conditional approval* granted on _____ for a period of one year.
- ☐Not approved*
- ☐ IRB approval is not required because:
- ☐Other

*Comments: _____

The committee performing this review is duly constituted and operates in accordance and compliance with local and federal regulations and guidelines.

Stephanie Oetting	*Stephanie Oetting*	10/12/2020
Printed Name (Chair or designee)	Signature	Date

IRB Committee Approval Form ajo 10/12/2020

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Intraoperative Hypothermia Prevention and Temperature Guideline Education in Anesthesia Providers

Chapter 1: Introduction

Once a patient enters the operating room (OR) the anesthesia provider is the primary advocate for the patient throughout the entire case. Proper monitoring devices are placed on every patient undergoing general anesthesia as the basic standard of care. Basic standard of care monitors and vital signs include pulse oximetry, heart rate, respiratory rate, blood pressure, and body temperature. When looking specifically at these vital signs, temperature encompasses one of the most diverse criteria for the anesthesia provider to monitor (Diaz & Becker, 2010). It is completely up to the anesthesia provider how and when body temperature will be monitored, as well as what preventative measures will be taken to help keep the patient normothermic throughout the procedure. With such a variation of monitoring preference from one anesthesia provider to another, would the use of a set guideline improve the prevalence of hypothermia occurrence in the operating room for adult patients undergoing general anesthesia?

PICOT Question

Does the utilization of an intraoperative hypothermia education and a Pre and Post-Test model program, with a specific temperature guideline, increase knowledge base and awareness in anesthesia providers, as evidenced by a decreased prevalence for hypothermia in adult patients having general anesthesia?

Problem

Problem Statement

The administration of general anesthesia requires continuous monitoring of vital signs, but the assessment of body temperature is often overlooked. Up to 25-90% of patients experience

unintended perioperative hypothermia, with a defined core temperature reading below 36 degrees Celsius (96.8 degrees Fahrenheit) perioperatively (Hart, Bordes, & Harmon, 2013). A specific temperature guideline is not in place at the healthcare facility of EGH, rather a standard anesthetic protocol is used. The lack of proper temperature monitoring by the anesthesia providers during these vital phases can result in adverse outcomes for the patient.

Background of the Problem

The administration of general anesthesia is the most common cause of hypothermia in patients, as it affects the core-to-peripheral redistribution of body heat. The normal core temperature ranges from 36.6-37.5 degrees Celsius. During the induction of anesthesia, the body temperature of a patient can decrease 0.5-1.5 degrees Celsius within the first thirty minutes of a procedure (Hart et al., 2013).

Hypothermia during general anesthesia is a frequent perioperative thermal disturbance that patients encounter (Diaz & Becker, 2010). The result of hypothermia occurring has multiple effects within the body systems of the patient. Almost all of the body systems are affected when normothermia drops, but the most pronounced body systems include the patient's circulation and respiration center which can lead to immunosuppression. The circulation becomes compromised and causes a decrease in the patient's heart rate, pulse volume, and cardiac contractility (Cam, Yonem, & Ozsoy, 2016). During a severe drop of temperature, around 27 degrees Celsius, the risk of ventricular fibrillation can result. Next, the respiratory center is suppressed due to the dilation of the airways from an increase of dead space within the alveoli. As the body temperature continues to drop, the frequency of respirations per minute also decreases until the onset of apnea (Cam et al., 2016). The primary issue with hypothermia and the decline of respiratory drive involves the increase of oxygen solubility within the blood. When the oxygen

solubility in the blood increases, the tissues pull less oxygen from the blood, resulting in a left shift in the oxyhemoglobin dissociation curve (Hart et al., 2011). Ultimately, less oxygen is delivered throughout the entire body, causing harm to the patient.

Multiple factors can affect a patient's body temperature during the perioperative period. The ability to maintain normothermia during a surgical procedure can become difficult due to various factors such as the OR temperature, the irrigation fluids used by the surgeon, the amount of skin exposure during the procedure, the vasodilating effects of the anesthetic gas, and drugs administered by the anesthesia provider (Bindu, Bindra, & Rath, 2017). These factors cause an increased risk of postoperative surgical complications and can delay the patient's healing and recovery time. Anesthesia providers must be ready to implement guidelines and protocols to provide the highest quality of care to the patients.

Definition of Key Terms

1. Hypothermia: A core body temperature less than 36 degrees Celsius (96.8 degrees Fahrenheit) (Hart et al., 2013).
2. Intraoperative period: This period begins the start of general anesthesia and ends during the transition into the post-anesthesia recovery unit (PACU). Hypothermia occurs throughout the intraoperative phase of the patient's surgical experience. Anesthesia eliminates the patient's ability to adequately warm their core body temperature, as the anesthetized patients cannot move to warmer environments (Scott et al., 2015).
3. Temperature monitoring: The measurement of body temperature is included as one of the five standards for basic anesthetic monitoring (American Society of Anesthesiologist, 2020).

4. Basic monitoring equipment: During a general anesthetic case, the respiratory rate, blood pressure, heart rate, pulse oximeter, body temperature, and end tidal CO2 are all included. (John, Ford, & Harper, 2014).
5. Prevention measures to avoid hypothermia: The different types of heating devices include forced air warming devices (Bair Huggers), heat moisture exchangers (HME), warm blankets, and fluid warmers to prevent heat loss throughout surgery (Macario & Dexter, 2002).
6. Age category searched within articles: The age at which an individual is considered an adult in the eyes of Indiana State law is 18 years old (Indiana Legal Laws, 2020).
7. American Society Anesthesiologists (ASA) Physical Status Classification: The ASA physical status allows for proper assessment of patient's comorbidities and is helpful in predicting perioperative risks. Factors such as length of surgery, type of surgery, and overall health are also incorporated into the physical classification system. Classifications range from ASA I normal healthy patient to ASA VI brain death and organ donation (ASA, 2020).
8. Hypothermia guideline created by the National Institute for Health and Care Excellence (NICE): The NICE guideline includes various ways to improve temperature management and to prevent hypothermia (National Institute for Health and Care Excellence, 2016).

Practice/Knowledge Gap

The identification of best practice for the prevention of hypothermia helps anesthesia providers implement appropriate warming measures to inhibit harmful side effects. Hypothermia during general anesthesia can result in short and long-term side effects. Short-term side effects include delayed drug metabolism, increased blood glucose, tachycardia, and vasoconstriction of

blood vessels (Sessler, 2008). Hypothermia can also affect the patient with long-term damage if not prevented or addressed by the anesthesia healthcare provider. Long-term side effects include impaired blood coagulation, which leads to an increased risk of blood loss post-surgery; impaired resistance to surgical-site infection; and neurological injury (Moola & Lockwood, 2012). Proper identification of risk factors will decrease the incidence of side effects from hypothermia. The process of incorporating a temperature monitoring guideline allows the anesthesia provider to deliver optimum quality of care to the surgical patient and also provides best practice.

Best Practice

Various guidelines and protocols have been developed for the prevention of hypothermia, but identification of the best practice is the primary goal. From the review of the literature, three anesthesia guideline resources were identified: National Institute for Health and Care Excellence (NICE), American Society of Anesthesiologists (ASA) Basic Anesthesia Monitoring, and the Association of Perioperative Registered Nurses (AORN).

The context of a guideline is critical for temperature monitoring and the prevention of hypothermia. The NICE was identified as the primary guideline, because it explicitly relates to temperature monitoring throughout all four stages of surgery (NICE, 2016). The four stages of surgery as defined by the NICE include 1.1: Perioperative Care, 1.2: Preoperative Phase, 1.3: Intraoperative Phase, and 1.4: Postoperative Phase (NICE, 2016). From the review of the literature, it was made apparent that the preparation of surgery not only occurs within the operating room, but within the preoperative unit and continues throughout the post-anesthesia care unit (Hart et al., 2013; Urits et al., 2019). Anesthesia providers must be vigilant in assessing the surgical patient throughout all stages of surgery. The NICE: Hypothermia Prevention and Management Guideline in adult patients having colorectal surgery and the ASA: Basic

Anesthesia Monitoring were reviewed. The results concluded that hypothermia occurred around 22-30% of patients following the NICE guideline, compared to 35-55% of patients while using the ASA: Basic Anesthesia Monitoring (Nicholson, 2013).

The NICE temperature guideline also includes specific temperature ranges/examples and warming prevention devices to help reduce the effect of hypothermia, as outlined in the review of the literature. Defined temperature values were included throughout the NICE guidelines and left no room for guessing appropriate temperature ranges throughout surgery (NICE, 2016). The ASA: Basic Anesthesia Monitoring Guideline does not include any temperature values, and ultimately leaves the anesthesia provider to predict what they believe is an adequate and appropriate body temperature.

Overall, the NICE is an independent organization and is responsible for providing national guidance on the prevention and treatment of adverse health factors while promoting an increased quality of care (NICE, 2020). The NICE has over 50 clinical guidelines published, as one is specifically related to temperature monitoring for the prevention of hypothermia (Chidgey, Leng, & Lacey, 2016). The process of staying up to date on evidence-based care is an essential task for all healthcare providers. The NICE provides clinical guidance to ensure confidence on evidence-based resources and cost effectiveness for healthcare providers.

The Gap

Implementation of this project occurred at the clinical site of EGH located in Elkhart, Indiana. The primary policy and procedure document found at EGH for anesthesia providers included the "Anesthesia Standard of Care Policy" referenced from the American Society of Anesthesiologists (ASA) Standards and Guidelines (ASA, 2008). Elkhart General Hospital's policy was last reviewed in August 2018 and is set to be reviewed every three years, with the

next review date scheduled for August 2021 (Elkhart General Hospital, 2018). It is important to note that EGH does include a basic guideline for anesthesia providers to follow as provided above, but a guideline specifically related to temperature management in prevention of hypothermia does not exist at this clinical facility for best practice. Another gap discovered about the standard policy present at EGH is an inadequately updated reference used from the ASA. The refence date provided for the "Anesthesia Standard of Care Policy" was cited from 2008 (Appendix A).

It is essential that all anesthesia providers stay updated with best practice. It is evident that EGH has exposed a "gap" within their facility's outdated policy, and the need for a new practice guideline specifically related to temperature monitoring is crucial. This specific gap was brought to the attention of Dr. Eric Torbert, Chief Anesthesiologist at EGH, and subsequent support was gained from the anesthesia department and from Dr. David Van Ryn, Director of Medical Education, to move forward with the doctoral project. The process of incorporating the NICE: Hypothermia Prevention and Management Guideline would greatly benefit EGH and help close the gap by advancing best practice and increasing knowledge.

Facility Vision and Doctoral Nursing Practice Role

Elkhart General Hospital's primary vision entails an expansion of knowledge for all anesthesia providers in the prevention of hypothermia during general anesthesia. In order to gain this knowledge, the best practice guideline known as the NICE: Hypothermia Prevention and Management Guideline will need to be accepted into everyday anesthesia practice. The goal from the acceptance and implementation of the NICE Guideline at EGH includes an overall increase of patient safety, improved temperature monitoring outcomes, and enhanced patient's quality of care.

In order to provide substantial information about EGH and temperature monitoring a retrospective chart audit was completed on February 17, 2020. This chart audit acknowledged that there was in fact a problem pertaining to temperature monitoring and documentation, as body temperature was not documented 29% of the time out of 110 charts assessed. From the completion of the chart audit, the project manager talked with the anesthesia providers at EGH and updated them on their knowledge and awareness over hypothermia and prevention of the occurrence from general anesthesia. An education handout about the side effects from hypothermia and the NICE Guidelines was provided to EGH anesthesia providers through an educational presentation.

The process of obtaining, remembering, and understanding information over time can be difficult for healthcare providers (Brem, Ran, & Pascual-Leone, 2013). With proper cues and updated information, the memory of hypothermia prevention strategies can be refreshed and renewed into daily practice. Next, a prospective chart audit was completed on February 20th, 2021 to evaluate any positive or negative changes from the educational update over hypothermia prevention with proper temperature monitoring.

Facility Barriers

The process of change is difficult, and even positive changes are hard and can produce unintentional stress for healthcare providers (Al-Abri, 2007). One barrier present at EGH included change. The policy for anesthesia providers and standard of care has not been updated with new references since 2008. A new change will need to occur as this reference is more than 12 years old, and no current guideline specifically related to temperature monitoring and prevention of hypothermia exists at the facility. It is common for anesthesia providers to become

comfortable in their daily practice, but it is vital to evolve as new recommendations are published for best practice.

The second barrier that coincides with change includes loss of control at EGH. Anesthesia providers strive to be autonomous within their daily practice, but when change interferes with autonomy, it can make anesthesia providers feel a loss of control (Al-Abri, 2007). It is important to remind the anesthesia providers that over time, the feelings of loss of control will diminish once they become more familiar with the temperature guideline provided by the NICE.

The third and most critical barrier was the large size of the anesthesia group present at EGH. The Northern Indiana Anesthesia Services at EGH contains more than 17 Certified Registered Nurse Anesthetists (CRNAs) and 7 Anesthesiologists. The challenges that were faced included contacting all of the anesthesia providers to become involved with the educational update on hypothermia management and following the updated guideline. The project manager did receive adequate support from the chief anesthesiologist and director of medical education, which helped strengthen the education on hypothermia guidelines and knowledge advancement.

Practice Gap

Identification of the best practice for anesthesia providers allowed the development of the most efficient guidelines and overall improvement in the patient's quality of care. The NICE provides a detailed guideline specifically for hypothermia prevention and management. The process of incorporating this guideline into the facility of EGH would help close the gap of not having a guideline tailored to temperature monitoring with prevention of hypothermia. Ultimately, this guideline of best practice will increase patient safety and the anesthesia providers knowledge.

Needs Assessment

Project Necessity

A thorough review of literature provided evidence to support the need for intraoperative hypothermia prevention and temperature guideline education in anesthesia providers. However, there lied a gap in the standard of care requirements and recommendations for the anesthesia providers located at EGH. This project is supported by the project manager along with the Beacon Health System and EGH (Appendix B).

Early education for the anesthesia providers and assessment of the baseline knowledge can help decrease the prevalence of hypothermia development (ASA, 2020; Moola & Lockwood, 2011; National Institute for Health Care and Excellence, 2020). The development of intraoperative hypothermia not only has short-term effects, but also long-term effects can result. The incidence of hypothermia can produce complications such as myocardial ischemia, surgical site infection, prolonged drug effects, bleeding difficulties, shivering within the post-operative phase, increased length of stay and cost, and ultimately decreased patient satisfaction (Hart et al., 2011). According to the National Institute for Health and Care Excellence (NICE, 2020), if anesthesia providers stay up to date on the preventative measures for the development of hypothermia and how to respond appropriately, and understanding the long-term consequences, hypothermia throughout the intraoperative phase may be identified early with proper strategies in place.

DNP Project Overview

Scope of Project

The scope of this DNP scholarly project was to provide education for increased knowledge and awareness regarding intraoperative hypothermia prevention measures in anesthesia providers. The project was intended for practicing CRNAs or anesthesiologists

employed through Northern Indiana Anesthesia Services (NIAS). Exclusions from the project included any healthcare providers under the age of 18 years old and not employed through the NIAS. The educational intervention covered many domains within the topic of hypothermia development and preventative measures, such as the definition of intraoperative hypothermia, signs, and symptoms of hypothermia (how to recognize), side effects, common warming devices, and locations of guidelines and protocols related to hypothermia within the intraoperative phase. Providing a uniformed and streamlined educational opportunity for anesthesia providers to learn about the risks, consequences, and best practice guidelines was the overall goal of this doctoral project completed at EGH.

This project did not include any physical studies, deception, major risk to the anesthesia provider participants, participant compensation, or cost for the participants at the clinical facility. Compensation was not awarded to the anesthesia provider participants, and there was no direct benefit to the anesthesia providers for participating within the implementation of the doctoral project.

Stakeholders

Key stakeholders included the project manager, Sarah Brotherson, BSN, RN, DNP-CRNA student; project advisor Dr. Susan Lown; and project mentor Dr. Gregory Louck, Director of Nurse Anesthesia Program. Other key stakeholder's imperative to this project included Dr. Eric Torbert D.O. Chief Anesthesiologist Beacon Health System, Elkhart General Hospital; Dr. David Van Ryn M.D. Director of Medical Education Beacon Health System, Elkhart General Hospital; and the University of Saint Francis faculty and staff.

Budget and Resources

Cost

In-kind cost was generously provided by the faculty and staff at the University of Saint Francis for the project's advising, mentoring, and attending scholarly project events/presentations, along with EGH's anesthesia group of CRNAs and anesthesiologists. Direct costs were associated with the price of SPSS Statistics Version 26 and 27 for $152, educational handouts, and snacks provided for the anesthesia providers. Educational handouts and flyers were provided to anesthesia providers with quick tips for hypothermia development and preventative measures with a direct cost of $12. Cupcakes were included by Adam's Cake Shop approximately $30 and was provided by the project manager for participation within the scholarly project. In total, the project manager paid $194 in direct costs (Appendix C).

Description of Resources

Email work verification for all of the anesthesia providers employed at EGH was utilized as the method to distribute the educational intervention. Through EGH's work email address each anesthesia provider was emailed the electronic informed consent, Pre-Test, educational PowerPoint Presentation, Post-Test, and Likert Scale Post Survey. Anesthesia providers were asked to allocate one hour of their time for the completion of all of the intervention documents. Prior to beginning, the anesthesia providers completed the electronic informed consent, then continued on for the completion of the Pre-Test within the online software tool of Microsoft Forms. Once the Pre-Test was completed, a PowerPoint presentation was utilized to present the intraoperative hypothermia prevention material geared towards anesthesia providers.

The PowerPoint presentation was developed by the project manager. The anesthesia providers were required to have access to internet connection and a computer (personal or work) to locate the doctoral project documents and presentation. After the completion of the Pre-Test

and PowerPoint presentation, the anesthesia providers were then asked to complete the Post-Test and Likert Scale Post Survey. These two documents (Post-Test and Likert Scale Survey) were provided in the software tool Microsoft Forms and served to test the anesthesia provider's knowledge and awareness and any changes or improvements developed after the educational intervention. Microsoft Forms was used to collect statistical data regarding scores between the Pre-Tests and Post-Tests result section.

Process and Outcomes

General Timeline

The project design began in September of 2019 (Appendix D). The clinical question was developed and refined throughout the following three semesters Fall, Spring, and Summer 2020-2021 in the core doctoral coursework. CITI training for five various certificates were completed in January of 2020 (Appendix E). In February of 2020, the clinical site of EGH was contacted to determine the need and feasibility of the project. The chief anesthesiologist and director of medical education at Beacon Health System, EGH found the project was necessary and supported the educational intervention, Quality Improvement Project for intraoperative hypothermia prevention in anesthesia providers.

A retrospective chart audit was completed February 17, 2020 to acknowledge that a gap was present at the clinical facility and a quality improvement project would be beneficial. April 2020, a thorough review of literature was collected, and the scholarly project was solidified with the appropriate project team members formulated. CITI training and stakeholder identifications with meetings were completed in the month of April 2020. During the months of May, June, and July 2020 a gap analysis, needs assessment, risk assessment, budget spreadsheet, timeline, educational questionnaires/tests, and the data collection plan were completed. Correspondents with the project manager and EGH, Anesthesia Services continued throughout the entirety of the

doctoral project. Implementation occurred on November 30, 2020 after receiving approval from the USF IRB and DNP faculty. The anesthesia providers were given three weeks to complete the emailed doctoral intervention. The three weeks to complete the intervention allowed the anesthesia providers adequate time. A prospective chart audit was then completed February 20th, 2021 after 30 days had passed from implementation day. Finally, the results and analysis from implementation were completed April 2021.

Setting and Target Population

Northern Indiana Anesthesia Services is the primary group that employs the anesthesia providers and included 18 certified registered nurse anesthetists (CRNAs) and 6 anesthesiologists. The location of the clinical facility for the anesthesia providers was Beacon Health System, EGH Elkhart, Indiana.

Data collection for the retrospective chart audit was completed on February 17, 2020 located at EGH Elkhart, Indiana with the use of the patient's paper medical chart. Data collection of implementations was started at EGH on November 30, 2020, as the setting for data collection varied from each anesthesia provider as the documents were completed online throughout their email addresses. The educational intervention was emailed to all anesthesia providers and included the Pre-Test, PowerPoint Presentation, Post-Test, and Likert Scale Post Survey. The educational intervention was open for three weeks for the anesthesia providers to complete all emailed documents through Microsoft Forms. Data collection for the prospective chart audit was completed at least one-month (30 days) post closure of the online Pre/Post Test February 20th, 2021 and the setting/location was EGH Elkhart, Indiana.

Participant Inclusion and Exclusion Criteria

The educational presentation was intended for practicing CRNAs or anesthesiologists employed through Northern Indiana Anesthesia Services. Criteria for exclusion included under the age of 18 years old, internship for anesthesia, operating/surgical staff, pre-operative staff, post-anesthesia care unit Staff (PACU), post-operative staff, anesthesia students (SRNAs), locums (traveling anesthesia providers not employed through Northern Indiana Aesthesia Service), and medical residents.

Expected Outcomes

Prior to beginning the emailed educational intervention on November 30, 2020, the anesthesia providers completed the emailed electronic informed consent for participation within the doctoral project (Appendix F). Next, the anesthesia providers completed the Pre-Test via Microsoft Forms on their electronic devices and then immediately opened the educational PowerPoint presentation intervention. All information was deidentified and anonymous with the prevention of the anesthesia participant's email and IP addresses from appearing within the survey results. After the completion of the educational PowerPoint presentation intervention, the providers completed a Post-Test and Likert Scale Post Survey also within the software tool Microsoft Forms on their electronic devices. Privacy and confidentiality were achieved, as the data collected was only shared with the project manager on a password protected device. Data was stored in aggregate form. The Pre-Test and Post-Test (Appendix G) were designed to measure knowledge and awareness gained by participation in this educational intervention. A 15 percent increase on Post-Test scores from Pre-Test scores was expected. Anesthesia providers were also expected to be able to state or describe their level of awareness about the development

of hypothermia, identification of side effects, and possible implementation of the hypothermia practice guideline as evidenced by the Likert Scale Post Survey results (Appendix G).

Anesthesia providers were also asked to allocate one hour of their time for the completion of all of the doctoral project documents which included the Pre-Test, PowerPoint presentation, Post-Test, and Likert Scale Post Survey. The length of time required for the anesthesia providers also included stable internet access for one hour.

Risk Analysis

Risk Analysis

No physical risks existed. The anesthesia providers did not have to answer any questions they did not want to answer. Strategies to mitigate any risks to the participant were considered. Additional educational resources were provided to the anesthesia providers if they wished to locate further readings or guidelines related to intraoperative hypothermia prevention. No harm or damages resulted from the anesthesia providers in the completion of the doctoral project intervention documents online by the software tool Microsoft Forms. The Pre-Tests and Post-Tests were deidentified and anonymous via the software tool of Microsoft Forms. Pre and Post-Test data remained confidential and anonymous, as the project manager was the primary collection of data for the project. Data was stored in aggregate form. Anesthesia providers were able to withdraw from this quality improvement project at any time without penalty. Participation in the quality improvement project was voluntary. Informed consent was obtained through online resources with the use of electronic signatures before the completion of the doctoral documents. The data will be stored for one (1) year, March 2022. All data paper records will be shredded and properly disposed in compliance with HIPAA Shredding and Retention requirements for healthcare information. All records stored on the project manager's password protected computer will be erased using commercial software applications designed to remove

all data from the storage device. The use of a Force Field Analysis (Appendix H) was completed for the project clinical site of EGH Elkhart, Indiana, along with a SWOT Analysis (Appendix I) to further identify strengths and weaknesses within the clinical facility from implementation of the doctoral project.

The project did not include any physical studies, deception, major risk to the participants, participant compensation, or cost for the participants. Compensation was not awarded to the anesthesia participants and there was no direct benefit to the anesthesia providers for participating within the project. No forms of audio or voice recording of the anesthesia providers participants were used during the implementation of the doctoral project.

Chapter 2: Synthesis of Supporting Evidence and Project Framework

Relevant Theory and Concepts

Methodological Model

The Donabedian Model focuses on three key factors to help form a conceptual model. The three key factors include Structure, Process, and Outcome (Moran, 2017, p. 137). The use of the Donabedian Model allowed the project manager to clearly identify the setting of implementation, current practices, who was involved as participants within the project, how the project was delivered, and measured outcomes.

Structure

The anesthesia staff performing general anesthesia on surgical patients was the primary structure. The equipment of temperature monitoring devices such as temperature probes, esophageal, nasal, and skin, warming devices such as Bair Huggers, and IV fluid warmers encompassed the secondary structure for the use of preventative hypothermia temperature devices. The use of these materials was available within EGH surgical unit. No increased use of technology or computer-based programs were needed.

Process

The implementation of the doctoral project was included within the process. The educational learning intervention was planned to include a Pre-Test over risk and development of hypothermia, educational PowerPoint presentation, and a Post-Test. A retrospective and prospective chart audit (110 charts per audit) was also collected to obtain comparable and measurable outcomes.

Outcome

The comparison of the Pre-Test and Post-Test scores, with completion of prospective chart audit after implementation of project was completed for the outcome. The overall goal included the improvement of the anesthesia providers' increased knowledge and awareness for hypothermia development from general anesthesia and implementation of best practice for temperature monitoring throughout a surgical case.

Framework

The RE-AIM Framework was developed in 1999 to help establish and report growth of diseases and advancement of health literature (Glasgow, Boles, &Vogt, 1999). The use of the RE-AIM Framework identifies areas of growth and specific steps to undertake to reach an overall goal in the healthcare practice. The RE-AIM Framework was an appropriate option for the specific topic on hypothermia prevention and temperature management in adult patients during general anesthesia. The application of the RE-AIM Framework into the clinical site of EGH was beneficial for the anesthesia providers, as the framework provided five phases to incorporate the educational update for the prevention of hypothermia in surgical patients having general anesthesia.

The RE-AIM Framework includes five important phases to promote health production: Reach, Effectiveness, Adoption, Implementation, and Maintenance (White, 2016). The first phrase, *Reach* looks at the target population or number of representatives that would be willing to participate within a study. This included the anesthesia providers within the operating room setting and the providers who administer general anesthesia at EGH.

The second step of the framework includes *Effectiveness*. It is important to look at the actual educational intervention and the possible outcomes which may include positive or

negative effects (Gaglio, Shoup, & Glasgow, 2016). The organization of the temperature monitoring guideline and how effective it served for temperature management was an important aspect at EGH. The third phase of the RE-AIM framework requires the evaluation of how the new proposed practice will be *Adopted*. Support was essential from the clinical site of EGH and how the anesthesia providers responded to the educational update of a temperature monitoring guideline. Along with gaining support from the anesthesia providers, it was also crucial to gain support from the Director of Medical Education and Chief Anesthesiologist. Positive reinforcements and trust from the entire anesthesia service team during the *Adoption* phase was important, as the Northern Indiana Anesthesia Services at EGH is a large group encompassing over 17 Certified Registered Nurse Anesthetists (CRNAs) and 7 Anesthesiologists.

The fourth phase of the RE-AIM Framework includes *Implementation* and is the process of delivery and how specific changes will be put into action (White, 2016). The development of a temperature monitoring guideline to prevent hypothermia was put into place at the healthcare facility of EGH. The last phase of the RE-AIM Framework encompasses *Maintenance*. The overall goal during this phase is for the policy or guideline to become institutionalized and part of the routine practice (White, 2016). RE-AIM Framework stresses the importance of impacting not only at the individual level of one patient or one healthcare provider but the healthcare institution as a whole (White, 2016). Maintenance of a temperature guideline at EGH provided a standard of practice of how to monitor body temperature throughout a surgical procedure requiring general anesthesia.

Supporting Evidence and Literature

Literature on general anesthesia with the development of hypothermia has been documented and recorded not only within the United States but has been found internationally as

a common occurrence. One literature review performed in Margburg, Germany focused on the development of hypothermia and the risk factors between 2012 and 2014 (Torossian et al., 2015). Another review of the literature pertaining to hypothermia development and risk factors from general anesthesia was conducted in Beijing and was recently published in 2015 (Yi et al., 2015). The Canadian Anesthesiologist Society also released a review of the literature ranging from 2015-2018 of preventive measures for hypothermia development. Multiple studies and reviews of the literature have been concluded around the world. The overall goal is to better understand the development of hypothermia from general anesthesia and ways to form proper prevention strategies from this occurrence in the future practices.

Literature Review

A systematic review was conducted searching for updated and relevant articles. Various databases were applied to this review and comprised four categories of databases which included unfiltered databases, filtered evidence resources, guideline resources, and other anesthesia resources. The unfiltered databases were primarily used and encompassed evidence resources from CINAHL Plus, ProQuest Nursing and Allied Health, PubMed, and EmCare (OVID). Four search terms were completed in each of the databases and entered simultaneously. Table 1.1 provides search results based on subject terms and the number of articles read in the unfiltered databases with no date range applied.

Table 1.1 Unfiltered Database Results Based on Search Terms.

Search Terms	CINAHL Plus	ProQuest and Allied Health	PubMed	EmCare (Ovid)
Intraoperative hypothermia	Results: 51 Read: 5	Results: 728 Read: 2	Results: 167 Read: 4	Results: 2,000 Read: 5
Temperature monitoring and anesthesia	Results: 19 Read:2	Results: 46 Read: 2	Results: 61 Read: 2	Results: 2,700 Read: 4
Prevention of hypothermia in operating room	Results: 626 Read: 5	Results: 5 Read: 1	Results: 16 Read:1	Results: 1,000 Read: 5
Hypothermia and anesthesia	Results: 184 Read: 5	Results: 3 Read: 1	Results: 10 Read:0	Results: 150 Read: 4

The Campbell Collaboration Library from filtered evidence resources was searched for systematic reviews related to hypothermia management during general anesthesia. The database was searched twice using the search terms “intraoperative hypothermia” and “temperature monitoring AND anesthesia.” A total of eight results were located, but all eight results included therapeutic hypothermia dealing specifically with cardiac arrest and not anesthesia factors.

Next, two guideline resources were accessed and included the National Guideline Clearinghouse and National Institute of Health and Care Excellence (NICE). The search terms “intraoperative hypothermia,” and “temperature monitoring AND anesthesia” were used. While using the National Guideline Clearinghouse the first search term resulted in 700 documents, but none of the documents were related to the topic of intraoperative hypothermia. The second searched term resulted in 500 documents, one of the documents was helpful and in comparing the standards for patient monitoring during general anesthesia at Harvard Medical School (Eichhorn et al., 2000). The National Institute of Health and Care Excellence (NICE) resulted in

one helpful guideline pertaining to temperature management during anesthesia care and a pictorial pathway (NICE, 2016).

The last type of information accessed were anesthesia related resources and included the American Association of Nurse Anesthetists (AANA) and the American Society of Anesthesiologist (ASA). The AANA provided 100 articles related to hypothermia and general anesthesia factors. Three of the articles specifically related to temperature monitoring protocols and guidelines. The ASA located three helpful guidelines that included Standards of Care for Pre-Anesthesia Care, Basic Anesthesia Monitoring, and Post-Anesthesia Care (ASA, 2020). These three guidelines were defined as standard monitoring during the administration of general anesthesia (ASA, 2020).

The process of searching multiple databases for review of the literature was primarily used, but two other methods were also performed. The first method entailed researching the citations found at the end of significant articles. Overall, ten more articles were found by using this maneuver. The second method included the resources and guidance from the University of Saint Francis librarian from medical health and science references. The librarian was further able to narrow down the search history from the database of CINAHL, with including the search term of "intraoperative hypothermia NOT cardiac arrest." A total of 30 articles were retrieved with six of them related specifically to the topic of hypothermia during general anesthesia and included temperature monitoring examples.

After the searching of literature was concluded, it was important to review the highlighted articles and how each of them related to the purpose of the project. First, the title of the article was categorized as within the scope of the project. Next, the abstract was read and allowed a quick synopsis of the article and if it related to the purpose of the project. The

advanced search options that were included within the databases were publication date within the last 5 years (2015-2020), documented in the English language, and contained information related to the development of hypothermia in adult patient for general anesthesia.

Topics of Discussion

The extensive review of the literature allowed the development of four categories to evolve for the synthesis of the information. Each of these categories incorporated a level of knowledge gained to the reader. To determine the interventions that must occur to help reduce the incidence of hypothermia from general anesthesia, the following questions need to be addressed:

1. What type of national guidelines and protocols exist for temperature monitoring while in the operating room?
2. What are the risk factors that heighten the result of hypothermia from general anesthesia?
3. What are the preventative measures used for management of hypothermia development?
4. What types of temperature monitoring devices exist during a surgical procedure?

Guideline and Protocol Development

The use of a set guideline allows anesthesia care providers to decrease the effect of hypothermia occurring during the intraoperative phase. Various guidelines and protocols have been developed and it is vital that anesthesia providers are up to date with common practices to obtain the best outcomes for patients.

National Institute for Health and Care Excellence (NICE). The first guideline includes the National Institute for Health and Care Excellence (NICE, 2016). The primary role of this guideline covers preventing and managing inadvertent hypothermia in patients 18 years and

older during general anesthesia. The recommendations from the NICE are formatted in four section and include 1.1: Perioperative Care, 1.2: Preoperative Phase, 1.3: Intraoperative Phase, and 1.4: Postoperative Phase (NICE, 2016).

The perioperative care involves education to the patient's family members about how to keep their loved ones warm due to environmental changes and to voice if they feel cold at any time during their hospitalization (NICE, 2016). Expectations are also included within this section of care to help prepare the patient for the surgical procedure with general anesthesia. Lastly, understanding the locations of temperature monitoring is also discussed within the perioperative care section (NICE, 2016). The NICE explains common sites of temperature readings include pulmonary artery catheter, distal esophagus, urinary bladder, sublingual, axilla, skin, and rectum.

The preoperative phase per the NICE is defined as one hour before the induction of anesthesia (NICE, 2016). Each patient needs to be addressed with any possible risk factors that may cause adverse consequences before transfer to the surgical suite; the American Society of Anesthesiologist (ASA) physical status grade II to V equals a greater risk of complications (ASA, 2020). NICE also recommends that active warming to be started in the preoperative phase if the patient's temperature is below 36 degrees Celsius (NICE, 2016).

The next phase discussed within the NICE guidelines includes the intraoperative phase. NICE defines the intraoperative phase as the total anesthesia time ranging from the first anesthetic intervention to recovery in the post-anesthesia care unit (PACU) (NICE, 216).
Per the NICE guideline, 1.3 Intraoperative phase:

- 1.3.1: The patient's temperature should be measured and documented before induction of anesthesia and continued every 30 minutes until the completion of the surgery (NICE, 2016).

- 1.3.2: Standard critical incident reporting should be considered for any patient with a temperature below 36 degrees Celsius arriving in the PACU (NICE, 2016).
- 1.3.3: Induction of anesthesia should not begin until patient's temperature is 36 degrees Celsius or above (NICE, 2016).
- 1.3.4: The ambient temperature should be at least 21 degrees Celsius while the patient is exposed within the operating room (NICE, 2016).
- 1.3.5: All patients must be adequately covered throughout the intraoperative phase to conserve heat and energy (NICE, 2016).
- 1.3.6: Intravenous fluids (>500ml) and blood products should be warmed to 37 degrees Celsius using a warming device (NICE, 2016).
- 1.3.7: Forced-air warming devices are used when an anesthetic case lasts longer than 30 minutes or patients are at a heightened risk of inadvertent perioperative hypothermia (NICE, 2016).
- 1.3.8: The temperature set on the forced-air warming devices should be set at the maximum heat and then adjusted to maintain the temperature of at least 36.5 degrees Celsius (NICE, 2016).

The final phase of the NICE guideline is the postoperative phase and is defined as the 24-hour mark after the patient has entered the post-anesthesia recovery unit (PACU). During the postoperative phase, the patient's temperature should be measured and documented once admitted into the PACU and then following every 15 minutes (NICE, 2016). If the patient's temperature is below 36 degrees Celsius, the patient needs to be actively warmed using forced-air warming devices. Overall, patients should be kept warm and provided with proper warming

devices during the recovery phase. The NICE outlines all four stages of surgery in an organized fashion for the anesthesia provider to follow and properly addresses safe temperature values.

American Society of Anesthesiologist (ASA). Standards for basic anesthetic monitoring from the ASA can be categorized into Standard I and Standard II. The American Society of Anesthesiologist (ASA) standards apply to all anesthesia care, but if an emergent situation occurs appropriate life support takes precedence (ASA, 2020). It is also important to note that the ASA standards of care do not relate to laboring obstetrical patients or pain management situations. Standard I outline that a qualified anesthesia provider must be present in the room throughout the entire general anesthetic case, as rapid changes within a case may arise (ASA, 2015).

Standard II outlines that during all anesthetics the patient's circulation, oxygenation, ventilation, and temperature should be continually assessed (ASA, 2015). The patient's body temperature management per the ASA Standard II is outlined as the following:

- 5.1 Objective: To aid in the maintenance of appropriate body temperature during all anesthetics (ASA, 2015).
- 5.2 Methods: Every patient receiving anesthesia must have temperature monitored when clinically significant changes in the body temperature are suspected, intended, or anticipated (ASA, 2015).

One primary limitation to the ASA Guideline is the result of not including a specific temperature range or value, as the NICE Guidelines include multiple ranges and values of temperature ranges throughout their guideline. Anesthesia providers may understand the importance of maintaining an appropriate body temperature, but the definition of an "appropriate body temperature" may vary from one provider to the next. The specific nature and detail of a

guideline does not allow the anesthesia provider to guess what the best practice entails, but clearly identifies best practice with examples.

Association of Perioperative Registered Nurses (AORN). The AORN Guidelines Advisory Board approved the Prevention of Hypothermia Guideline to represent what is held as the optimal level of practice for anesthesia care providers (AORN, 2017). In previous studies, hypothermia was defined as a core body temperature less than 36 degrees Celsius (AORN, 2018). Within the updated AORN guideline, the definition of hypothermia is further divided into three sub-categories of mild 32 degrees – 35.9 degrees Celsius, moderate 28.1 degrees – 31.9 degrees Celsius, and severe less than 28 degrees Celsius. One of the goals within the AORN guideline of Prevention of Hypothermia is achieving a body temperature of at least 36.9 degrees Celsius upon entering the post-anesthesia care unit (AORN, 2017). When the patient's temperature is below 36.9 degrees Celsius, the patient is at an increased risk of unplanned myocardial events, wound infections, postoperative pain, increased blood loss, and decreased drug metabolism (AORN, 2017). The prevention of a severe hypothermia occurrence is one of the main safety-patient concerns for anesthesia providers (Bashaw, 2016). Lastly, the patient's length of stay may be prolonged due to these adverse side effects due to hypothermia.

Risk Factors for Hypothermia Development

Within the first hour of induction from general anesthesia, there is a rapid decrease of the patient's core-body temperature. The core temperature drops due to the redistribution of heat within the body from the core towards the peripheral thermal compartments (Macario & Dexter, 2002). Currently, there are no algorithms in place to help anesthesia care providers determine the appropriate warming measures for every patient, however common risk factors have been identified for an increase development of intraoperative hypothermia occurrence.

Multiple Risk Factors. Common risk factors that were included in various literature reviews encompassed the age of the patient, the American Society Anesthesiologist (ASA) physical classification, and pre-existing conditions that impair thermoregulation such as diabetes mellitus, polyneuropathy, and hypothyroidism (Macario & Dexter, 2002; Torossian et al., 2015; Yi et al., 2015). The age of the participants within one literature review addressed the exact age of 60 years and over as the primary risk factor for the development of intraoperative hypothermia, as other reviews only mentioned the term of advanced age or older adults (Torossian et al., 2015). The American Society of Anesthesiologist (ASA) physical classification was further defined within one review of the literature as a positive correlation with ASA physical status 2 or greater for hypothermia development post-operatively (Yi et al., 2015). Per the ASA, physical status of 2 results in a patient with mild systemic disease, well-controlled disease of one body system, and no functional limitations. (ASA, 2020). The ASA physical status classification allows a quick overview for risks that may develop throughout a surgical procedure.

Body Mass Index (BMI) Score. Another review of the literature focused primarily on the weight of the patient and compared core-body temperatures in obese and non-obese patients (Fernandes et al., 2012). The classification of body mass index was used to classify three levels: Grade 1 BMI 30-34.9, Grade 2 BMI 35.0-39.9, and Grade 3 BMI morbid obesity >40.0. The review included two groups of females (total 22 participants), non-obese, and obese with the result of having open-abdominal surgery and accessing for the incidence of intraoperative hypothermia. Within the review of literature, it was stated that obese patients are more likely to vasoconstrict in cooler environments and have reduced heat redistribution from core to peripheral tissues (Fernandes et al., 2012). The results of the study concluded the core

temperature data was significantly lower in the non-obese group (60%) compared to the obese group (10%) (Fernandes et al, 2012, p. 1365-1367). Overall, it was concluded that obese individuals and non-obese individuals vary significantly with the risk of developing hypothermia throughout the intraoperative phase.

Intensive Care Unit Time Frame. In addition to looking at the patient's age, weight, and the physical status per the ASA classification, the patient's length of stay within an intensive care unit was also reviewed due to hypothermia, specifically with open-abdominal procedures (Akers et al., 2019; Yang et al., 2015). One review of the literature found that when body temperatures ranged between 35.5 degrees – 36.9 degrees Celsius, there was a 31% decrease of time spent within the intensive care unit post-operatively (Akers et al. 2019). A negative correlation occurred between the length of the stay in the ICU and the overall body temperature in the post general anesthesia administration (Yang et al., 2015).

Preventative Measures

The consequences from the development of hypothermia during general anesthesia have been recognized and with new technology the process of warming equipment was designed with increased improvements overtime. Currently, multiple temperature conservation and warming devices exist to help maintain or raise body temperature. These consist of forced-air warming devices, passive insulation, circulating water mattresses, resistive heating blankets, intravenous fluid warmers, and cotton blankets (Bonner & Barth, 2015; Chan & Venus, 2016; John et al., 2014; Lau et al., 2018; Moola & Lockwood, 2018; Nieh & Su, 2016). When a variety of warming devices are manufactured, it is important to understand which device is the most effective in the prevention of hypothermia in patients undergoing general anesthesia, but also cost effective for the providers and the healthcare facilities.

Types of Warming Devices. Throughout two literature reviews multiple types of warming devices were explained and categorized into two main types of intravenous fluid warmers and body warming devices (John et al., 2014; Nieh & Su, 2016). Classifications of the warming devices are included in Table 1.2.

Table 1.2 Classification of Warming Devices.

Intravenous Fluid Warmers	- Heated block warming system -Heated cylinder warming system -Insulated intravenous tubing -Convective warming system
Body Warming Devices	-Forced-air warmer -Circulating water garments -Resistive heating blankets -Passive insulation -Water filled mattress -Radiant warming systems

The most commonly tested body warming modality was the forced-air warmers, specifically the Bair Hugger. The Bair Hugger device was associated with significantly higher postoperative core temperatures ($p<0.01$) (Nieh & Su, 2016). Within the discussion, it was also found that there was no significant difference between forced-air warmers used for the top half of the body versus the lower half of body coverage (Nieh & Su, 2016). The use of forced-air warming devices in limiting hypothermia is not only through heat transfer but also by preventing radiant and convection heat loss from the patient's exposed skin (John et al., 2014).

In the literature, categories of warming techniques for body temperatures post-operativity resulted in forced air warming, passive warming, circulating water mattress, and no form of warming (Costanzo et al., 2013; Hart et al., 2011; Moola & Lockwood, 2010; Nieh & Su, 2016). Forced air warming was more effective than passive warming, circulating water mattress, and no form of warming (Hart et al., 2011; Moola & Lockwood, 2010). However, Nieh & Su (2016) found no statistically significant difference between forced air warming, radiant

warming systems, resistive heating blankets, and circulating water garments (P=0.369). In addition to existing systematic reviews, it was found that forced air warming devices result in the highest core body temperature post-operatively (Moola & Lockwood 2015; Proveda, Clarke, & Galvao, 2012). The documentation and measurement of the body temperature during the first hour of induction is also a critical factor to consider when evaluating the development of hypothermia (Chan & Venus, 2016). Multiple warming methods exist, and identification of the best practice is vital for anesthesia providers to provide the highest quality of care.

Limitations discussed include the topic of increased risk of infection from forced air warmers, as it disrupts laminar flow was also reviewed for prevention of hypothermia (Bonner & Barth, 2015). An increase of microbial particles may be exposed to the surgical incision, but it is difficult to identify the cause of a surgical site infection due to the multiple variables (Bonner & Barth, 2015). Other limitations were also found from the forced air warming in another literature review. Examples included the expense of the disposable blankets for every patient, the increased heat for the surgical staff when in close proximity to the device, and again the potential contamination of the surgical field from the hose and blower on the machine (Bair Hugger) with a possible risk of infections (Brandt et al., 2015).

Pre-warming Method. Pre-warming methods were the primary focus in prevention for hypothermia with short-interruption times in various reviews of the literature (Grote et al., 2019; Horn et al., 2012; Lau et al., 2018). The actual timing of active pre-warming with forced air is critical in the results of hypothermia (Grote et al., 2019). One systematic review discussed the difference of hypothermia occurrence specifically in the post-recovery unit with pre-warming methods. The results concluded in 50% of patients with no warming were hypothermic, while

only 12% of patients in the recovery unit were hypothermic with warming methods applied (Hooven, 2014).

Another systematic review looked at three intervals of prewarming within the general ward of 10, 20, and 30 minutes and found no significant difference between the time frames with reducing hypothermia ($p = 0.54$) (Horn et al., 2012). However, it was found that patients within the non-pre-warmed group, declined more than with the pre-warmed groups despite active warming during the induction of anesthesia. Overall, the use of 10 minutes of pre-warming was sufficient in preventing hypothermia.

Interruption Times. Grote et al., (2019) found patients exposed to cold environments such as the operating room after pre-warming in the general wards resulted in higher hypothermia rates between 24-42%. In comparison, when pre-warming was applied directly before induction of anesthesia, lower intraoperative hypothermia rates of 15.8% were achieved (Grote et al., 2019). The possible conclusion of this result could be the long interruption time from the end of pre-warming to the beginning of the intraoperative warming; ultimately reducing the effect of pre-warming as if the pre-warming method were never applied. The results of this study concluded a negative correlation was found between increased warming interruption time and lowest intra-operative core body temperature (Grote et al., 2019). Patients with forced-air warming interruptions less than 20 minutes showed significant lower intraoperative hypothermia rates compared to interruptions greater than 20 minutes (Grote et al., 2019). It is evident that pre-warming can help decrease the effect of intraoperative hypothermia, but the interruption time from ending pre-warming and beginning warming the patient within the operating room is also an important factor to add to the equation for prevention of hypothermia development.

Types of Temperature Monitoring

Temperature monitoring during a surgical procedure is outlined within Standard II per the American Society of Anesthesiologist (ASA) for all anesthesia providers (ASA, 2020). It is vital that clinicians have a proper understanding of the various temperature monitoring sites and devices, the effects from hypothermia, and even the direct indications for the use of therapeutic hypothermia (Sappenfield, Hong, & Galvagno, 2013).

Core Temperature Monitoring. Core body temperature is the single best indicator of thermal status in patients (Erdling, & Johansson, 2015; Scott et al., 2015; Sessler, 2008). Examples of common core temperature monitoring include tympanic membrane, pulmonary artery, distal esophagus, and nasopharynx. Most core temperature devices are easily located in healthcare facilities, but not all of measurement sites are completely noninvasive as some measurements may produce unwelcome side effects (Sessler, 2008). The use of an esophageal stethoscope can also be used to measure core temperature, but the probe must be positioned at the point of maximal heart sounds to provide accurate readings (Freund & Brengelmann, 2002). Nasopharyngeal probes should be inserted at least five to six centimeters past the nares to obtain core temperature (Lim et al., 2016). Nasopharyngeal probes are only accurate if the patient is not breathing throughout their nostrils, as increased airflow can deter an accurate temperature reading (Erdling & Johansson, 2015). Body temperature should be monitored in patients undergoing general anesthesia that exceed 30 minutes and in surgeries lasting longer than one hour (Scot et al., 2015). Temperature devices that are parallel with core temperature readings help prevent the severe development of hypothermia in patients undergoing general anesthesia.

Nasopharynx and Esophageal Temperature Monitoring. Although the measurement of core body temperature can be achieved by various measurements, two literature reviews examined esophageal and nasopharyngeal temperatures in a randomized clinical trial (Duggappa

et al., 2018; Erdling & Johansson, 2015). When the nasopharyngeal temperature probe was inserted with guidance by a fiberscope and measured specifically at the fossa of Rosenmuller, there was no significant difference found between the temperature readings of esophageal and nasopharynx (Duggappa et al., 2018).

Erdling and Johansson (2015) focused on a numerical value for insertion for each of the probes to follow in a specific manner. The nasopharyngeal probe was inserted six to eight centimeters beyond one of the nostrils using the patient's nose-to-ear distance. The esophageal probe was inserted post-intubation with a distance of 40 +/- 3 centimeters from the nostrils using the Mekjavic-Rempel formula (Erdling & Johansson, 2015). The results concluded the temperatures in the esophagus and nasopharynx groups showed significant mean difference of 0.2 degrees Celsius throughout the entire 210-minute procedures. The esophageal temperature declined at the 30- and 60-minute mark post-surgical start, whereas no drop-in temperature was noted from nasopharyngeal temperatures (Erdling & Johansson, 2015). Higher temperature values in the nasopharyngeal readings were found during the surgery and exceeded the average temperatures in the esophagus. Overall, the review of literature concluded that both temperature monitoring devices can measure core body temperature, but the esophageal measurement may indicate a higher accuracy rate to core body temperature.

Depth of Temperature Measurement Probe. Other studies have focused solely on nasopharyngeal temperature probes and the depth of placement within the nose (Jeongwoo et al., 2014; Lim et al., 2016; Wang et al., 2016). The depth of insertion influences the accuracy of the probe, as measurements near the nares can be cooled by the ambient air or if the probe is inserted too deep the reading can be altered by the ventilation gases and be cooled as well (Wang et al., 2016). Three nasal temperature locations were recorded within the nasal cavity, upper portion of

nasopharynx, and oropharynx and all locations were compared to temperatures within the esophageal probe readings (Lim et al., 2016). Lim et al. (2016) concluded that the most accurate position of the nasopharyngeal temperature probe is the upper portion of the nasopharynx approximately 10 centimeters. The location for the probe within the upper nasopharynx was found to closely resembled the esophageal readings.

Another review of the literature concluded the use of a deeper insertion of the nasopharyngeal probe ranging from 10-20 centimeters as the most accurate reading to represent core body temperature and similar to the esophageal probe readings (Wang et al., 2016). Complications are also vital to include, as temperature probes and monitoring are not entirely noninvasive (Dabbous, El- Ghoul, & Ibrahim, 2018; Kuwahara, Takahashi, & Takahashi, 2015). The process of inserting an esophageal probe can result in misplacement into the tracheobronchial tree during a lung lobectomy surgery (Dabbous et al., 2018).

Practice Recommendations

After review of the literature pertaining to hypothermia guidelines and temperature monitoring devices, the follow practice recommendations are encouraged.

1. Locate the guidelines and protocols for the anesthesia providers to follow. Most common guidelines are formed from the National Institute for Health and Care Excellence (NICE) or the American Society of Anesthesiologist (ASA).
    a. Guidelines provide an up-to-date format of the best evidence-based research for patient care and outcomes.
    b. NICE provides detailed temperature ranges and examples of devices for prevention of hypothermia.
2. Healthcare providers need to be vigilant in identifying increased risk factors for hypothermia to occur from general anesthesia.

   a. Risk factors include advanced age of the patient, weight, pre-existing complications that impair thermoregulation such as diabetes or polyneuropathy, poor nutritional intake, and the length of the surgery.

3. Proper education and training on warming devices and temperature monitoring devices. Most commonly used warming device: forced air warmers.
   a. Understanding when to apply pre-warming devices.
   b. Decreasing the time frame between the preoperative phase of warming to the induction of anesthesia (<20 minutes).
   c. Education with proper insertion depth of core body temperature probes.
      i. Nasopharyngeal (10-20 cm) and esophageal core body temperatures used as best practice.

Summary of Supporting Evidence

The measurement of body temperature is a standard of care during general anesthesia cases. According to the American Society of Anesthesiologist (2015), "Standard II, during all anesthetics the patient's circulation, ventilation, oxygenation, and body temperature should be continuously evaluated" (p. 4). The percentage of patients that undergo elective surgery that result in hypothermia range from an astonishing 25-90% with a core body temperature below 36 degrees Celsius (Torossian et al., 2015). Healthcare providers need to be vigilant in identifying increased risk factors for hypothermia to occur from general anesthesia and understanding the standards of care for providing a safe anesthetic.

Identification of risk factors in a timely manner allows all healthcare providers to be prepared with extra equipment or supplies needed for an individual. In the prevention of adverse effects there are various modes of heating devices that are available. These devices should be used by the anesthesia care provider during the intraoperative phase for prevention of severe

hypothermia (Macario & Dexter, 2002). Assessment of the patient's physiologic vitals and making sure the proper temperature monitoring is working appropriately is critical (Sessler, 2013). Current guidelines must be updated and followed by all anesthesia providers to provide the highest quality of care to patients throughout the intraoperative phase.

Chapter 3: Project Design

Methodology

Project Design

The project was a Quality Improvement (QI) Project and also utilized a comparative descriptive project design. The process of a QI project allows for evaluation, activities to monitor, and provides ways for improvement of quality within a healthcare system process (Rouen, 2017, p. 157). Comparative descriptive design allows the comparison of the variables before and after. This process looks for changes in the products, protocols, or utilization and how the results correlate to one another (Sutherland, 2017, p. 204). The approach for the project manager's DNP project included enhancing the educational awareness and implementation of Hospital (EGH) for the anesthesia providers.

Ethical Considerations

Ethical considerations were reflected upon throughout the creation of this project. This project was approved by University of Saint Francis, Institutional Review Board on October 12, 2020. Support for the project was also provided by Beacon Health System, Elkhart General Hospital and Nurse Anesthesia Program (Appendix A).

The anesthesia providers did not have to answer any question they did not want to answer and could choose not to participate within the doctoral project. To ensure the highest of ethical quality, the project manager completed the Collaborative Institutional Training Initiative (CITI) program (Appendix E). Full disclosure was given to the anesthesia provider participants located at EGH for the purpose of the project. Electronical informed consent was obtained from the anesthesia provider participants prior to the start of the completion of the assigned Pre-Test. Next, the anesthesia providers were directed to complete and view the educational PowerPoint presentation. The educational intervention was completely voluntary for the anesthesia providers.

The anesthesia providers could choose to not take part or exit the online documents at any point. No compensation was awarded to the anesthesia providers for participating in the educational intervention via online.

Pre-Test and Post-Test data were kept confidential. Pre-Test and Post-Tests were administered via the software tool Microsoft Forms, allowing the anesthesia providers to utilize their personal or work computer devices. The Pre-Test and Post-Test data in Microsoft Forms was only accessible by the project manager.

Microsoft Forms guarantees confidentiality by allowing the creator to collect anonymous responses and the ability to not collect IP addresses throughout the process. Microsoft Forms software tool complies with two applicable laws and regulations which include the General Data Protection Regulation (GDPR) and Health Insurance Portability and Accountability Act (HIPAA).

Project Schedule

As stated in Chapter One, the project evolved over a period of one year from August 2020 to August 2021. Further refinement of the Pre-Test, Post-Test, and Likert Scale Post survey questions occurred throughout the Fall 2020 semester. These components were finalized by the end of the Fall 2020 semester to be incorporated into the software tool Microsoft Forms in time for the online distribution for all of the doctoral documents (informed consent, Pre/Post Test, educational PowerPoint presentation, and Likert Scale Post Survey) on November 30, 2020.

The objectives and content of the PowerPoint presentation presented by the project manager were discussed with nurse anesthesia faculty and chief anesthesiologist located at EGH. These discussions ensured that necessary content was covered, as key stakeholders have

differing knowledge bases and views that add depth and breadth to the subject of intraoperative hypothermia prevention and temperature monitoring for anesthesia providers.

Data collection for the retrospective chart audit was completed on February 17, 2020 located at EGH Elkhart, Indiana with the use of the patient's paper medical chart. The educational intervention was scheduled to be sent out to all anesthesia providers that met the inclusion criteria located at EGH on November 30, 2020. The setting for data collection varied from each anesthesia provider as the documents were completed online throughout their personal or work email addresses. The emailed educational intervention was scheduled to be open for a two-week time period, this allowed adequate time for the anesthesia providers in completion of the doctoral documents. Data collection for the prospective chart audit was completed at least one-month (30 days) post closure of the online Pre/Post Test February 20th, 2021 and the setting/location was EGH Elkhart, Indiana.

Implementation Methods

Intervention Plan

This scholarly project was approved for implementation by the DNP faculty (Appendix J). Implementation occurred during November 30, 2020-December 21, 2020 and included the doctoral documents: Informed Consent, Pre-Test, PowerPoint Intervention, Post-Test, and Likert Scale Survey to be emailed to all participating anesthesia providers. Anesthesia providers were required to complete the Pre-Test prior to the educational PowerPoint intervention. The Pre-Test was completed anonymously with the use of Microsoft Forms, an online survey tool. The educational intervention began with a PowerPoint presentation by the DNP project manager. Following the PowerPoint presentation, the anesthesia providers were then required to complete the Post-Test and Likert Scale Post Survey (both included on Microsoft Forms).

Educational Teaching Plan

The educational PowerPoint intervention was presented and narrated by the project manager (Appendix K). The following educational intervention learning objectives were centered around knowledge and awareness pertaining to intraoperative hypothermia prevention and temperature guideline education in anesthesia providers. At the completion of the educational intervention the anesthesia providers were able to:

1. Identify the incidence of unplanned perioperative hypothermia.
2. Describe how body temperature is regulated.
3. Discuss core body temperature measurement.
4. Discuss causes of unplanned perioperative hypothermia.
5. Describe the effects of unplanned perioperative hypothermia.
6. Identify thermoregulation measures that healthcare providers can use.
7. Plan of implementation for temperature guideline development.

The 30-minute PowerPoint presentation included multiple visual aids to help keep the anesthesia providers engaged in their learning. The effectiveness and outcome of this educational PowerPoint intervention was assessed by the Pre-Test and Post-Test scores, as well as the Likert Scale Post Survey results.

Measures, Tools, and Instruments

The development of two aims were constructed with two outcomes per aim to help enable measurable results for the DNP project. The first aim for the development of the Quality Improvement Project entailed an increase knowledge among anesthesia providers regarding temperature monitoring during general anesthesia for the prevention of hypothermia. Two outcomes were achieved, the first outcome encompassed the baseline knowledge of hypothermia

prevention measures in anesthesia providers, as measured by a Pre-Test to indicate that 65% percent of anesthesia providers had scores below 60%. The Post-Test administered after the educational intervention exhibited a 15% higher score than Pre-Test scores in 75% of anesthesia providers. The second outcome related to the first aim was an increase of knowledge for the factors that contribute to unplanned perioperative hypothermia. The overall goal for a total increase of mean scores was by 10%. This outcome looked specifically at question number 14 on the Pre-Test and question number 7 on the Post-Test (same question), as this included a multi-level/case study scenario question and answer.

The second aim that was developed focused on improving the anesthesia providers likelihood of implementing updated techniques and patient outcomes in prevention of hypothermia development. Two outcomes were also included for the second aim. The first outcome focused on the quantitative data from the Likert Scale Survey and how it demonstrated the anesthesia provider's ability to understand the various guidelines for hypothermia and possible plan to use these techniques in future practice. The second and last outcome concentrated on the completion of the retrospective and prospective chart audit and demonstrated a decrease of prevalence by 10% of hypothermia in all adult patients having general anesthesia at EGH.

Permission was granted to use and adapt the Pre-Test and Post -Test questions provided by AORN, John Wiley and Sons on July 27, 2020 (Appendix L). Instruments used for this educational intervention included a Pre-Test Examination and Learner Evaluation comprised of seven demographic questions and ten multiple choice quiz questions. The Post-Test excluded the demographic questions and included the same ten multiple choice quiz questions from the Pre-Test. The Pre-Test and Post-Test questions were adapted from AORN, John Wiley and Sons

Examination and Learner Evaluation Questions. The Likert Scale Post Survey consisted of four Likert-scale questions and sections for comments formulated and developed by the project manager. The Pre-Tests and Post-Tests that were utilized were short multiple-choice question (some with multiple answers) based on evaluating the anesthesia providers baseline knowledge and awareness gained post educational PowerPoint intervention. The Pre-Test and Post-Test questions were originally developed from the AORN Examination and Learner Evaluation Continuing Education Questions (Appendix M). The Pre-Test and Post-Test created by AORN were aimed at certified registered nurse anesthetists (CRNAs), perioperative nurses, and other surgical providers. The Pre and Post Test questions were adapted for EGH's anesthesia providers by omitting specific questions, the use of rewording questions was utilized, and the addition of questions that specifically pertained to the anesthesia providers with the use of a case study scenario question. The Likert Scale Post Survey Questions were designed and developed by the project manager to gain awareness level data of the anesthesia providers.

To ensure confidentiality of storing primary and secondary data with maximum level of safety and security was utilized on the project manager's password-protected network drive for all completed doctoral documents. The data was backed up regularly, as this ensured minimal risk of data loss and confidentiality breach. All data was deidentified, as no names or level of identifications was used throughout the data collection and data storage process. Microsoft Forms software program was also utilized for collection of the primary data. Microsoft Forms complies with strict requirements with applicable laws and regulations with following HIPPA requirements in the use of collecting, storing, handling, and sharing confidential health documents. Microsoft Forms also carefully selects providers that adhere to the best practices and

security within the technical support system. The entirety of the data was only shared with the project manager for review and ensured complete confidentiality.

Evaluation Plan

Measures and Data Sources

The population targeted for this educational intervention included approximately 24 anesthesia providers. Anesthesia provider demographic variables collected included Age (Scale), Gender (Dichotomous), Living State, Education, Occupation (Nominal), Years of Practicing Anesthesia (Scale), and Employment Status (Nominal). These variables were collected as aggregate Pre-Test demographics. Primary Data Collection consisted of the Pre/Post Test, Likert Scale Survey, and chart audit collection. A comparative descriptive design was utilized for the retrospective (pre) and prospective (post) chart audit completed at EGH (Sutherland, 2017, p. 204). Pre/Post Test comparison of the results were applied for the project design. Ten questions were used to assess the anesthesia providers knowledge on the topic of hypothermia. Adapted questions from AORN continuing education site were utilized. The Pre-Test included demographic data (7 questions) to be collected. Pre-Test included a total of 17 questions (7 from demographic section) for anesthesia providers to answer from the adaption of the AORN reference. The Post-Test encompassed a total of 10 questions to be collected, as the demographic questions were omitted.

Methods for Collection of Data

Pre/Post Tests and Likert Scale Survey. Microsoft Forms was used to collect data for the statistical tests. Anesthesia providers were emailed the PowerPoint presentation with a link to take the Pre-Test prior to the PowerPoint presentation and instructed to take the Post-Test immediately following the PowerPoint presentation. (Sutherland, 2017, p. 232). Pre/Post Test

comparison (AORN Evaluation Questions) allowed for measurable outcomes of knowledge and awareness of information obtained from the educational PowerPoint presentation. It was important to include the same questions on both tests, as this allowed for measurable results of knowledge gained. Data collection within a Quality Improvement project entails the use of check sheets, surveys, cause-and-effect diagrams and are important throughout the development of the project (Rouen, 2017, p. 159). The data collection of the project manager included the format of a Pre-Test, educational presentation PowerPoint format, and Post-Test evaluation. Likert Scale Post-survey was also applied to collect quantitative data rating if anesthesia providers agree or disagree to update their practice for temperature monitoring and prevention of hypothermia (agree, neutral, disagree, etc.). The use of a Likert Scale was applied for the collection of quantitative date. No qualitative data was collected for this doctoral project.

The event was the educational PowerPoint intervention for anesthesia providers located at EGH. Variables collected at the educational intervention included baseline knowledge, awareness, knowledge gained, and feedback/comments provided by the anesthesia providers. Baseline knowledge data was collected as Pre-Test prior to the educational presentation intervention. The mean percentage scores of the Pre-Test were collected, these scores were based on the number of questions answered correctly by the providers. Awareness level was collected as Likert Scale Post Quantitative Surveys and were filled out by the anesthesia providers once the Post-Test was completed. The mean percentage from Post-Test scores was compared to the mean percentage scores of the Pre-Test scores. The educational intervention was determined effective if there was at least a 15 percent increase in the mean percentage between the two total tests scores.

Chart Audit Collection. Chart audit collection for the retrospective chart audit was completed at EGH. Two data points were completed with 100 charts collected and audited on February 17, 2020, as the second data point was completed for the prospective chart audit with 100 charts collected and at least one-month post implementation of Pre/Post Test February 20th, 2021 and intervention of educational PowerPoint presentation. Paper/electronic medical health records are performed at EGH through the software program Cerner for charting purposes, but the anesthesia records are recorded through paper charting and then professionally scanned into the Cerner program for patient data collection. Retrospective chart audit variables were obtained on February 17, 2020. The demographic variables consisted of: Age (scale) and Gender (scale). The variables used to collect data and measure/event specific included: Date (nominal), Surgery Type (nominal), Length of Surgery (scale), Temperature Monitoring Documented (nominal), Temperature Range (scale), Prevention Measures Used (nominal), Temperature in PACU Range (nominal), and Temperature PACU Value (scale). The project manager was responsible for collecting, checking, and storing all data related to the informed consent, Pre-Test, Post-Test, Likert Scale Quantitative Survey, and paper chart data for retrospective/prospective chart audit.

Data Analysis Plan

Baseline scores were compared to Post-Test scores to evaluate the effectiveness of the educational PowerPoint intervention in terms of knowledge gained in the anesthesia providers. There should be an increase of correct answers on the Post-Test of at least 15 percent. The overall goal for the anesthesia providers was to have an increase of knowledge gained and awareness concluding the completion of the intervention PowerPoint presentation.

The Microsoft Forms software program was also utilized for collection of the primary data and data analysis during the Pre/Post-Test result. All data was only shared with project

manager for review up to one year from completion of implementation, March 2022. Maximum level of safety and security was utilized on a password-protected network drive. The data was also backed up regularly, as this ensured minimal risk of data loss and confidentiality breach. All data was deidentified, as no names or level of identifications was used throughout the data collection and data storage process.

Dissemination Plan

After the educational intervention was completed and the tests results were completely analyzed, a formal presentation took place to disseminate in June 2021 the outcomes for the anesthesia providers located at EGH, along with disclosure of the feedback to the NAP faculty, DNP faculty, and NAP cohorts. No manipulation was used throughout the doctoral project, as implementation pertained to a Quality Improvement Project and was not an experimental project.

Evaluation of the data outcomes provides important information for other stakeholders and it is imperative that data collected be shared with the constituents (Titler et al., 2001). Continuation of the doctoral project can also be accomplished through future educational clinical conferences, DNP projects, and adoption of the presented material by other healthcare members for best practice guidelines. It was critical that the data collected to be shared to allow for prospective improvements of the prevention of intraoperative hypothermia development and increased knowledge within anesthesia providers in future practices.

Chapter 4: Results and Outcomes Analysis

Data Collection Techniques

Data for the scholarly project was collected via Microsoft Forms in an electronic format. A total of 18 CRNAs and 6 anesthesiologists were included within the implementation of the project with a grand total of 24 anesthesia providers. The anesthesia providers were emailed the educational PowerPoint presentation with the required links to take the Pre-Test, Post-Test, and Post-Qualitative Likert Scale Survey. The Pre-Test was required to be completed first to assess the anesthesia provider's overall baseline knowledge and understanding of the topic pertaining to the prevention of hypothermia. Once the Pre-Test was completed, then the providers were asked to review the educational PowerPoint Presentation. After reviewing the PowerPoint Presentation, the anesthesia providers completed the Post-Test and Post-Qualitative Likert Scale Survey. All required documents were submitted in the electronic format of Microsoft Forms. No incentive was given to the anesthesia providers to complete the Pre-Test, Post-Test, or the Post-Qualitative Likert Scale Survey.

According to the Microsoft Forms timeline, the Pre-Test, Post-Test, and Likert Scale Survey was taken between the days of December 4th, 2020 and December 20th, 2020, as the implementation phase for the completion of the documents was over a three-week time period (November 30th, 2020-Decemeber 21st, 2020). There were 13 participants for the Pre-Test, and 15 participants for the Post-Test and Likert Scale Survey. The Pre-Test, Post-Test, and Likert Scale Qualitative Survey were completed between the hours of 0800 and 2100, with an average response time of three minutes and thirty-four seconds for the Pre-Test, two minutes and six seconds for the Post-Test, and thirty seconds for the Likert Scale Survey. After implementation, a total of 13/24 (54%) anesthesia providers participated within the doctoral project for the Pre-

Test, Post-Test, and Likert Scale Survey. Once completed, the data from Microsoft Forms was exported into IBM's SPSS Statistics 27 for further data analysis.

The anesthesia provider's demographic variables collected included Age, Gender, Living State, Education, Occupation, Years of Practicing Anesthesia, and Employment Status (Appendix N). These variables were collected as aggregate Pre-Test demographics. Ages of the anesthesia providers ranged from 21 years old to 49 years old (Figure 1.1). The average age range of the anesthesia providers were 30-39 years old (77%). Male anesthesia providers were the primary gender that participated within project with 11/13 (85%) and 2/13 (15%) were females. All of the anesthesia providers were residents within the state of Indiana 13/13 (100%). The highest level of education among the anesthesia providers was a doctorate (15%), as the majority of the providers had completed a master's degree (85%).

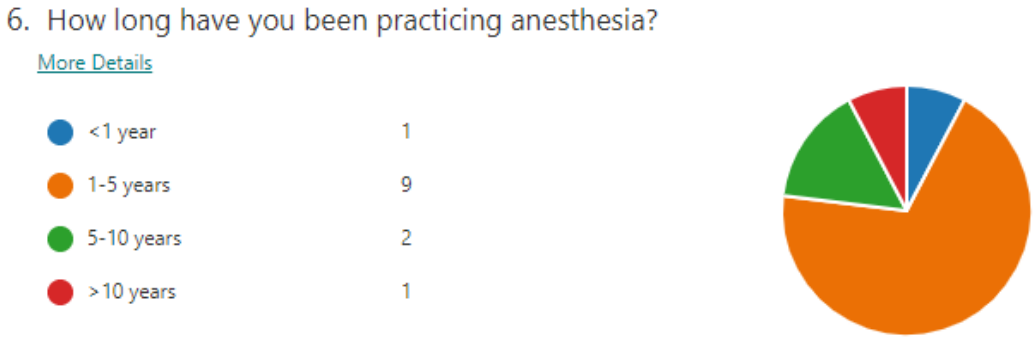
After reviewing the completed section of the demographic survey within the Pre-Test it was clear that the 13 participants (100%) only consisted of certified registered nurse anesthetists (CRNAs). No anesthesiologists completed the required documents, as 6/24 providers were anesthesiologists. The number of years practicing anesthesia ranged from less than one year to greater than ten years. The average amount of anesthesia practice was one to five years (69%) (Figure 1.2). The last question within the demographic section was employment status at EGH. Almost all of the anesthesia providers selected full-time (92%) with one person as PRN status (8%).

Figure 1.1

Microsoft Forms Pre-Test: Question 1

Figure 1.2

Microsoft Forms Pre-Test: Question 6



Measures/Indicators

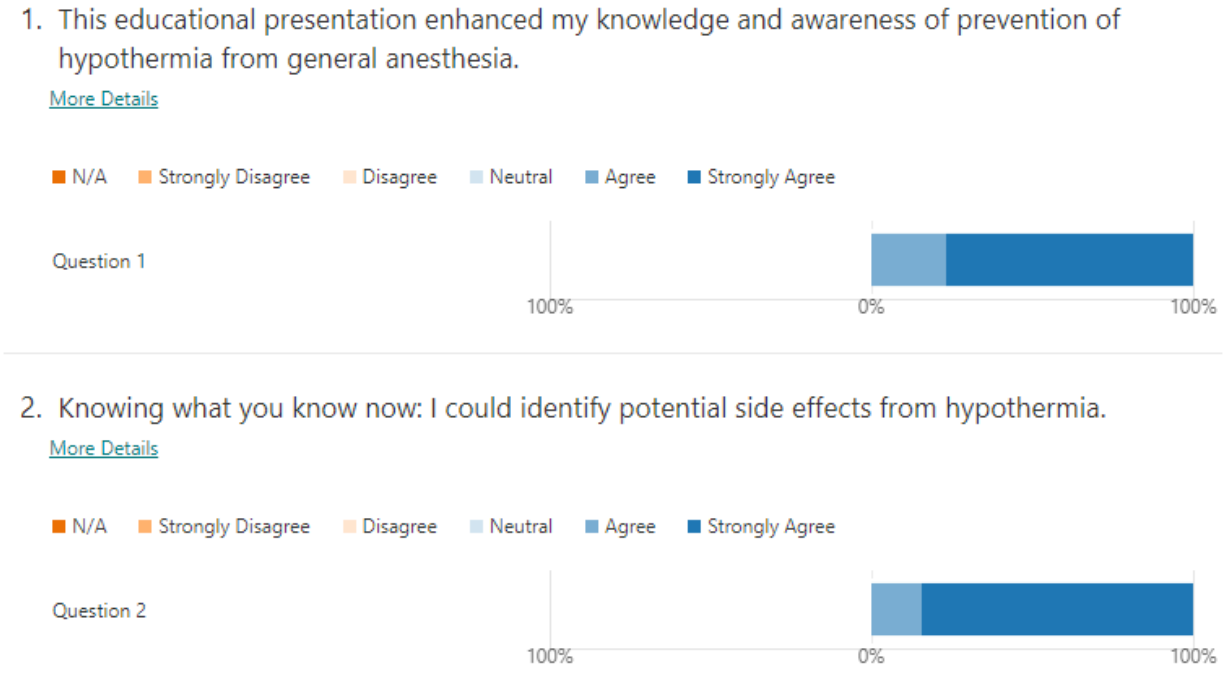
The scholarly project presentation was evaluated based on the ability to achieve the proposed project outcomes and learning objectives. The average Pre-Test score was 62% (6.2/10 points). The lowest score was 40% (4/10) and the highest score was 80% (8/10) with a standard deviation of 1.4%. The most missed question was question thirteen with only 8% of the participants answering the question correctly. In contrast, the question answered the most correct was question seventeen at 100%.

The average Post-Test score was 80.7% (8.07/10 points). The Post-Test scores ranged from 40%-100% with a standard deviation of 1.6. The most missed question was question nine with only 20% of the participants answering the question correctly. In contrast, the questions that were answered the most correct were questions one, three, and ten with a 100% correct score. Appendix N displays the Microsoft Forms Pre-Test (Questions 1-17) and Post-Test (Questions 1-10) Results.

Thirteen anesthesia providers also completed the four question Post-Qualitative Likert Scale Survey. Figure 3.1 displays the average responses from the electronic Microsoft Forms results. The average responses among the four questions were “Agree” shaded in light blue and “Strongly Agree” shaded in dark blue.

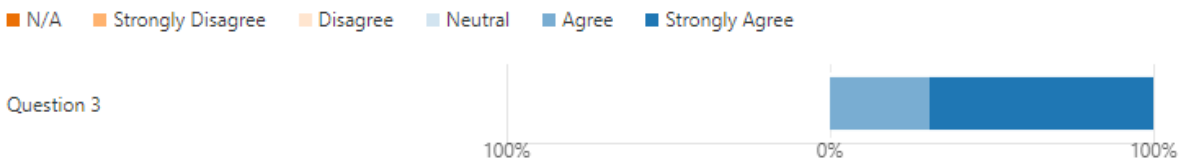
Figure 3.1

Post-Qualitative Likert Scale Reponses



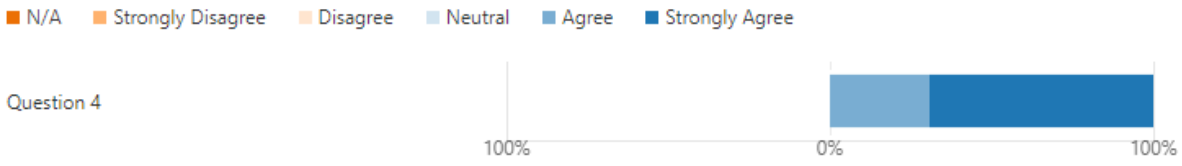
3. After reviewing the presentation: I feel more confident in identifying patients more at risks for the development of hypothermia.

More Details



4. After reviewing this presentation: I feel more confident with understanding the various guidelines/protocols for hypothermia and plan to implement some of these techniques into practice.

More Details



A retrospective chart audit was also completed on February 17, 2020. One of the primary factors assessed from the chart audit was if temperature monitoring was documented within the patient's chart for adult surgeries lasting longer than 60 minutes. After review of the 110 charts, a frequencies statistical analysis was completed, and the results concluded that temperature monitoring was documented in 76/110 charts (69%) and was not documented in 34/110 chart (31%) (Appendix O). To examine predictive behaviors between two chart audits and future behaviors, a prospective chart audit was completed on February 20, 2021 with 110 charts reviewed. The same factor assessed from the chart audit was if temperature monitoring was documented for adult surgeries lasting longer than 60 minutes. After further review of the 110 charts, another frequency statistical analysis was completed using SPSS Statistics 26. The prospective chart audit concluded that temperature monitoring was documented 88/110 times (80%) and was not documented 22/110 times (20%) (Appendix O). A percentage of change analysis was completed between the retrospective and prospective chart audit, with an increase

of temperature monitoring documentation of 11% among the anesthesia providers at EGH. The aims and outcomes set to be met by the project manager for the scholarly project included:

1. Aim: Increase knowledge among anesthesia providers regarding temperature monitoring during general anesthesia for prevention of hypothermia.

    1a. Outcome: Baseline knowledge of hypothermia prevention measures in anesthesia providers as measured by a Pre-Test indicated that 65% percent of anesthesia providers had scores below 60%. Post-Test administered after educational intervention exhibited a 15% higher score than pre-test scores in 75% of anesthesia providers.

    1b. Outcome: Increase of knowledge for the factors that contribute to unplanned perioperative hypothermia. Total increase of mean scores by 10%. Looking specifically at question number #14 on Pre/ #7 Post Test (same question), as this includes a multi-level/case study question and answer.

2. Aim: Improve anesthesia providers likelihood of implementing updated techniques and patient outcomes in prevention of hypothermia development.

    2a. Quantitative data from Likert Scale will demonstrate anesthesia providers ability to understand the various guidelines for hypothermia and possible plan to use these techniques in future practice.

    2b. Completion of retrospective and prospective chart audit demonstrated a decrease of prevalence by 11% of hypothermia in all adult patients having general anesthesia at EGH.

Data Analysis Inferences

A percentage change was conducted to analyze the scores of the Pre-Test and Post-Test and evaluate the change between them (Appendix P). Each of the N=13 participants who completed the Pre-Test and Post-Test Score were compared to determine if knowledge gained was achieved. The mean Pre-Test score was 6.15 (60.2%) (SD=1.46), while the mean Post-Test score was 8.07 (80.1%) (SD=1.60). The mean increase between the Pre-Test and Post-Test was 1.9 with a 95% confidence interval stretching from a lower bound of 3.3 to an upper bound of 0.49. The percent change between the Pre-Test score and Post-Test score was an increase of 18.7%, as the average score on the Pre-Test was 62% and the average score on the Post-Test was 80.7%.

Gaps

No incentive was offered to the anesthesia providers to complete the Pre-Test, Post-Test, or Post-Qualitative Likert Scale Survey. Most of the anesthesia providers completed the required electronic documents within the three-week time period (13/24). The project manager sent out weekly reminders to the anesthesia providers in the format of email and text messages to complete the documents. The anesthesia providers also encouraged one another to complete the required electronic forms.

The main gap between the completion of the Pre-Test, Post-Test, and Post-Qualitative Likert Scale Survey was how the total number of participants/responses varied. The Pre-Test and Post-Qualitative Likert Scale Survey had a total of 13 participants, but the Post-Test resulted in 15 participants/responses. Since the results were anonymous, the project manager was not able to link who had taken the Post-Test, but not the Pre-Test and Post-Qualitative Likert Scale Survey.

Unanticipated Consequences

A total of 18 CRNAs and 6 anesthesiologists were included within the implementation of the project with a grand total of 24 anesthesia providers. The primary unanticipated consequence was the total lack of participation from the anesthesiologists located at EGH. The project manager is not sure why there was a lack of participation from the anesthesiologists, as positive relations and communication were formed. Overall, the project manager still felt it was vital to include all of the anesthesia providers (24) within the scholarly project for the implementation, as no one should be excluded from an educational update with the goal of increasing knowledge and patient safety.

Expenditures

Purchasing of SPSS Statistics Versions 26 and 27 was the primary expenditure to run the output data analysis totaling at $152 over two years ($76 for 12 months). SPSS was purchased for one year to cover the academic course of Statistics and learning how to use SPSS Version 26, as the second year SPSS Statistics Version 27 was purchased to analyze the completed retrospective and prospective chart audit data analysis and the Pre-Test and Post-Test comparison. Other small expenditures included the purchase of Adam's Cake Shop cupcakes ($30) in thanking the anesthesia providers for participating in the scholarly project, and educational handouts printed and displayed within the anesthesia lounge ($12). A grand total of $194 was counted as out-of-pocket costs to the project manager.

Chapter 5: Leadership and Management

Organizational Culture

Organizational assessment consisted of the Institutional and Organizational Performance Assessment (IOA). The development of an organizational assessment (OA) allows a systematic approach to analyze the organization's performance and the ability to look for ways of improvement (Moran, Burson, & Conrad, 2017, p. 128). The doctoral nursing project titled Intraoperative Hypothermia Prevention and Temperature Guideline Education in Anesthesia Providers was implemented at the clinical site of EGH and an OA was performed. Various organizational assessment formats exist, but the (IOA) model was the primary focus and format.

Institutional and Organizational Performance Assessment

The framework and format of the IOA are important concepts, as the evolution of the framework was not to be project focused (Lusthaus et al., 2002). Instead, the path of looking at the environment the organization exists in and how it functions takes the lead. From the development of the IOA, four key concepts were formed and included organizational motivation, external environment, organizational capacity, and organizational performance (Reflect & Learn, n.d.). These four insights served as the backbone of the framework in completion of an organizational assessment.

Organizational Motivation

The organizational motivation encompasses the personality of the system and looks at the history, mission, and values within the organization. The development of EGH first became incorporated in 1909, with a new hospital to be established from a large donation from Dr. Franklin Miles in 1913 (Beacon Health System, 2020). Years later, EGH included a four-story addition with a capacity of over 300 beds. The latest development at Elkhart General included the opening in 2016 of a 165,000 square-foot Surgery Center (Beacon Health System, 2020).

Elkhart General Hospital is included within the family of the Beacon Health System and continues to provide world-class care to all members of the community.

The mission driven by EGH encompassed the process to reinforce the mental, physical, emotional, and spiritual well-being of the community (Beacon Health System, 2020). Implementation of the DNP project coincided nicely with EGH's mission and values. The values of providing the highest quality of care with the best possible outcomes are essential for all anesthesia providers to fulfill.

External Environment

The external environment within the IOA Model serves to include factors and feedback outside of the organization and are commonly called an open system. These factors are key for survival of the organization and resources available to make improvements or changes within the organization (Lusthaus et al., 2002).

The social culture within the external environmental factors is also a vital step in understanding the community support for the organization. In March 2015, the Community Health Needs Assessment (CHNA) was reviewed for Elkhart County, as EGH is located within this county. The topic of interest included the expansion and development of the Surgery Center in 2016 to allow increased access of quality care for surgical services (Community Health, 2016). In order for the surgery center to become successful, the infrastructure of the surrounding area needed to be cleared for the external environment.

Organizational Capacity

The organizational capacity focuses on the resources available such as the financial well-being of the organization, human resources, and the infrastructure (Reflect & Learn, n.d.). Elkhart General Hospital's financial well-being includes a not-for-profit hospital, as the hospital

is funded by charity or educational funds. The Community Foundation for Elkhart County is one resource available for donations for the hospital. Currently, EGH provides full healthcare service with 356 medical beds and is financially stable to support more than 30 medical specialties with over 2,000 medical employees (Beacon Health, 2020).

The next section that is included within the organizational capacity pertains to the infrastructure. The development of building a 165 square-foot Surgery Center at EGH encompassed the knowledge for change and growth within this community. The EGH's Surgery Center includes 43 private patient rooms, three endoscopy suites, and ten state-of-the-art operating rooms (Beacon Health System, 2020). With the addition of the Surgery Center at EGH, implementation of the doctoral nursing project was completed while having the capability and access to all ten operating rooms. Due to the increase of volume from the operating rooms, this ultimately expanded the data collection (retrospective and prospective chart audits) in patients from the development of hypothermia during general anesthesia. Proper resources such as various operating rooms, medical equipment, anesthesia machines, and monitors were available for the anesthesia providers and patients in completion of the doctoral nursing project.

Organizational Performance

The performance of an organization can be assessed by examining how well goals were achieved in comparison of their mission statement (Lusthaus et al., 2002). This is especially true for not-for-profit organizations such as EGH. Efficiency and relevance are two key factors for organizational performance. The efficiency of Elkhart General is prevalent, as their services have been accredited by various state and national organizations. Throughout all of EGH's achievements, it is still important to note a weakness that Elkhart General has not earned status as a magnet hospital awarded by the American Nurses' Credentialing Center (ANCC).

Stakeholders that were incorporated within the DNP project included organizations that have made supporting statements on the importance of normothermia during general anesthesia. Medical stakeholders include the National Institute for Health and Care Excellence (NICE), World Health Organization (WHO), and the American Association of Nurse Anesthetists (AANA). The Elkhart General Board of Medical Education was also included as a key stakeholder, as the relationship to implement the project pertained to education among all anesthesia providers. Proper identification of the stakeholders throughout the DNP project allowed for progress reports to be successfully updated and the ability to address any concerns that may have occurred.

Change Strategy

Malcolm Knowles's Theory of Andragogy was used as the framework for change strategy for the doctoral project, with the use of an educational intervention for best practice. The Theory of Andragogy examines the science and art of adult learners in comparison to children (Knowles, 1984; Smith, 2002). Six assumptions from the Theory of Andragogy were formulated and include: Self-concept, Foundation, Readiness, Orientation, Motivation, and Need-to-know. The use of Malcolm Knowles's theory allowed the project manager to apply each assumption to the adult learners of anesthesia providers located at EGH to help provide a successful change.

Self-concept

Adults are responsible for their individual decisions and become more self-directed in their choices in life (Knowles, 1984; Smith, 2002). With age, adults typically want to choose what they learn and the time frame for the learning, as it is vital to make the adult's time count. Adult anesthesia providers are prime examples of self-directed adults, as they must navigate the strict daily schedule of planned and emergent surgeries, staying up to date on their continuing

education requirements, preceptorship, personal lives, and time management to be successful within their career.

Foundation

Adults accumulate experiences that become the basis for their learning and ultimately shape future learning behaviors (Knowles, 1984; Smith, 2002). Time is one of the most important concepts for the foundation of adult learners. With time, adults are able to accumulate numerous life experiences, whether they are positive or negative results and can help conquer life's obstacles. Anesthesia providers can vary greatly with age and the amount of time they have been practicing anesthesia, from new graduates to seasoned older adults. When comparing new graduates and seasoned anesthesia providers the method of learning styles can vary, and it is vital to acknowledge these differences of learning to allow change to successfully occur. Each age group brings their own set of unique life experiences with them as they complete their educational paths and gain additional career experiences.

Readiness

Adults are interested in learning topics that have relevance to their work (Knowles, 1984; Smith, 2002). Anesthesia providers are eager to learn about the specifics in their field of healthcare and how to provide optimal quality of care to future patients. It is also vital to include that continuing educational requirements are essential for all anesthesia providers to complete, as the practice of healthcare is a never-ending process of change and improvements.

Orientation

Adult learners want immediate application of knowledge (Knowles, 1984; Smith, 2002). Intraoperative hypothermia prevention and education for anesthesia providers is directly

applicable, as it can be used by the anesthesia providers immediately following the educational intervention. Knowledge gained can be utilized once the educational intervention is concluded.

Motivation

Adults lean more towards internally motivated as opposed to externally motivated; this ties in with the themes of self-concept and self-direction (Knowles, 1984; Smith, 2002). Anesthesia providers at EGH must hold themselves accountable and motivate themselves to put forth the highest of their ability in providing care to patients, support to their fellow colleagues, and maintain time management skills.

Need-to-know

Adults need to know the rationale behind learning a topic and how it will affect them (Knowles, 1984; Smith, 2002). Much like evidence-based practice, adult anesthesia providers located at EGH need to know the why behind practicing safe anesthesia care and function as knowledgeable healthcare providers to efficiently make a change in their overall practice of care. The use of best practice protocols and guidelines ultimately help guide anesthesia providers in delivering optimum quality of care.

Leadership Style

The term leadership is often talked about in discussions in length, but when it comes time to actually define what leadership entails it becomes an entire web of various ideas and thoughts. Leadership is not tidy, but rather more of an art than science (Grossman & Valiga, 2017, p.19). Throughout the review of literature, numerous resources have been utilized to formulate the "artwork" of leadership and the various styles and formats. Leadership does not have to be held by an individual that holds authority but can be provided by anyone that has the strength and

potential (Grossman & Valiga, 2017, p.18). The primary leadership style that the project manager encompassed was a Transformational Leader.

Transformational leadership includes both leaders and followers, who help encourage one another with motivation to reach the end goal (Burns, 1978, p.20). The idea of motivating one another helps formulate a feeling of productivity with reaching the end mission. Transformational leaders have the characteristics of providing "pep talks" and acting as a positive role model to their fellow colleges or co-workers (Grossman & Valiga, 2017, p. 73). Throughout the DNP project, the project manager was continuously encouraging the anesthesia provides at EGH to correctly utilize temperature management and reminding them of the adverse effects that can result from hypothermia. Transformational leaders highlight the importance of following a goal/vision and help assist others to participate in making that goal a reality (Grossman & Valiga, 2017, p. 74). The project manager sent out numerous reminders to the anesthesia providers throughout the implementation phase to complete the required documents. The reminders consisted of encouraging comments to all of the providers to participate within the project, as knowledge gained and increase of patient safety was the main focus.

The leadership style of the key stakeholders within the EGH anesthesia department and anesthesia program can be described as coaching. The nurse anesthesia department and project advisor exemplify the characteristics of coaching leadership styles. The coaching leadership style allowed the project manager to take the lead throughout the doctoral project. It was vital to reach out for help when needed and accept constructive feedback. Overall, this helped to improve the outcomes of the project and grow into a stronger leader throughout the doctoral project process.

Interprofessional Collaboration

The process of leading a team was definitely new to the project manager, but it was essential to have proper feedback and interprofessional collaboration from the project team members. Interprofessional collaboration among providers with various knowledge levels and skills sets helps formulate creative solutions that may not occur normally (Zaccagnini et al., p. 239). The DNP project required various forms of collaboration which included the USF nurse anesthesia program, project advisors, DNP faculty, and the NIAS.

The use of DNP Essential VI in combination with the Leadership and Innovation course allowed the project manager to assimilate appropriate knowledge for the proposed project design, measurement tools, professional interactions with the project team members, and the project site of EGH. Consultation within the interprofessional team at EGH was overwhelming at first for the project manager. It was important for the project manager to fully integrate the project site's goals of the hypothermia DNP project, along with the project manager's own ideas for the completion of the proposed goals. The use of DNP Essential VI was definitely helpful, as interprofessional collaboration is essential in the completion of a large project (Tschannen, Dorn, & Tedesco, 2018). As the project manager, it was important to remember the roles and responsibilities of a strong leader, but also recognize the strengths of the numerous project team members and how they are experts in various healthcare topics and settings.

The anesthesia providers located at EGH were highly engaged in the project, as the overall goal of the project was to increase their knowledge of hypothermia and ways to help decrease the occurrence throughout the intraoperative phases. Dr. Eric Torbert, chief anesthesiologist was the first helpful contact for the development of the doctoral project. The primary forms of communication were through emails, text messaging, and a couple in-person

discussions about the update of the project. The use of the anesthesia clinical coordinator, Lindsay Vasil CRNA, at EGH was also extremely helpful in bridging the gap for the communication among the anesthesia providers, if Dr. Torbert was unavailable. The project manger's advisor was also readily available through email and in-person meetings, which allowed for successful and smooth communication. Overall, effective interprofessional collaboration was achieved, as various professional experts were able to collaborate together and provide constructive feedback to enhance the result of the scholarly project.

Conflict Management

Professional and structured communication occurred between all parties within the project, as there was only a small amount of conflict that transpired during the development of the scholarly project. The primary conflicts were the initial meetings with the chief anesthesiologist and director of medical education located at EGH, along with the participation of the anesthesiologists within the scholarly project during the implementation phase.

Scheduling of the initial meetings between the chief anesthesiologist and the director of medical education was complicated at first to finalize, as both of their schedules were extremely busy at EGH. The chief anesthesiologist had a busy schedule within the operating rooms and the director of medical education was also an emergency physician. The project manager was able to schedule a meeting with both of them on the same day February 10, 2020, which allowed for an in-person conversation and exchange of the initial aims and goals for the scholarly project. After the completion of the initial meetings, the primary communication among the professionals were text messages and email. An in-person meeting was essential in forming strong communication for future conversations.

The lack of participation of the anesthesiologists within the implementation phase was a small conflict/disappointment within the scholarly project. The actual online format of implementation went smoothly, as the project manager allowed three weeks for the anesthesia providers to complete the required documents. A total of 18 CRNAs and 6 anesthesiologists were included within the implementation of the project with a grand total of 24 anesthesia providers. After implementation, 13/24 (54%) anesthesia providers participated within the doctoral project. Overall, the project manager found it was still important to include the anesthesiologists within the project for the first implementation. Regardless of the educational level of the anesthesia provider, no one should be excluded from an educational update, if the overall goal is to increase the knowledge gained and patient safety factors.

Chapter 6: Discussion

Impact of Project

The project received positive feedback and encouragement from the anesthesia providers participants at EGH. The anesthesia providers also commented on how easy the required documents were to complete with the use of Microsoft Forms. The use of the online version of the PowerPoint presentation was also successful providing updated knowledge and information on the project. The education and knowledge gained from the project not only impacts the anesthesia providers at EGH, but future patients, healthcare providers located at EGH, and the overall quality of care received during a surgical procedure.

Revision of the target population would be necessary to apply the project framework to other institutions. Changes would need to arise to the project's aims and goals if presented to various target populations outside of the anesthesia providers at EGH. Policies and guidelines that cover temperature management vary from one healthcare facility to the next; alterations would need to be made to the project's education and main goals for generalization. Overall, the project would be easy to adapt and change to reach various healthcare facilities to increase knowledge and education on temperature management and the prevention of hypothermia.

Decisions and Recommendations

After further review of the data, anesthesia providers need updated education on ways to prevent hypothermia throughout a surgical procedure. Future recommendations include a seminar on updated guidelines and policies that relate directly to temperature management while in the OR. The seminar would need to cover the specific healthcare facility's guidelines when looking at hypothermia prevention, as the facilities may vary with the protocols and guidelines followed.

Monumental incentives were not offered or needed for the anesthesia providers to participate within the project. The majority of the anesthesia providers (CRNAs) completed the required documents through Microsoft Forms with ease and no complications. Positive comments were received by the anesthesia providers to the project manager in text messaging format. A thank you for participating within the project was provided to the anesthesia providers by the project manager in the form of cupcakes, which was greatly appreciated.

Limitations of the Project

After reviewing the completed section of demographic survey within the Pre-Test it was clear that the 13 participants only consisted of certified registered nurse anesthetists (CRNAs) and was a strong limitation of the project. Text messages were sent out to all of the providers with reminders to complete the required documents. The project manager is unsure why the six anesthesiologists did not complete the required documents, as the project manager formed a positive and professional relationship at the surgical facility.

An unforeseen limitation of the project included the knowledge of the project manager. The project manager was the first nurse anesthesia student to implement a doctoral project at EGH. Limited knowledge of the proper routes of communication in contacting the correct medical director and chief anesthesiologist located at EGH, along with the process in bypassing the need for an IRB approval at EGH. This was all new territory for the project manager and the implementation site of EGH.

COVID-19 created additional limitations in reaching the anesthesia providers throughout the implementation phase of the doctoral project. The project was implemented November-December 2020 for three weeks, which also consisted of a busy schedule for the anesthesia department with high case numbers of new COVID positive patients. The project manager had

originally thought of delaying implementation of the doctoral project to allow the COVID positive cases to decline, but even six months from implementation with the development of a vaccine the state of Indiana is still dealing with elevated COVID-19 positive cases.

Application to Other Settings

As previously mentioned, education on temperature management and prevention of hypothermia during a surgical procedure can easily be applied to other healthcare facilities for not only the anesthesia providers, but the entire intraoperative surgical staff. The sharing of this project with other healthcare facilities would help enhance the overall knowledge on the prevention of hypothermia and ways to improve/update temperature guidelines. Distributing the doctoral project to the AANA and INANA would also be beneficial, as this allows a large scope of anesthesia providers to be reached.

The process of sharing this project with college students involved in healthcare would also serve to update current knowledge and education about hypothermia prevention. Educating all health professionals involved in a surgical procedure will promote an increase an increase in the quality of care for future surgical patients.

Strategies for Maintaining and Sustaining

The strategies for maintaining and sustaining the doctoral project was for it to continue with future nurse anesthesia cohorts. Ideally, the nurse anesthesia students would compile feedback such as strengths and weaknesses identified and apply the recommendations to their interpretation of the doctoral project. Throughout the passing of every year, the doctoral project could have improved multiple clinical sites and healthcare facilities.

The overall goal was to provide an increase of knowledge and education for anesthesia providers on the prevention of hypothermia. This goal could have been reached at a larger level

with the relationship of multiple clinical sites throughout the years. Unfortunately, the University of Saint Francis decided to sunset the Doctor of Nursing Practice, Nurse Anesthesia program by summer 2022. This decision ultimately left few sustainability options for future nurse anesthesia students in spreading the goal of increased knowledge and education on the doctoral topic to future healthcare providers. Continuation of the doctoral project could be accomplished through future educational clinical conferences, and adoption of the presented material by other healthcare members for best practice guidelines.

Lessons Learned

The process of being organized and having a strict schedule for completion of various components of the project was crucial. Many moving parts are involved in the completion of a doctoral project, which not only includes the project itself but multiple other educational factors that must go on throughout the three years of nurse anesthesia school. Balancing a full-time clinical schedule four-five days a week, doctoral courses for the curriculum of the nurse anesthesia program at USF, along with traveling back home to spend time with family all needed to be managed efficiently. The use of a strict planner was essential to complete the doctoral project in a timely manner.

Input from individuals that were not involved within the doctoral project were also beneficial. Reaching out to the USF's tutors, family members, and peers became essential in editing the manuscript, as they provided insight of the weaknesses or areas that needed improvement for the project. The project manager found it easy to become buried with the large task at hand and found it helpful to ask for help to organize and guide future ideas. Having multiple people read through the manuscript helped further refine it. In addition, the project manager also asked to read through the manuscripts of peer's part of the nurse anesthesia

program. The project manager developed other ideas that related to the doctoral project and improved the overall outcome.

Chapter 7: Conclusion

Potential Project Impact on Health Outcomes Beyond Implementation Site

Various healthcare populations were impacted at a positive level, as the educational PowerPoint was made available. The thirteen CRNAs that participated in the project and updated their knowledge of hypothermia prevention will take their knowledge into future practices. The project manager is hopeful that the anesthesia providers will also share the PowerPoint presentation with other healthcare providers for the prevention of hypothermia.

On a personal level, the project manager gained self-confidence in speaking and organizing meetings with well-established healthcare providers. The confidence that was gained from setting up meetings and speaking with the chief clinical site personal will carry into the project manager's future of nurse anesthesia practice.

All eight essential elements of DNP practice were met with the completion of the doctoral project through the educational intervention. According to the AACN (2006), DNP essentials define the curricular elements that must be present in DNP programs, and essential for all Advanced Practice Registered Nurses (APRNs).

- Essential I: Scientific underpinning for practice includes combination of nursing science, middle-range nursing theories, patterns of human behaviors, and the endless interaction with their environment (AACN, 2006). Essential I was met by incorporating Malcolm Knowles's Theory of Andragogy and The RE-AIM Framework which included five important phases to promote health production in adults and help correlate knowledge gained into future practices.
- Essential II: Organizational and systems leadership for quality improvement and systems thinking includes critical skills to improve the development of clinical

practice guidelines and protocols, evidence-based interventions, and evaluating outcomes with improved strategies (AACN, 2006). The use of the literature review with evidence-based guidelines were met for the educational intervention.

- Essential III: Clinical scholarship and analytical methods for evidence-based practice encompasses the education of the Doctor of Nursing Practice to incorporate the skills needed to provide changes within an organization (AACN, 2006). The implementation site was completed at EGH and provided updated knowledge to the anesthesia providers to allow positive changes to occur in their daily practice.
- Essential IV: Information systems/technology and patient care technology for the improvement and transformation of health care allows the doctoral nurse to understand the information technology and how to evaluate the legal and ethical issues that may arise within healthcare (AACN, 2006). Multiple forms of technology were utilized in the making of the doctoral project and included: Microsoft Word, Microsoft Excel, Microsoft Forms, PowerPoint, IBMs SPSS Statistics 27, Information Technology (IT) Services, email documentations, and text messaging. Legal concerns were fully reviewed with the anesthesia providers and strategies were formed to minimize ethical issues.
- Essential V: Health care policy for advocacy in health care allows the doctoral graduate to analyze health policies and provide the best outcomes for the nursing profession (AACN, 2006). This process must start at the beginning of education for healthcare providers and continue throughout their future practices.

- Essential VI: Interprofessional collaboration for improving patient and population health outcomes help prepare the DNP graduate for a leadership role in the development of the scholarly project (AACN, 2006). The primary goal was to increase knowledge gained in the prevention of hypothermia for the anesthesia providers at EGH and improve the quality of care for future patient.
- Essential VII: Clinical prevention and population health for improving the nation's health incorporates nurse's knowledge to interpret occupational, and environmental data to improve the overall health of individuals and provide the safest outcome possible to the population (AACN, 2006). Nurses encompass a close-knit community and with the ultimate goal of providing updated information to their fellow peers. The doctoral project reached this essential in providing knowledge gained to the occupational practice of nursing.
- Essential VIII: Advanced nursing practice involves critical judgment skills, evidence-based care, and preceptorship with other healthcare providers involved in nursing practice (AACN, 2006). The prevention of hypothermia and educational update for the anesthesia providers at EGH incorporated the use of critical thinking skills. Overall, the providers were able to share the knowledge gained from the doctoral project to future anesthesia providers in providing optimum quality of care to all.

Health Policy Implications of Project

The doctoral project did not directly impact any health policies directly. The use of proper temperature monitoring and hypothermia prevention is strictly outlined and should be followed per the AANA Guidelines, *Standard Nine: Monitoring and Alarms* during a surgical

procedure. The NICE also covers preventing and managing inadvertent hypothermia in patients 18 years and older during general anesthesia, as this guideline was outlined as best practice throughout the doctoral project. The use of these guidelines allows anesthesia providers to provide high quality of care to future patients.

Proposed Future Direction for Practice

The project manager encouraged the online educational update to be continued among the anesthesia providers located at EGH. The project manager's educational PowerPoint presentation was made available online to the clinical site of EGH to aid in teaching future anesthesia providers at their healthcare facility. The PowerPoint provides an educational update to healthcare providers and ways to prevent hypothermia development.

Throughout the doctoral project, small positive steps were achieved in improving knowledge and education among anesthesia providers. Sadly, due to the sunsetting of the Nurse Anesthesia Program at the University of Saint Francis, there will not be future nurse anesthesia students to spread educational updates to multiple clinical sites. However, temperature management still continues to be a vital essential per the NICE Guidelines that must be completed in providing optimum quality of care to future patients. Continuation of the doctoral project can be accomplished through future educational clinical conferences, and adoption of the presented material by other healthcare members for best practice guidelines.

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Appendix A: Elkhart General Hospital Policy Document

ELKHART
GENERAL HOSPITAL

Policy /Procedure Document	
Category/Source:	Anesthesia Department
Origination Date:	12/12
Policy Number:	067
Last Review Date:	8/18
Last Revised Date:	
Next Review Due:	8/21
Policy Owner:	Anesthesia Department
Required Approvals:	Anesthesia Department
	MEC

TITLE: Anesthesia, Standard of Care

SCOPE: Anesthesia Providers

PURPOSE: Anesthesia care will be provided in accordance with the (ASA) American Society of Anesthesiologists Standards and Guidelines.

POLICY/PROCEDURE:

1. Qualified anesthesia personnel shall be present in the room throughout the conduct of all general anesthetics, regional anesthetics and monitored anesthesia care.
2. A pre-anesthesia evaluation shall be performed and an anesthesia plan of care documented.
3. The anesthesia machine is checked for proper functioning prior to induction of the anesthetics. All medications, supplies and equipment are checked prior to induction.
4. The patient is re-evaluated prior to induction and results are documented.
5. During all anesthetics, the patient's oxygenation, ventilation, circulation and temperature shall be continually evaluated.
   - A. Every patient receiving anesthesia shall have the electrocardiogram continuously displayed from the beginning of anesthesia until preparing to leave the anesthetizing location.
   - B. Every patient receiving anesthesia shall have arterial blood pressure and heart rate determined and evaluated every 5 minutes.
   - C. Every patient receiving anesthesia shall have, in addition to the above, circulatory function continually evaluated by at least one of the following: palpation of pulse, auscultation of heart sounds, monitoring of a tracing of intra-arterial pressure, ultrasound peripheral pulse monitoring or pulse oximetry.
   - D. Every patient receiving anesthesia shall have temperature monitored when clinically significant changes in body temperature are intended, anticipated or suspected.
6. All patients who have received general anesthesia, regional anesthesia or monitored anesthesia care shall receive appropriate post-anesthesia management.
7. A patient transported to the PACU shall be accompanied by a member of the anesthesia care team who is knowledgeable about the patient's condition. The patient shall be continually evaluated and treated during transport with monitoring and support appropriate to the patient's condition.
8. Upon arrival to the PACU, the patient shall be re-evaluated and a verbal report provided to the responsible PACU nurse by the member of the anesthesia care team who accompanies the patient.
   - A. The patient's status on arrival in the PACU shall be documented.
   - B. Information concerning the preoperative condition and the surgical/anesthetic course shall be transmitted to the PACU nurse.
   - C. The member of the Anesthesia Care Team shall remain in the PACU until the PACU nurse accepts responsibility for the nursing care of the patient.
9. The patient's condition shall be evaluated continually in the PACU.
   - A. The patient shall be observed and monitored by methods appropriate to the patient's medical condition. Particular attention should be given to monitoring oxygenation, ventilation, circulation, level of consciousness and temperature.
   - B. An accurate written report of the PACU period shall be maintained.
   - C. General medical supervision and coordination of patient care in the PACU should be the responsibility of an anesthesiologist.
10. A physician us responsible for the discharge of the patient from the post anesthesia care unit.

REFERENCES: American Society of Anesthesiologists – Standards, Guidelines and Statements. 2006

Document Revision History:			
Review Date: 8/18	Revised Date:	Reviewed/Revised By:	Summary of Changes:
			Original Document

SIGNATURES OF APPROVAL:

Date Signed	Signature	Name	Title
		Eric Torbert	Chairman

Appendix B: Letter of Support Elkhart General Hospital

ELKHART
GENERAL HOSPITAL

August 21, 2020

To the University of Saint Francis Institutional Review Board:

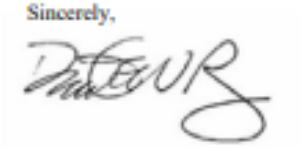
This letter is being written in support of University of Saint Francis NAP/DNP Sarah Brotherson's Doctor of Nursing Practice Scholarly Project entitled Intraoperative Hypothermia Prevention and Temperature Guideline Education in Anesthesia Providers. The healthcare leadership at Elkhart General Hospital supports the aims of the DNP Scholarly Project to:

- Increase knowledge among anesthesia providers regarding temperature monitoring during general anesthesia for prevention of hypothermia.
- Improve anesthesia providers likelihood of implementing updated techniques in prevention of hypothermia development.

The healthcare leadership at Elkhart General Hospital is committed to providing time for an educational presentation to anesthesia staff, allowing distribution of surveys to staff, and allowing access to electronic and paper medical records for collection of project compliance and outcomes data. Elkhart General Hospital does not require the DNP Scholarly Project to go through the hospital's institutional review board (IRB).

Please feel free to contact me with any questions regarding our support of this quality improvement project.

Sincerely,



David E. Van Ryn, M.D.

Director of Medical Education
Elkhart General Hospital

Appendix C: Excel Budget Spreadsheet

DNP Budget	Quality Improvement Budget: Intraoperative Hypothermia Prevention and Temperature Guideline Education in Anesthesia Providers.			
Legend	Direct Costs: United States Dollar (USD)	Location: Elkhart General Hospital Elkhart, Indiana		
	Indirect Costs (USD)	DNP Project Manager: Sarah Brotherson		
	In-Kind Costs (USD)			
Project Expenses				
Salaries and Wages	**Description**	**Year 1: 2020**	**Year 2: 2021**	**Total**
CRNA Salaries	Education held during monthly staff m	0	0	0
USF Faculty: DNP and Nurse Anesthesia S	Education for presentation and projec	0	0	0
PACU and OR Manager Salaries	Involved in educational project during	0	0	0
DNP Project Manager	Leader to provide educational handou	0	0	0
				0
Total Salary Costs		0	0	0
Startup Costs	**Description**	**Year 1: 2020**	**Year 2: 2021**	**Total**
Monthly Staff Meeting	First presentation provided to anesthe	0	0	0
Microsoft Forms	Tests to be completed over education	0	0	0
Retrospective Chart Audit	Chart Audit completed over 100 charts	0	0	0
Prospective Chart Audit	Chart Audit completed over 100 charts	0	0	0
Meeting with Chief Anesthesiologist	Development of DNP Project Idea. Res	0	0	0
Total Start Up Costs		0	0	0
Supplies and Materials	**Description**	**Year 1: 2020**	**Year 2: 2021**	**Total**
Educational Handouts/Flyers	Flyers to be given to CRNA providers d	12	0	12
PowerPoint Presentation on Hypotherm	Presentation given to anesthesia provi	0	0	0
SPSS Statistics Grad Pack 26/27	SPSS Data Analysis	76	76	
Presentation Food	Anesthesia provider attendee snacks:	30	0	30
Total Supplies and Materials		118	76	194

Appendix D: Gant Chart Timeline

Intraoperative Hypothermia Prevention and Temperature Guideline Education in Anesthesia Providers.

Activity Timeline: September 2019-August 2021

	***Sept.-Dec. 2019**	**Jan.-Feb. 2020**	**March-April 2020**	**May-June 2020**	**July-Aug. 2020**	**Sept.-Oct. 2020**	**Nov.-Dec. 2020**	**Jan.-Feb. 2021**	**March-April 2021**	**May-June 2021**	**July-August 2021**
DNP Project Idea: Hypothermia	Early Sept.	Modified topic									
Facilitator/ Academic Advisor for Approval: Dr. Lown and updates through email and in person meetings	Dec. 8th	Jan. 14th PICO	April Review Lit.	On-going development							
SPRING Semester 2020 Start		Jan.		Early May							
Comprehensive Search on Hypothermia Topic		Jan.									
Compiling Evidence for Literature Review		Feb.									

Literature Review for DNP Project		First draft Jan-late Feb.	Second draft April								
In person meetings with Dr. Torbert, Dr. Van Ryn, and Jessica Saunders: Discuss Project ideas.		Feb.	March								
Email Correspondents with Dr. Torbert and Jessica Saunders		*On-going	March Project ideas	June 15th email for Budget Review patient cost	Aug. Plan for update on project		Dec. Follow-up with IRB status	Jan. Pre/ Post Test, Power-Point		June. Complete project. Executive Summary passed along	
Retrospective Chart Audit Completion: 100 charts		Feb. 17th									
Project Team Agreement Signed: Dr. Torbert, Dr. Lown, Professor Louck			March 31st								

- Presentation: Lit. Review and Gap Analysis Zoom Meeting -Gap Analysis and Purpose Paper			-April 3rd -April 12th								
Informed Consent Made for DNP Project -Anesthesia staff sign consents before implementation late Feb or early March.			April 19th					Late Feb. sign consents	OR Early March		
CITI Training Completed			April 19th								
Stakeholder Identification and meetings development			On-going growth development								
SUMMER Semester Start 2020				May 4th	Aug.						

Organizational Assessment completed on Elkhart General Hospital (EGH): IOA Model				May 31st							
SWOT Analysis Completed EGH				May 31st							
Force Field Analysis Completed EGH				June 7th							
Budget Development and Spreadsheet				June 20th							
Timeline Development and Spreadsheet				June 24th							
Start Course NUR 710 with Dr. Spath (8 weeks)					July 2nd- Aug.						
Development of Aims, Outcomes, and Project Procedure. - Measurable Outcomes Identified					July 12th - Aug.						

Demographics Questionnaire DNP Project: - Anesthesia providers on Pre and Post Test used for future Microsoft Forms					July-Aug.	Sept.					
Data Collection and Analysis Plan Preparation for future IRB Approval in Fall 2020					Early Aug.						
Creation of Data Dictionary for DNP Project manuscript					Aug.						
FALL Semester Start 2020					Aug.		Dec.				
First and Second Executive Summary Presentation to Faculty (Residency weeks)					Aug. Week 3		Nov. week 12				
Determine plan and requirements to					Late Aug.	Sept. We					

Submit to USF IRB						ek 5					
Get Approval from Elkhart General Hospital IRB					Aug.	Sept.					
Discuss Barriers for future survey implementation with anesthesia providers						Sept.					
Start and Completion of chapters 1,2,3 within DNP manuscript. Fall 2020					Start: Aug.		End: Dec.				
Develop PowerPoint guideline - Hypothermia tips and handouts for anesthesia providers							Nov./ Dec.				
Update Dr. Torbert: review email contact information for all anesthesia providers for future							Dec.	Jan.			

implementation of PowerPoint											
SPRING Semester 2021 Start								Jan.		May	
Review Microsoft Forms Pre and Post Test. Plan for Subscription for Microsoft Forms for 1 month: Late Feb. (GOAL)							Late Nov				
***MAIN Implementation: Send out Pre-Test, PowerPoint guideline update on hypothermia, Post-Test on Microsoft Forms. -GOAL: Late Nov! Open for 3 weeks.**							Late Nov. Early Dec				
Update with Dr. Torbert throughout implementation process								Late Feb.	Early March		

Keep Pre-Test PowerPoint and Post Test open for 1 month for anesthesia providers to complete for implementation								Nov 30-Dec 21			
Request Pre-Post Test results from Microsoft Forms: Analysis of Results								Dec.			
Prospective Chart Audits: 100 charts once 30 days passed after Implement ation date.									Late Feb-March		
SUMMER Semester May 2021: DNP courses (8 weeks)										May-June -8 weeks DNP courses	Aug. NAP
Results and Analysis of Implement ation: Summer 2021										May	

Development of chart, graphs/materials from results, SPSS etc.										May-June?	
Completion of Chapters 4,6,7 DNP manuscript : 8 Weeks Summer 2021										May-June	
Final Completion and Review of DNP Manuscript !										May-June	July
Presentation of FINAL DNP Project: Executive Summary to class and NAP/DNP faculty										June	
Completion of DNP course work										Late June	
Graduation USF 2021!											Aug.

Appendix E: CITI Training Certificates (5)

CITI PROGRAM

Completion Date 26-Jan-2020
Expiration Date 25-Jan-2023
Record ID 34923860

This is to certify that:

Sarah Brotherson

Has completed the following CITI Program course:

Social & Behavioral Research - Basic/Refresher (Curriculum Group)
Social & Behavioral Research (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

University of Saint Francis

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w8a62954c-f2a3-49f5-90b0-fbb85fedf2e5-34923860

CITI PROGRAM

Completion Date 29-Jan-2020
Expiration Date 28-Jan-2023
Record ID 34923862

This is to certify that:

Sarah Brotherson

Has completed the following CITI Program course:

Social and Behavioral Responsible Conduct of Research (Curriculum Group)
Social and Behavioral Responsible Conduct of Research (Course Learner Group)
1 - RCR (Stage)

Under requirements set by:

University of Saint Francis

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?wbb7022cf-7646-4f7f-9a74-3b696a25bc5f-34923862

CITI PROGRAM

Completion Date 18-Jan-2020
Expiration Date 17-Jan-2023
Record ID 34923863

This is to certify that:

Sarah Brotherson

Has completed the following CITI Program course:

GCP – Social and Behavioral Research Best Practices for Clinical Research (Curriculum Group)
GCP – Social and Behavioral Research Best Practices for Clinical Research (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

University of Saint Francis

Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w81d8ecba-25fb-4299-978d-2d456ba41e3f-34923863

CITI PROGRAM

Completion Date 19-Jan-2020
Expiration Date N/A
Record ID 34923861

This is to certify that:

Sarah Brotherson

Has completed the following CITI Program course:

Information Privacy Security (IPS) (Curriculum Group)
Researchers (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

University of Saint Francis

Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w7d90c3f8-81aa-4bc6-9b9c-c40af199ff1a-34923861

CITI PROGRAM

Completion Date 18-Jan-2020
Expiration Date 17-Jan-2023
Record ID 34923864

This is to certify that:

Sarah Brotherson

Has completed the following CITI Program course:

Public Health Research (Curriculum Group)
Public Health Research (Course Learner Group)
1 - Basic (Stage)

Under requirements set by:

University of Saint Francis

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w728abdb7-5eec-4360-9e9b-39d2e7248e00-34923864

Appendix F: Informed Consent Form

INFORMED CONSENT FORM

Intraoperative Hypothermia Prevention and Temperature Guideline Education in Anesthesia Providers

Project Manager: Sarah Brotherson

DNP Scholarly Project Advisor: Dr. Susan Lown

Introduction:
I am a full-time SRNA in the Doctor of Nursing Practice-Nurse Anesthesia Graduate Program at the University of Saint Francis Fort Wayne, Indiana. I am conducting a project looking at the use of temperature monitoring during general anesthesia and the result of hypothermia occurrence. I would appreciate your participation in this project, as it will assist me in making recommendations for improving temperature management during general anesthesia.

Purpose:
"Intraoperative Hypothermia Prevention and Temperature Guideline Education in Anesthesia Providers" Doctor of Nursing Practice (DNP) scholarly project aims to implement the best practice for temperature monitoring guideline for surgical patients undergoing general anesthesia. Once a patient enters the operating room (OR) the anesthesia provider is the primary advocate for the patient throughout the entire case. Proper monitoring devices are applied on every patient undergoing general anesthesia as the basic standard of care. Basic standard of care monitors and vital signs include pulse oximetry, heart rate, respiratory rate, blood pressure, and body temperature. When looking specifically at the vital sign of temperature, many variations exist of how an anesthesia provider can properly monitor the patient. The overall purpose of this project includes an updated temperature monitoring guideline and knowledge development to improve the prevalence of hypothermia occurrence in the operating room for adult patients undergoing general anesthesia.

Procedures:
1. Anesthesia providers: Completion of Pre-Test Hypothermia Prevention via Microsoft Forms (17 questions), review of Hypothermia PowerPoint presentation and handout, completion of Post-Test (10 questions) Hypothermia Prevention, and Likert Scale Post Survey.
2. Total amount of time for completion of Pre-Test, Hypothermia presentation, and Post-Test is one hour.
3. A total of one hour of participation time required of the subjects.
4. Approximately 24 certified registered nurse anesthetists (CRNAs) and anesthesiologists employed at Elkhart General Hospital will participate within this study.

Alternative Procedures:

Although this author could study this question by solely reviewing the patient's medical records through retrospective and prospective chart audits, this author feels that speaking with the anesthesia providers is another beneficial way to find out the current practice and knowledge that pertains to temperature monitoring.

Explanation of the Risks and Benefits:

1. No foreseeable risks or discomforts for the anesthesia providers may incur as a result of participation.
2. Discomfort is not greater than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests. No extraneous physical activity will occur throughout this project.
3. Participants may experience inconvenience of time requirements in completion of the required documentations, but no additional costs will occur as a result of participation.
    a. Participants will not be paid for participation within this project and no other forms of compensation will occur throughout this project.
    b. No potential punitive action will occur to the anesthesia providers for voicing their opinions throughout the completion of the required documentations.
4. The main benefit of participation within the project is to increase the subject's knowledge on temperature management and ways to prevent the development of hypothermia during general anesthetic cases.

Explanation of the Safeguards:

1. Participants will not be identified directly or indirectly through the information collected and completed. Confidentiality for the participants in this project will remain secure.
    a. Subsequent uses of records and data will be subject to standards data use polices which protect the anonymity of the individuals and institutions.
2. Completion of the required Pre-Test and Post-Test will occur through the software program of Microsoft Forms. Data collected from these two tests will have no identifiable information to link the participants to his/her data, the data will be anonymous.
    a. Online survey participants can withdraw at any time prior to the completion of the online survey by simply abandoning the survey.
    b. To have your responses included, please click the "submit" button at the end of the survey.
3. Participants and patient's records (including anonymous surveys and informed consents filled out by the participants) will be kept confidential and will not be released without consent except as required by law.
4. If the results of this project are written in a scientific journal or presented at a healthcare meeting, participants and patient's name will not be used, and only grouped data will be presented. No identifying information will be released.
5. The data will be stored for one (1) year after the implementation of the quality improvement temperature monitoring intervention.
    a. All data paper records will be shredded and properly disposed in compliance with HIPAA Shredding and Retention requirements for healthcare information.
    b. All data will be password protected. Access only to the principal project manager.

c. All records stored on a password protected computer will be erased using commercial software applications designed to remove all data from the storage device.

Freedom to Withdraw:

1. Participation within this project is completely voluntary.
2. Participants may refuse to take part in or withdraw from the project at any time and for any reason without penalty.
3. Participation or decision not to participate will not affect treatment or involve penalty or loss of benefits to which the subject is otherwise entitled (i.e. at a clinic, hospital, organization, etc.). If participants choose to withdraw, proper disposal of all completed and collected information will occur in compliance with HIPAA Shredding and Retention requirements.

Questions:

Signing this form indicates that you voluntarily agree to participate in a DNP project entitled: "Intraoperative Hypothermia Prevention and Temperature Guideline Education in Anesthesia Providers" to be carried out by Sarah Brotherson. Sarah Brotherson can be contacted at 269-967-3659, brothersonse@cougars.sf.edu, 2826 Neff Street Elkhart, Indiana. The DNP scholarly project advisor, Dr. Susan Lown, can be contacted at 260-399-7700 ext. 8543, slown@sf.edu, 2701 Spring Street, Fort Wayne, Indiana 46808.

If you have any complaints about your treatment as a participant in this project, please call or write IRB Chairperson University of Saint Francis 2701 Spring Street Fort Wayne, Indiana 46808 (260) 399-7700 Administration email: DFILLER@sf.edu

I have received an explanation of this project and agree to participate. I understand that my participation in this project is strictly voluntary.

Name: _____ Date _____

Signature:_____

This research project has been approved by the University of Saint Francis' Institutional Review Board for the Protection of Human Subjects for a one-year period.

Thank you for your time.

Appendix G: **PRE-TEST**

Demographic information to be used only for the purpose of this study.

Please fill in the blank or check the appropriate spot for each of the following questions.

1. Age years: ☐ 21-29 years ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60 or older
2. Gender Assigned at Birth: ☐ Male ☐ Female
3. Living State: ☐ Indiana ☐ Michigan ☐ Other_____
4. Highest Educational Level: ☐ Bachelors ☐ Masters ☐ Doctoral

   ☐ Medical School
5. Occupation:

   ☐ Certified Registered Nurse Anesthetists (CRNA) ☐ Anesthesiologist
6. How long have you been practicing anesthesia? ☐ <1 year ☐ 1-5 years

   ☐ 5-10 years ☐ >10 years
7. Your employment status at Elkhart General Hospital is:

   ☐ Full-Time ☐ Part-time ☐ PRN
8. Unintended perioperative hypothermia is most commonly defined as a core body temperature less than_____?

   a. 95 degrees F (35.0-degree C)
   b. 96.8 degrees F (36.0 degrees C)
   c. 98 degrees F (36.6 degrees C)
   d. 97.5 degrees F (36.3 degrees C)

9. Approximately _____ patients experience unplanned perioperative hypothermia each year.

   a. 100,000
   b. 1 million
   c. 7 million
   d. 14 million

10. Body temperature is regulated by the:

    a. Brain stem.
    b. Hypothalamus.
    c. Anterior pituitary.
    d. Frontal lobe.

11. Transfer of heat from an object surface without direct contact to another surface.

    a. Conduction.
    b. Convection.
    c. Evaporation.
    d. Radiation.

12. A potential complication of using bladder temperature readings to estimate core temperature is that decreased urine flow can pose interpretation difficulties.

    a. True
    b. False

13. To help prevent unintended hypothermia, the mattress on the operating room table can be warmed with a forced-air warming unit before the patient enters the room?

    a. True
    b. False

14. Case Scenario: Female patient, 65 years of age scheduled to have laparoscopic cholecystectomy. Patient's past medical history includes: PONV, diabetes mellitus, poor nutritional status, GERD, and polyneuropathy. No serious complications noted from anesthesia in past. What are some of the factors that can contribute to unplanned perioperative hypothermia for this patient?

    1.Ambient room temperatures.
    2. Effects of general anesthesia.
    3. Length of surgery >60minutes.
    4. Presence of pre-existing conditions: diabetes mellitus, PONV, and GERD.
    5. Presence of pre-existing conditions: diabetes mellitus, poor nutritional status, and polyneuropathy
    6. Skin exposure related to specific surgical procedures or positioning.
    7. Use of cold or room-temperature fluids for body cavity irrigation and skin preps.

        a. 1, 3, 5, and 7
        b. 2, 4, and 6

c. 1, 2, 3, 4, 5, and 6
d. 1, 2, 3, 5, 6, and 7

15. Core body temperatures should be monitored in anesthetized patients for all procedures that are longer than _____ minutes.

a. 20
b. 45
c. 60
d. 90

16. Vasoconstriction from hypothermia can
    1. Inadvertently alter wound healing by lessening oxygen delivery to tissue.
    2. Prevent neutrophils from performing at optimal levels, which increases the risk of infection.
    3. Reduce the flow of nutrients to the body.
    4. Increase the patient's pain, making it difficult to control the patient's comfort level.

    a. 1 and 4
    b. 2 and 3
    c. 1, 2, and 3
    d. 1, 2, 3, and 4

17. Hypothermia can alter medication metabolism and cause variations in electrolyte levels.

a. True
b. False

POST-TEST

1. Unintended perioperative hypothermia is most commonly defined as a core body temperature less than_____?

    a. 95 degrees F (35.0-degree C)
    b. 96.8 degrees F (36.0 degrees C)
    c. 98 degrees F (36.6 degrees C)
    d. 97.5 degrees F (36.3 degrees C)

2. Approximately _____ patients experience unplanned perioperative hypothermia each year.

    a. 100,000
    b. 1 million
    c. 7 million
    d. 14 million

3. Body temperature is regulated by the:

    a. Brain stem.
    b. Hypothalamus.
    c. Anterior pituitary.
    d. Frontal lobe.

4. Transfer of heat from an object surface without direct contact to another surface.

    a. Conduction.
    b. Convection.
    c. Evaporation.
    d. Radiation.

5. A potential complication of using bladder temperature readings to estimate core temperature is that decreased urine flow can pose interpretation difficulties.

    a. True
    b. False

6. To help prevent unintended hypothermia, the mattress on the operating room table can be warmed with a forced-air warming unit before the patient enters the room?

    a. True
    b. False

7. Case Scenario: Female patient, 65 years of age scheduled to have laparoscopic cholecystectomy. Patient's past medical history includes: PONV, diabetes mellitus, poor nutritional status, GERD, and polyneuropathy. No serious complications noted from anesthesia in past. What are some of the factors that can contribute to unplanned perioperative hypothermia for this patient?

    1.Ambient room temperatures.
    2. Effects of general anesthesia.
    3. Length of surgery >30 minutes.
    4. Presence of pre-existing conditions: diabetes mellitus, PONV, and GERD.
    5. Presence of pre-existing conditions: diabetes mellitus, poor nutritional status, and polyneuropathy
    6. Skin exposure related to specific surgical procedures or positioning.
    7. Use of cold or room-temperature fluids for body cavity irrigation and skin preps.

    a. 1, 3, 5, and 7
    b. 2, 4, and 6
    c. 1, 2, 3, 4, 5, and 6
    d. 1, 2, 3, 5, 6, and 7

8. Core body temperatures should be monitored in anesthetized patients for all procedures that are longer than _____ minutes.

    a. 20
    b. 45
    c. 60
    d. 90

9. Vasoconstriction from hypothermia can
    1. Inadvertently alter wound healing by lessening oxygen delivery to tissue.
    2. Prevent neutrophils from performing at optimal levels, which increases the risk of infection.
    3. Reduce the flow of nutrients to the body.
    4. Increase the patient's pain, making it difficult to control the patient's comfort level.

    a. 1 and 4
    b. 2 and 3
    c. 1, 2, and 3
    d. 1, 2, 3, and 4

10. Hypothermia can alter medication metabolism and cause variations in electrolyte levels.
    a. True
    b. False

Post-Presentation Quantitative Survey

Using the Likert scales below, please rate your feelings/opinions on the questions provided:

1) This educational presentation enhanced my knowledge and awareness of prevention of hypothermia from general anesthesia.
   Why or why not?

   0----------1----------2----------3----------4----------5
   N/A Strongly disagree Neutral Agree Strongly agree

2) Knowing what you know now: I could identify potential side effects from hypothermia
   Why or why not?

   0----------1----------2----------3----------4----------5
   N/A Strongly disagree Disagree Neutral Agree Strongly agree

3) After listening to this presentation: I feel more confident in identifying patients more at risks for the development of hypothermia
   Why or why not?

   0----------1----------2----------3----------4----------5
   N/A Strongly disagree Disagree Neutral Agree Strongly agree

4) After listening to this presentation: I feel more confident with understanding the various guidelines/protocols for hypothermia and plan to implement some of these techniques into practice.
   Why or why not?

   0----------1----------2----------3----------4----------5
   N/A Strongly disagree Disagree Neutral Agree Strongly agree

Comments (optional):

Appendix H: Force Field Analysis: Elkhart General Hospital

Forces		
Driving Forces (For)	**Restraining Forces (Against)**	**Actions to be Taken**
• Values within Elkhart General Hospital (EGH): respect, compassion, integrity, and trust. • Common theme within Organizational Assessment and SWOT Analysis. • Provides safe working environment for anesthesia providers and future patients.	• Anesthesia providers that are "burnt out" due to long hours and on call time can start to lack compassion and integrity. • Lack of time to review new guideline for hypothermia prevention. Unwilling to make changes to daily practice from decreased integrity and respect.	• Encourage anesthesia providers to take breaks often. • Scheduling of providers must be monitored with number of hours worked each week. • Schedule provided by Chief CRNA and Anesthesiologist. Shifts of hours worked organized by time frame:7-3, 3-11, 11-7.
• Newly built Surgery Center • Increased volume and opportunity of providing care with state-of-the-art equipment. 10 operating rooms (OR). • Large anesthesia staff members: 18 CRNAs, and 7 Anesthesiologists	• Updated environment causes need for change and update on daily routine for anesthesia providers. • Must locate where extra equipment and supplies are held on "down time" and not during emergent situations.	• Arrive early to surgery center, locate where emergent supplies are held. • Ask for help when stocking OR rooms for equipment. Temperature monitors and warming devices needed. • Ask anesthesia tech for help, as they are the primary organizers of all OR rooms.
• Support from Chief Anesthesiologist: Dr. Torbert. • Support from Director of Medical Education: Dr. Van Ryn.	• Busy schedule with working long hours at EGH and at off-site hospitals. • Difficult to set-up in person meetings to discuss DNP project and ideas.	• Correlate DNP meetings with Chief Anesthesiologist and with anesthesia providers during staff meetings. • Allows for all providers to be involved with potential ideas and ways to decrease risk of patient's developing severe hypothermia.
• Medical Stakeholders for prevention of hypothermia development during general anesthesia include National Institute for	• EGH does not include a primary guideline related to hypothermia development for anesthesia providers.	• Provide anesthesia staff data from retrospective chart audit. • Results concluded the need for change to update and

Health and Care Excellence (NICE). Best Practice for guideline to follow. • Outlines procedural steps for: perioperative care, preoperative phase, intraoperative phase, and postoperative phase.	• Current guideline used by anesthesia providers is the standard AANA surgery protocol. • AANA protocol is outdated, as the reference used is from 2008. • Potential push back from seasoned providers in changing/updating guideline.	improve temperatures monitoring throughout surgery to prevent hypothermia development. • NICE Guideline related to hypothermia care to be implemented at EGH. • Educational handouts given to all anesthesia providers with tips and side effects for the development of hypothermia.
• Decreased post-operative complications related to perioperative hypothermia: delayed extubation, shivering, and hypoxia. • Improved patient's satisfaction and recovery time from surgery.	• Patient comorbidities: thermoregulation varies from surgery recovery time and response to general anesthesia. • Patients may have comorbidities that increase risk of hypothermia. • Comorbidities increase risk of hypothermia: diabetes mellitus, polyneuropathy, hypothyroidism, American Society Anesthesiologist (ASA) physical classification >2.	• Full assessment needed by anesthesia provider. SRNA to complete pre-operative assessment of patient. • Heightened awareness can occur if proper assessment is completed for comorbidities of patients. • PROACTIVE: Have adequate warming measures and fluids ready if patient at an increased risk to develop hypothermia.
• Interprofessional collaboration: multidisciplinary approach with team-members from pre-operative unit, surgical unit, and post-anesthesia care unit (PACU). • Allows for team-based approach with increase of quality of care and satisfaction of patients.	• Poor communication skills between pre-operative unit and surgical suites. • Problems of bringing patient too soon or too late to OR for surgery. • Interrupts proper warming protocol and time for providers to prepare room temperature.	• Staff and skills meeting related to education on hypothermia. • Updated guideline on importance of warming and decreasing time spent during transfer from pre-operative unit to OR suite. • Educational handout included within staff meetings for hypothermia prevention for all healthcare providers.

Appendix I: SWOT Analysis: Elkhart General Hospital

Strengths	**Weaknesses**
• Shared values from Elkhart General Hospital (EGH) with the anesthesia providers in administering care to patients. • Internal attributes EGH values: respect, compassion, integrity, and trust. • Staff is ready for change and on board for education on prevention of hypothermia. • Decreased post-operative complications related to perioperative hypothermia: delayed extubation, shivering, and hypoxia. • Based on best practice guidelines (NICE) and quality of care. Medical stakeholders: NICE and AANA. • Increased patient centered care: EGH places people at the center of care for mission and values. • Support from Chief Anesthesiologist and Director of Medical Education. • Newly built Surgery Center: Increased volume and opportunity of providing care with state-of-the-art equipment. 10 operating rooms.	• Need for an updated guideline for prevention of hypothermia and management tools. • Diminished communication skills from Chief Anesthesiologist: delayed response from emails or messages. • Time consuming schedule from Chief Anesthesiologist with working at offsites. • Internal traits: process of change with new guideline for hypothermia management may be difficult for seasoned anesthesia providers.
Opportunities	**Threats**
• Opportunity to delivery best practice with increased quality of care. • Creation of leaders in providing warming measures in prevention of perioperative hypothermia. • External: medical stakeholders NICE and potential community stakeholders. • INTERPROFESSIONAL COLLABORATION: multidisciplinary approach with team-members from pre-operative unit, surgical unit, and post-anesthesia care unit (PACU). • Reduction in time-spent in post-anesthesia care unit and decrease in post-operative complications. • All team-members working towards a common guideline development to increase patient satisfaction and quality of care.	• RESISTANCE external factors: from community stakeholders primary Elkhart County medical providers and Community Funders from Elkhart County. • FEAR: process of change with implementation of new guideline. • LEGISLATION: delay in implementation with approval from medical education. • PATIENT comorbidities: thermoregulation varies from surgery recovery time and response to general anesthesia. Patients may have comorbidities that increase risk of hypothermia. • Comorbidities increase risk of hypothermia: diabetes mellitus, polyneuropathy, hypothyroidism, American Society Anesthesiologist (ASA) physical classification >2.

Appendix J: DNP Scholarly Project Proposal Initial Approval

University of Saint Francis
Institutional Review Board
Human Subjects Review Committee/ACUC/IBC
Institutional Review Board Approval Form

Protocol Number: 16000262490-HSRC

Review by (underline one): HSRC ACUC IBC

Date Reviewed: 10/12/2020
Principal Investigator: Sarah Brotherson
Faculty Advisor: Dr. Susan Lown
Protocol Title: Intraoperative hypothermia prevention and temperature guideline education in anesthesia providers
Study Site(s): Elkhart General Hospital

Type of Proposal:
Original research
Replication or extension of previous research
Quality Improvement/Evidence-Based Practice Project

Items submitted for review:
☒CITI Certificate
☒Initial protocol
☒Abstract
☒Informed Consent Form (if applicable)
☒Approval letter from outside institution
☒Other – explain: pre/post surveys, educational intervention, post-intervention survey

Type of Review:
☒Full Review
☐Expedited Review
☐Exempt Review

Approval:
☒Approval granted on 10/12/2020
☐Approval granted on _____ for a period of one year.
☐Conditional approval* granted on _____ for a period of one year.
☐Not approved*
☐ IRB approval is not required because:
☐Other

*Comments: _____

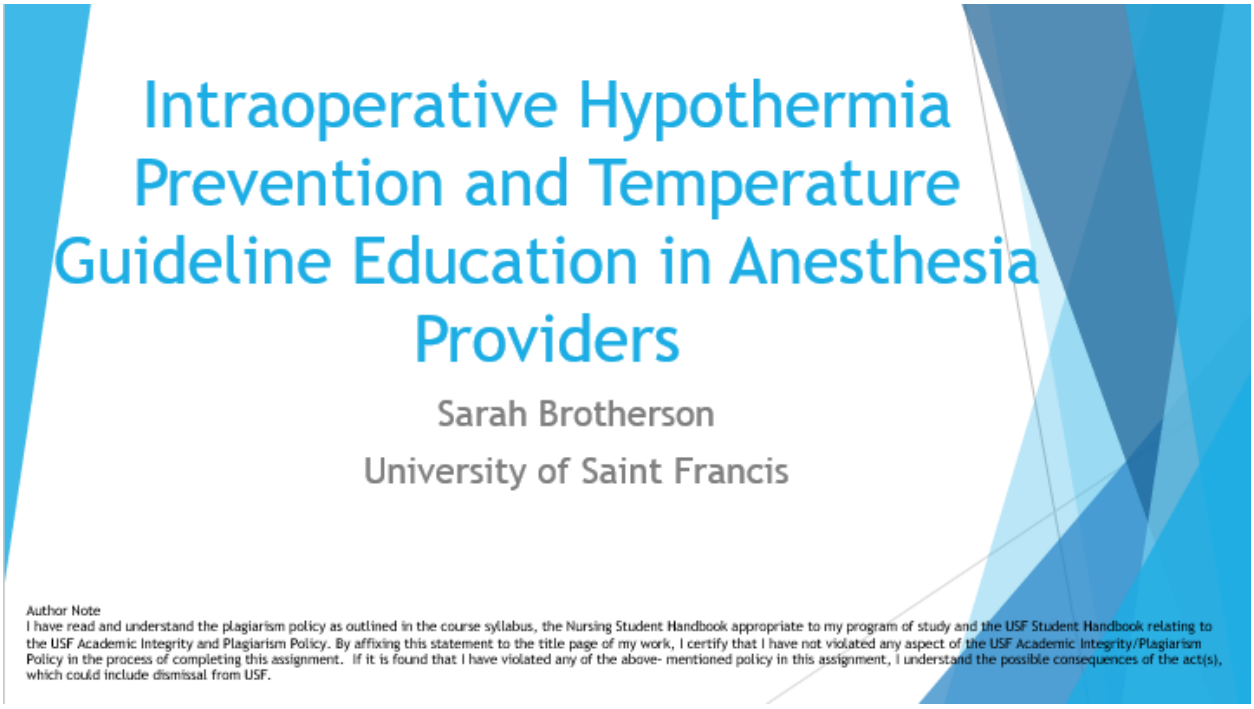
The committee performing this review is duly constituted and operates in accordance and compliance with local and federal regulations and guidelines.

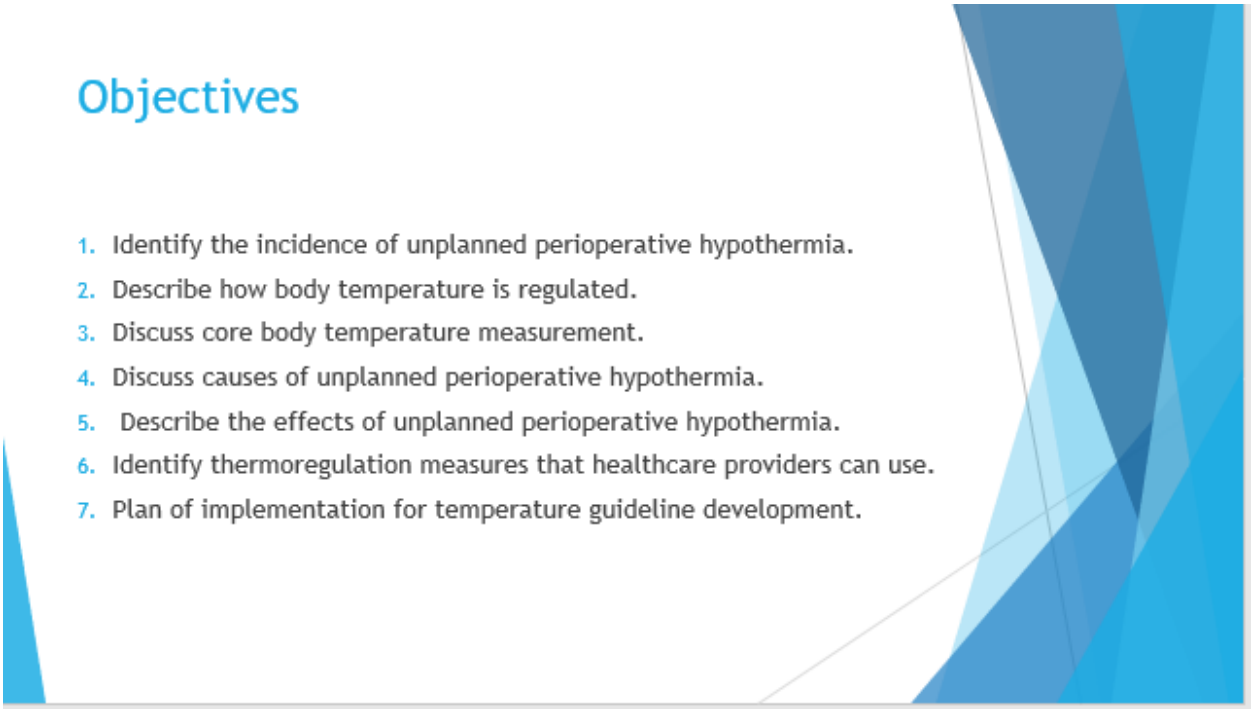
Stephanie Oetting	*Stephanie Oetting*	10/12/2020
Printed Name (Chair or designee)	Signature	Date

IRB Committee Approval Form ajo 10/12/2020

Appendix K: PowerPoint Presentation

PowerPoint Presentation: Intraoperative Hypothermia Prevention and Temperature Guideline Education in Anesthesia Providers.





Outline

- Introduction
- Problem
- Background
- Temperature Guidelines
  - Best Practice Identification
- Literature Review
  - Risk Factors
  - Warming Devices
  - Temperature Monitors
- Practice Recommendations

Introduction

Anesthesia provider = primary advocate for patient.

Basic Standard of Care: Monitors applied to all patients receiving general anesthesia.

Body Temperature: Diverse way for anesthesia provider to monitor.

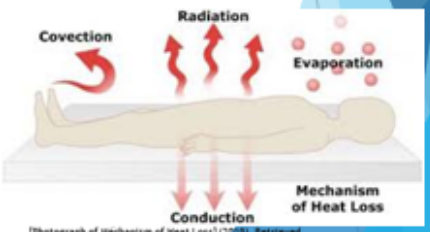
-Types of temperature monitoring: Esophageal, nasal, skin, bladder etc. (Diaz & Becker, 2010).

Problem and Background

- The normal core temperature ranges from 36.6-37.5 degrees Celsius.
  - Hypothalamus key regulation of temperature (Checketts et al., 2015).
- Up to 25-90% of patients experience unintended perioperative hypothermia.
  - General anesthesia is the most common cause of hypothermia in patients.
  - Yearly 14 million patients experience unplanned perioperative hypothermia
- Perioperative hypothermia: Core temperature below 36˚C (96.8˚F) perioperatively (Hart, Bordes, & Harmon, 2013).

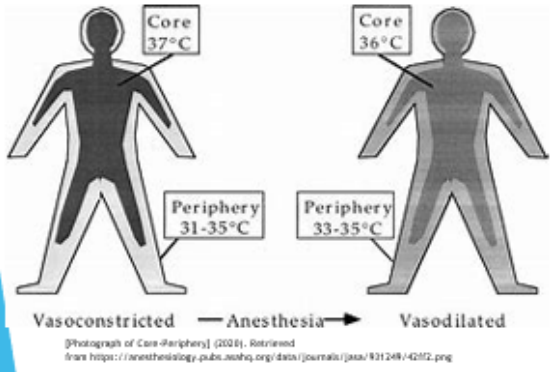
Types of Heat Loss

- Heat Loss: Evaporation, Radiation, Conduction, and Convection.
- Radiation is the most critical factor and accounts for 60% of total heat loss
  - Radiation: Transfer of heat from an object without direct contact
- Side Effects Hypothermia:
  - Surgical site infection risk, MI, Prolonged drug effect, increased risk bleeding, shivering, increase length of stay, and decrease patient satisfaction



[Photograph of mechanism of Heat Loss] (2019). Retrieved from http://www.onlinesurgicals.com/store/hypothermia-prevention

Problem and Background Continued



[Photograph of Core-Periphery] (2020). Retrieved from https://anesthesiology.pubs.asahq.org/data/journals/jasa/931249/42052.png

Maintaining normothermia difficult due to multiple contributing factors:

- Operating room temperature.
- Irrigation fluids used by the surgeon.
- Amount of skin exposure during the procedure (Bindu, Bindra, & Rath, 2017).
- Vasodilating effects of the anesthetic gas.
- Other drugs administered by the anesthesia provider (Cam, Yonem, & Ozsoy, 2016).

Risk Factors

- Patient's Common Comorbidities:
  - Diabetes Mellitus
  - Poor Nutritional status
  - Polyneuropathy
  - Advanced age
  - Pediatric patients

Temperature Guidelines: Best Practice

- Various guidelines and protocols have been development.
  - Anesthesia providers up to date with common practices = best outcomes.
- Common anesthesia guidelines:
  - **National Institute for Health and Care Excellence (NICE).**
  - American Society of Anesthesiologist (ASA).
  - Association of Perioperative Registered Nurses (AORN).

[Photograph of Best Practice] (2020). Retrieved from https://s3.amazonaws.com/cdn.cartoonstock.com/business-commerce-best_practice-business_venture-business_model-business_practice-bankrupt-rmsn2464_low.jpg

NICE Guideline for Best Practice

- NICE outlines four stages and guidelines to follow within each stage:
  - 1.1: Perioperative Care: Education to patient and family members.
  - 1.2: Preoperative Phase: One hour before the induction of anesthesia.
  - 1.3: Intraoperative Phase: Total anesthesia time, first anesthetic intervention to recovery in PACU.
  - 1.4: Postoperative: 24 hours after the patient has entered the recovery suite (PACU).

NICE National Institute for Health and Care Excellence

[Photograph of NICE] (2020). Retrieved from https://www.nice.org.uk/Media/Default/About/Branding-guidelines/Logos/master-logo3.png

NICE Intraoperative Phase

- 1.3.1: The patient's temperature should be measured and documented before induction of anesthesia and every 30 minutes until the completion of the surgery (NICE, 2016).
- 1.3.2: Standard critical incident reporting should be considered for any patient with a temperature below 36 degrees Celsius arriving in the PACU (NICE, 2016).
- 1.3.3: Induction of anesthesia should not begin unless patient's temperature is 36 degrees Celsius or above (NICE, 2016).
- 1.3.4: The ambient temperature should be at least 21 degrees Celsius while the patient is exposed within the operating room (NICE, 2016).
- 1.3.5: All patients must be adequately covered throughout the intraoperative phase to conserve heat and energy (NICE, 2016).
- 1.3.6: Intravenous fluids (>500ml) and blood products should be warmed to 37 degrees Celsius using a warming device (NICE, 2016).
- 1.3.7: Forced-air warming devices are used when an anesthetic case lasts longer than 30 minutes or patients are at a heightened risk of inadvertent perioperative hypothermia (NICE, 2016).
- 1.3.8: The temperature set on the forced-air warming devices should be set at the maximum and then adjusted to maintain the temperature of at least 36.5 degrees Celsius (NICE, 2016).

ASA Standards for Basic Anesthetic Monitoring

- Standard I: Qualified anesthesia provider present in the room throughout the entire general anesthetic case.
  - Rapid changes within a case may arise.
- Standard II: During all anesthetics the patient's oxygenation, ventilation, circulation, and temperature should be continually assessed.
- Body Temperature:
  - 5.1 Objective: To aid in the maintenance of appropriate body temperature during all anesthetics (ASA, 2015).
  - 5.2 Methods: Every patient receiving anesthesia must have temperature monitored when clinically significant changes in the body temperature are intended, anticipated, or suspected (ASA, 2015).

Limitations: ASA Standards, Basic Anesthetic Monitoring

- Does not list temperature range or what is considered hypothermic for body temperature.
- Room for guessing: "appropriate body temperature."
- No prevention strategies formatted for provider to follow: fluid warmer, pre-operative warming, or temperature goal.
- Both guidelines (NICE and ASA) are accredited professional organizations.
  - Proper identification/layout of guidelines are necessary.
- Detail is important with no guessing guidelines.
- *ASA Standards, Basic Anesthetic Monitoring used at Elkhart General Hospital.

Literature Review: Major Concepts

1. National guidelines and protocols: Temperature monitoring in operating room.
2. Risk factors that heighten the result of hypothermia from general anesthesia.
3. Preventative measures used for management of hypothermia development.
4. Types of temperature monitoring devices exist during a surgical procedure

[Photograph of Literature Review] (2019). Retrieved from https://www.thesisscientist.com/Blogs/Images/31/Literature_thesis.jpg

Literature Review: Risk Factors

- Common risk factors have been identified:
  - Age, American Society Anesthesiologist (ASA) physical classification, BMI, ICU length of stay, and pre-existing conditions that impair thermoregulation such as diabetes mellitus, polyneuropathy, and hypothyroidism (Macario & Dexter, 2002; Torossian et al., 2015; Yi et al., 2015)
- ASA physical classification: positive correlation with ASA physical status 2 or greater for hypothermia post-operatively (Yi et al., 2015).
- ICU length: Negative correlation between the length of the stay ICU and the overall body temperature in PACU(Yang et al., 2015).

Literature Review: Preventative Measures-Warming Devices

- Multiple temperature conservation and warming devices exist to help maintain or raise body temperature (Bonner, & Barth, 2015; Chan, & Venus, 2016; John, Ford, Harper, 2014; Lau et al., 2018; Moola & Lockwood, 2018; Nieh & Su, 2016).
  - Classification of warming devices:

Intravenous Fluid Warmers	-Insulated intravenous tubing -Convective warming system -Heated block warming system -Heated cylinder warming system
Body Warming Devices	-Forced-air warmer (FAW) -Water filled mattress -Radiant warming systems -Circulating water garments -Resistive heating blankets -Passive insulation

Literature Review: Preventative Measures FAW-Limitations

- Forced-air warmers: Increased risk of infection
  - Disrupts laminar flow (Bonner & Barth, 2015).
  - Increase microbial particles exposed to the surgical incision (Bonner & Barth, 2015).
- Expense of the disposable blankets for every patient within the OR.
- Risk of burns to patients: pre-warming OR table
- Increased heat for the surgical staff when near the device (Brandt et al., 2015).

[Photograph of Bair Hugger] (2019). Retrieved from http://i.ebayimg.com/00/s/NDU4WDUwMA==/z/BDkAAOSwaTxTV0Fx/$_3..JPG?set_id=2

Literature Review: Types of Temperature Monitoring

- Core body temperature is the single best indicator of thermal status in patients (Erdling, & Johansson, 2015; Scott et al., 2015; Sessler, 2008).
  - Examples: tympanic membrane, pulmonary artery, distal esophagus, and nasopharynx.
  - Esophageal most accurate
- Bladder temperature monitors:
  - Difficulties with decreased urine flow accuracy rate

[Photograph of Nasopharyngeal] (2019). Retrieved from https://www.rehabmart.com/include-mt/img-resize.asp?path=/images/ironrod/dr-01-025409nasopharyngeal320probec.jpg&newwidth=610

[Photograph of Esophageal] (2020). Retrieved from https://reliablemedsupplies.com/images/products/supplies/LVLE5400P_HRED1..JPG

Summary: Practice Recommendations

1. Most common guidelines: National Institute for Health and Care Excellence (NICE) or the American Society of Anesthesiologist (ASA).
   - NICE best practice focus.
2. Healthcare providers vigilant identifying risk factors.
   - Advanced age >60 years, weight, pre-existing complications, diabetes or polyneuropathy, poor nutritional intake, and the length of the surgery.
3. Proper education and training on warming devices and temperature monitoring devices.
   - Apply pre-warming methods: FAW #1.
   - Decrease interruption times <20 minutes.
   - Esophageal #1, Nasopharyngeal 10-20cm insertion.

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Client / Sponsor	Sarah Brotherson
Expected presentation date	Jul 2020
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Appendix M: AORN Questions

AORN: Examination and Evaluation Questions

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QUESTIONS

1. Approximately _____ patients experience unplanned perioperative hypothermia each year.
   a. 100,000
   b. 1 million
   c. 5 million
   d. 14 million

2. Body temperature is regulated by the
   a. brain stem.
   b. hypothalamus.
   c. pituitary.
   d. frontal lobe.

3. Vasoconstriction from hypothermia can
   1. inadvertently alter wound healing by lessening oxygen delivery to tissue.
   2. prevent neutrophils from performing at optimal levels, which increases the risk of infection.
   3. reduce the flow of nutrients to the body.
   4. increase the patient's pain, making it difficult to control the patient's comfort level.
   a. 1 and 4 b. 2 and 3
   c. 1, 2, and 3 d. 1, 2, 3, and 4

4. Core body temperature can be estimated by using temperature monitoring techniques from sources such as the
   1. axilla.
   2. bladder.
   3. forehead skin.
   4. mouth.
   5. pulmonary artery.
   6. rectum.

   a. 1, 3, and 5 b. 2, 4, and 6
   c. 1, 2, 3, 4, and 6 d. 1, 2, 3, 4, 5, and 6

5. A potential complication of using bladder temperature readings to estimate core temperature is that decreased urine flow can pose interpretation difficulties.
   a. true
   b. false

6. Core body temperatures should be monitored in anesthetized patients for all procedures that are longer than _____ minutes.
   a. 30
   b. 45
   c. 60
   d. 90

7. Transfer of heat through a gas or liquid is called
   a. conduction.
   b. convection.
   c. evaporation.
   d. radiation.

8. Factors that can contribute to unplanned perioperative hypothermia include
   1. ambient room temperatures.
   2. effects of anesthesia.
   3. length of surgery.
   4. presence of some pre-existing conditions.
   5. skin exposure related to specific surgical procedures or positioning.
   6. use of cold or room-temperature fluids for body cavity irrigation and skin preps.
   a. 1, 3, and 5 b. 2, 4, and 6
   c. 2, 3, 5, and 6 d. 1, 2, 3, 4, 5, and 6

9. Hypothermia can alter medication metabolism and cause variations in electrolyte levels.
   a. true
   b. false

10. Perioperative nurses should implement appropriate thermoregulation measures such as
    1. selecting temperature-monitoring devices based on identified patient needs.
    2. placing warm irrigation bottles under the patient's knees while the patient is in the supine position.
    3. implementing appropriate passive warming measures to implement before surgery (eg, head coverings, socks).
    4. implementing appropriate active warming measures (eg, forced-air warming, warmed irrigation and IV fluids, elevated OR room temperature).
    5. inserting or applying temperature-monitoring and regulation devices to the patient according to the plan of care, facility practice guidelines, and manufacturers' written instructions.
    a. 4 and 5 b. 1, 2, and 3
    c. 1, 3, 4, and 5 d. 1, 2, 3, 4, and 5

Appendix N: Microsoft Forms Pre-Test and Post-Test Results

Pre-Test (1-17)

1. Age in years?

More Details

21-29 years old	1
30-39 years old	10
40-49 years old	2
50-59 years old	0
60 years or older	0

2. Gender assigned at birth?

More Details

Male	11
Female	2

3. Living State?

More Details

Indiana	13
Michigan	0
Other	0

4. Highest level of education?

More Details

Bachelors	0
Masters	11
Doctorate	2
Medical School/ Residency An...	0

5. Occupation?

More Details

Certified Registered Nurse An...	13
Anesthesiologist	0

6. How long have you been practicing anesthesia?

More Details

<1 year	1
1-5 years	9
5-10 years	2
>10 years	1

7. Your employment status at Elkhart General Hospital?

More Details

Full-time	12
Part-time	0
PRN	1

8. Unintended perioperative hypothermia is most commonly defined as a core body temperature less than____? (1 point)

92% of respondents (12 of 13) answered this question correctly.

More Details

95 degrees F (35.0-degree C)	1	
96.8 degrees F (36.0 degrees C)	12	✓
98 degrees F (36.6 degrees C)	0	
97.5 degrees F (36.3 degrees C)	0	

9. Approximately _____ patients experience unplanned perioperative hypothermia each year. (1 point)

15% of respondents (2 of 13) answered this question correctly.

More Details

100,000	0	
1 million	8	
7 million	3	
14 million	2	✓

10. Body temperature is regulated by the _____? (1 point)

92% of respondents (12 of 13) answered this question correctly.

More Details

Brain stem	1	
Hypothalamus	12	✓
Anterior pituitary	0	
Frontal lobe	0	

11. Transfer of heat from an object surface without direct contact to another surface is defined as_____? (1 point)

69% of respondents (9 of 13) answered this question correctly.

More Details

Conduction	1	
Convection	3	
Evaporation	0	
Radiation	9	✓

12. True/False: A potential complication of using bladder temperature readings to estimate core temperature is that decreased urine flow can pose interpretation difficulties. (1 point)

77% of respondents (10 of 13) answered this question correctly.

More Details

True	10	✓
False	3	

13. True/False: To help prevent unintended hypothermia, the mattress on the operating room table can be warmed with a forced-air warming unit before the patient enters the room. (1 point)

8% of respondents (1 of 13) answered this question correctly.

More Details

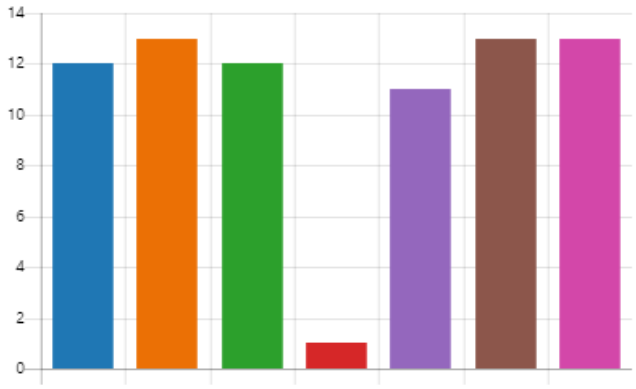
True	12	
False	1	✓

14. Case Scenario: Female patient, 65 years of age scheduled to have laparoscopic cholecystectomy. Patient's past medical history includes: PONV, diabetes mellitus, poor nutritional status, GERD, and polyneuropathy. No serious complications noted from anesthesia in past. What are some of the factors that can contribute to unplanned perioperative hypothermia for this patient? Select all that apply. (1 point)

62% of respondents (8 of 13) answered this question correctly.

More Details

Ambient room temperatures	12	✓
Effects of general anesthesia	13	✓
Length of surgery >60minutes	12	✓
Presence of pre-existing condi...	1	
Presence of pre-existing condi...	11	✓
Skin exposure related to speci...	13	✓
Use of cold or room-temperat...	13	✓



15. Core body temperatures should be monitored in anesthetized patients for all procedures that are longer than ____ minutes. (1 point)

85% of respondents (11 of 13) answered this question correctly.

More Details

20 minutes	1	
45 minutes	1	
60 minutes	11	✓
90 minutes	0	

16. Vasoconstriction from hypothermia can ____? Select all that apply. (1 point)

15% of respondents (2 of 13) answered this question correctly.

More Details

Inadvertently alter wound heal...	13	✓
Prevent neutrophils from perf...	12	✓
Reduce the flow of nutrients t...	11	✓
Increase the patient's pain, ma...	10	

17. True/False: Hypothermia can alter medication metabolism and cause variations in electrolyte levels. (1 point)

100% of respondents (13 of 13) answered this question correctly.

More Details

True	13	✓
False	0	

Post-Test (1-10)

1. Unintended perioperative hypothermia is most commonly defined as a core body temperature less than____? (1 point)

100% of respondents (15 of 15) answered this question correctly.

More Details

95 degrees F (35.0-degree C)	0	
96.8 degrees F (36.0 degrees C)	15	✓
98 degrees F (36.6 degrees C)	0	
97.5 degrees F (36.3 degrees C)	0	

2. Approximately _____ patients experience unplanned perioperative hypothermia each year. (1 point)

87% of respondents (13 of 15) answered this question correctly.

More Details

100,000	0	
1 million	2	
7 million	0	
14 million	13	✓

3. Body temperature is regulated by the _____? (1 point)

100% of respondents (15 of 15) answered this question correctly.

More Details

Brain stem	0	
Hypothalamus	15	✓
Anterior pituitary	0	
Frontal lobe	0	

4. Transfer of heat from an object surface without direct contact to another surface is defined as_____? (1 point)

93% of respondents (14 of 15) answered this question correctly.

More Details

Conduction	1	
Convection	0	
Evaporation	0	
Radiation	14	✓

5. True/False: A potential complication of using bladder temperature readings to estimate core temperature is that decreased urine flow can pose interpretation difficulties. (1 point)

93% of respondents (14 of 15) answered this question correctly.

More Details

True	14	✓
False	1	

6. True/False: To help prevent unintended hypothermia, the mattress on the operating room table can be warmed with a forced-air warming unit before the patient enters the room? (1 point)

64% of respondents (9 of 14) answered this question correctly.

More Details

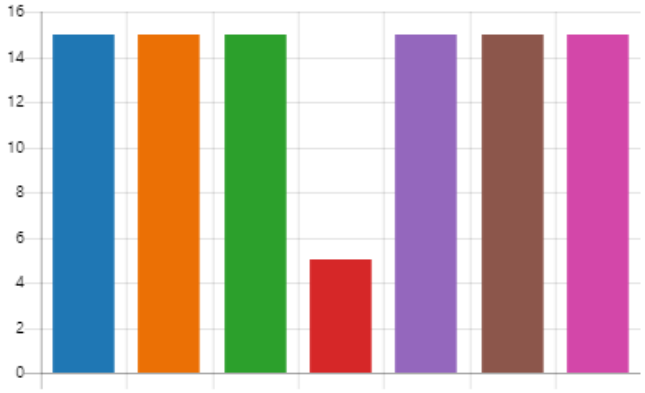
True	5	
False	9	✓

7. Case Scenario: Female patient, 65 years of age scheduled to have laparoscopic cholecystectomy. Patient's past medical history includes: PONV, diabetes mellitus, poor nutritional status, GERD, and polyneuropathy. No serious complications noted from anesthesia in past. What are some of the factors that can contribute to unplanned perioperative hypothermia for this patient? Select all that apply. (1 point)

67% of respondents (10 of 15) answered this question correctly.

More Details

Ambient room temperatures.	15	✓
Effects of general anesthesia.	15	✓
Length of surgery >60minutes.	15	✓
Presence of pre-existing condi...	5	
Presence of pre-existing condi...	15	✓
Skin exposure related to speci...	15	✓
Use of cold or room-temperat...	15	✓



8. Core body temperatures should be monitored in anesthetized patients for all procedures that are longer than _____ minutes? (1 point)

80% of respondents (12 of 15) answered this question correctly.

More Details

20 minutes	2	
45 minutes	1	
60 minutes	12	✓
90 minutes	0	

9. Vasoconstriction from hypothermia can_____? Select all that apply. (1 point)

20% of respondents (3 of 15) answered this question correctly.

More Details

Inadvertently alter wound heal...	15	✓
Prevent neutrophils from perf...	14	✓
Reduce the flow of nutrients t...	14	✓
Increase the patient's pain, ma...	11	

10. True/False: Hypothermia can alter medication metabolism and cause variations in electrolyte levels. (1 point)

100% of respondents (15 of 15) answered this question correctly.

More Details

True	15	✓
False	0	

Appendix O: SPSS Chart Audit Retrospective and Prospective Outputs

SPSS Retrospective Chart Audit: Temperature Documentation Percentage

Frequencies

Statistics

Temperature documented Y/N

N	Valid	110
	Missing	0

Temperature documented Y/N

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	76	69.1	69.1	69.1
	No	34	30.9	30.9	100.0
	Total	110	100.0	100.0	

SPSS Prospective Chart Audit: Temperature Documentation Percentage

Frequencies

Statistics

Temperature documented Y/N

N	Valid	110
	Missing	0

Temperature documented Y/N

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	88	80.0	80.0	80.0
	No	22	20.0	20.0	100.0
	Total	110	100.0	100.0	

Appendix P: SPSS Output Pre-Test and Post-Test Percent Change Results

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Scores	6.1538	13	1.46322	.40583
	Scores	8.0769	13	1.60528	.44522

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Scores & Scores	13	-.183	.550