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Clinical Practice Update on a Temperature Guideline to Decrease Intraoperative Hypothermia in Patients Undergoing General Anesthesia

Ashley Rigdon

CLINICAL PRACTICE UPDATE ON A TEMPERATURE GUIDELINE TO DECREASE INTRAOPERATIVE HYPOTHERMIA IN PATIENTS UNDERGOING GENERAL ANESTHESIA

by

Ashley Rigdon

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CLINICAL PRACTICE UPDATE ON A TEMPERATURE GUIDELINE TO

DECREASE INTRAOPERATIVE HYPOTHERMIA IN PATIENTS

UNDERGOING GENERAL ANESTHESIA

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ABSTRACT

CLINICAL PRACTICE UPDATE ON A TEMPERATURE GUIDELINE TO DECREASE INTRAOPERATIVE HYPOTHERMIA IN PATIENTS UNDERGOING GENERAL ANESTHESIA

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Intraoperative hypothermia is a common problem within the operating room. Anesthesia inhibits the body's normal thermoregulatory response to hypothermia, redistributing heat from the core to the periphery (Brandt et al., 2009). In the event of hypothermia, the incidence of infection triples as there is an increased risk for blood loss, increased risk for cardiac complications, and the thermal discomfort of patients (Brandt et al., 2009). Following a recent clinical practice guideline can help prevent hypothermia.

A descriptive project was organized utilizing current literature. The sample for this study is 45 CRNAs practicing at a multiple system healthcare facility in the Southeast. After education on current practice guidelines, the 9 CRNAs completed the pre-survey and 6 a post survey. Four CRNAs completing the case by case worksheets (N = 45) over 30 days.

Do anesthesia providers (P) using a temperature guideline (I) compared to not using a temperature guideline (C) affect the incidence of hypothermia (O) within the intraoperative period (T) in patients undergoing general anesthesia? The post survey revealed that 50% of the CRNAs observed hypothermia and 50% did not. This number is consistent with the data observed in the case by

case worksheet where 48.8% answered that the patient was above 36°C and 48.8% answered the patient was below 36°C. Outcomes of this project is to increase CRNAs cognizance of the patient's temperature and the different modalities to influence the patient's temperature.

Key Words: Hypothermia, hypothermia guideline, hypothermia protocol, intraoperative hypothermia, temperature management, temperature devices.

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DEDICATION

I would like to thank my husband, for his support at home throughout the duration of this project. I would also like to thank my family for their unwavering support and encouragement throughout this project.

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LIST OF ABBREVIATIONS

AANA	American Association of Nurse Anesthetists
AORN	Association of perioperative Registered Nurses
ASA	American Society of Anesthesiologists
ASPAN	American Society of PeriAnesthesia Nurses
AST	Association of Surgical Technologists
CW	Convection Warming
CRNA	Certified Registered Nurse Anesthetist
HME	Heat Moisture Exchanger
IRB	Institutional Review Board
NICE	National Institute for Health and Care Excellence
OR	Operating Room
RH	Resistive Heating
SCIP	Surgical Care Improvement Project
USM	The University of Southern Mississippi
WHO	World Health Organization

CHAPTER I- INTRODUCTION

In the operating room (OR) after induction of anesthesia, the anesthesia providers monitor a specific set of vital signs on every patient throughout the entirety of the procedure. These vital signs consist of blood pressure, heart rate, respiratory rate, pulse oximetry, and temperature. Of these vital signs, temperature contains the most various ways to monitor. There are multiple temperature conservation and warming devices and ways to maintain and raise temperature. These consist of Heat Moisture Exchangers (HME), forced warming devices, convection warmers, cotton blankets, and fluid warmers. With such a variety of devices to choose from, which one is the most effective for the anesthesia provider to use while still being cost effective and would a set guideline improve the incidence of hypothermia in the operating room, and is there a reduction in hypothermia if a guideline was implemented?

Clinical Question

To further develop the descriptive project, do anesthesia providers (P) using a temperature guideline (I) compared to not using a temperature guideline (C) affect the incidence of hypothermia (O) within the intraoperative period (T) in patients undergoing general anesthesia. Patients during these procedures are more likely to lose a large amount of heat through the exposed skin and vasodilatory effects of the volatile anesthetic, and thus, it is important to implement heat saving measures in this population of patients. According to Butterworth, Mackey, and Wasnick (2013), “hypothermia is associated with delayed drug metabolism, increased blood glucose, vasoconstriction, impaired

coagulation, and impaired resistance to surgical infections. Hyperthermia can likewise have deleterious effects in the perioperative period, leading to tachycardia, vasodilation, and neurological injury" (p. 136-137).

Background

In some facilities, anesthesia providers utilize a forced air warming device, resistive warming devices, passive warming, heat moisture exchangers (HME), and fluid warmers. The forced air warmer in general surgery is placed on the upper half of the body or the lower half of the body, depending on the surgical site; whereas, the HotDog, resistive warmer, is placed on the upper half of the patient and underneath the patient on the operating table. Both are placed on 43°C, which is the maximum temperature of each device. The most common device used by the anesthesia providers is the forced air warmer device, but some surgeons believe the forced air warming devices increase infection rates, so in these surgeons' rooms, the anesthetist uses a resistive warmer. "Hypothermia during surgery has been associated with adverse patient outcomes, the most significant of which is an increased rate of wound infection in patients who experience intraoperative and postoperative hypothermia" (Nicholson, 2013, p. 310). Other devices such as an HME, warm cotton blankets, and a warmer ambient temperature can be combined for the most effective increase and maintenance of the patient's temperature during the intraoperative period.

Significance

Multiple factors effect a patient's temperature throughout the perioperative period such as the ambient room temperature, the irrigation fluids, the amount of skin exposure during the procedure, prepping solution, and the vasodilating effects of anesthetic gas and drugs. The incidence of hypothermia can produce issues such as: surgical site infection, myocardial ischemia, prolonged drug effects, bleeding issues, shivering, increased length of stay and cost, and decreased patient satisfaction (Hart, Bordes, Hart, Corsino, & Harmon, 2011). In this project, the anesthetists implemented a set guideline on patients receiving general anesthesia, and through a pre-survey and post-survey, the anesthetists determined if the guideline implementation was effective in reducing intraoperative hypothermia. Having a set evidenced based clinical practice for anesthesia providers to follow will ideally help improve the incidence of hypothermia in this patient population.

Purpose

The purpose of this project was to determine if the implementation of this guideline enhances patient warming and prevents hypothermia by maintaining thermogenic homeostasis. There was a follow up with attitudes, the barriers, estimated use during the one month follow up period. It was then determined if the Certified Registered Nurse Anesthetists (CRNA) had a decrease in the occurrence of hypothermia in patients undergoing general anesthesia. By using devices that most efficiently maintain temperature and following a set guideline,

the anesthesia provider can prevent undesirable effects from hypothermia and save time and money.

Needs Assessment

Strengths (S) of this project was that there is an adequate amount of evidenced based literature involving the importance of preventing hypothermia and the devices and multimodal methods used to warm the patient. Weaknesses (W) of the project was that the entire OR staff will have to comply to the guideline to obtain an accurate assessment that the guideline worked. Opportunities (O) with this project included the availability of the warmers, temperature devices, and ease of changing ambient room temperature. Depending on the effectiveness of the hypothermia guideline, the staff could adopt this practice after the project or continue with their current methods. Threats (T) involved not using the devices correctly on the patient or not adequately placing the thermometer. Also, certain disease processes or obese patients could skew the data, because they could either lose or maintain heat more effectively.

Stakeholders

Due to the importance of temperature management, several organizations have made supporting statements on the importance of normothermia, including the Association of Surgical Technologists (AST), World Health Organization (WHO), the Association of perioperative Registered Nurses (AORN), American Society of PeriAnesthesia Nurses (ASPAN), American Society of Anesthesiologists (ASA), American Association of Nurse Anesthetists (AANA), and National Institute for Health and Care Excellence (NICE). The guideline used

for this project is one created by NICE and is used in other supporting articles. In this guideline the following recommendations are made:

- The patient's temperature is measured prior to induction and then taken every thirty minutes until the end of surgery.
- A critical incidence reporting should be involved with any patient entering the preoperative area with a temperature below 36°C (96.8°F).
- Anesthesia should not begin until the patient's temperature is above 36°C, unless in emergencies.
- Ambient room temperature should be at least 21°C (69.8°F), and once active warming is started, the ambient temperature can be decreased.
- Cover the patients adequately throughout the phases of care to prevent heat loss.
- Large amounts of intravenous fluids (>500ml) and blood products should be warmed with a fluid warming device to 37°C.
- If the anesthetic time is going to be 30 minutes or greater and the patient is at an increased risk for hypothermia, use a forced air warmer or resistive heating device.
- Set the temperature device to its maximum setting to maintain temperature of at least 36.5°C.
- Warm all irrigation fluids in a controlled cabinet to 38-40°C (National Institute for Clinical Excellence, 2016).

The anesthesia providers and operating room staff will implement these set guidelines to determine if there is a decreased incidence of hypothermia within this patient population.

Synthesis of Evidence

A systematic review was conducted searching for relevant, updated articles using Medline, Pub Med, EBSCOhost, CINAHL, and Google Scholar. Search terms used were: perioperative hypothermia, hypothermia protocol, resistive warmer, hypothermia guideline, preventing intraoperative hypothermia, and forced-air warmer leading to 11,600 results (on Google Scholar, PubMed, EBSCOhost, Medline, and CINAHL).

Articles included in the search included those that were published in the last 5 years, written in the English language, and correlated with hypothermia management and protocols. The article by Marcario and Dexter was an outlier because it was written 15 years ago and was used with this study due to focusing on both general and neuraxial anesthesia with hypothermia. With those applied search filters, 209 articles were related to a hypothermia protocol, intraoperative hypothermia, forced-air warmer, and resistive warming, so other articles were used as substantial evidence for which devices most effectively warm and maintain the patient's temperature intraoperatively. Of the articles reviewed, 4 articles were related to temperature protocols in the operating room. Other articles provided substantiating evidence towards the benefits of a normal temperature. For instance, 3 articles relay the implications of hypothermia, and 18 articles were found further explaining the methods used to warm the patient

and which ones are the most effective. After further review, 11 articles are used to provide evidence for the project.

Guidelines and Protocols for Preventing Hypothermia

Hart, Bordes, Hart, Corsino, & Harmon (2011) provided substantiating evidence emphasizing on the background of hypothermia and its deleterious effects and using the Surgical Care Improvement Project (SCIP) guidelines to decrease the incidence of hypothermia. The methodology of this study consisted of a literature review of "the physiology of temperature regulation, mechanisms of hypothermia, effects of anesthetics on thermoregulation, and consequences of hypothermia and summarize recent recommendations for maintaining perioperative hypothermia" (Hart, Bordes, Hart, Corsino, & Harmon, p. 259). The author proposed that warming the patient at 30 minutes minimum before surgery could decrease the incidence of hypothermia, and evading perioperative hypothermia through active and passive warming methods are significant in preventing complications from hypothermia (Hart et al., 2011, p. 259). Along with the evidence of the deleterious effects of hypothermia, the article also provided recommendations for preoperative, perioperative, and postoperative periods to identify vulnerable populations and prevent hypothermia.

Temperature management during an operation is a standard of care for anesthesia providers. According to Sappenfield, Hong, and Galvagno, "clinicians should have a sound understanding of available temperature monitoring sites, deleterious effects of hypothermia, and indications for therapeutic hypothermia" (2013, p. 1). The authors reviewed the importance of monitoring and preventing

perioperative hypothermia and concluded its finding with following the SCIP guidelines with an emphasis on understanding the physiology behind each measure in preventing hypothermia, while indicating that hypothermia is only allowable when trying to provide neuroprotection in special situations (Sappenfield et al., 2013).

Scott, Stonemetz, Wasey, Johnson, Rivers, Koch, and Frank (2015) utilized the data by retrospective chart review to determine which cases fell within the SCIP guidelines and which cases did not, forming a SCIP compliant group and a SCIP noncompliant group. Further data collection was used to find length of stay, infections, or other events and compare the two groups. The results showed that "body temperature on admission to the postoperative care unit was higher in the SCIP-compliant group (36.6° ± 0.5°C; n=44,064) compared with the SCIP-noncompliant group (35.5° ± 0.5°C; n = 1,240) ($p < 0.0001$)" (Scott et al., 2015, p. 116), and the SCIP compliant group showed a reduced number of infections, cardiovascular events, and length of stay.

The NQF-Endorsed Voluntary Consensus Standards for Hospital Care describes the various measures for surgical improvement, also known as the Surgical Care Improvement Project (SCIP). A description of the measure was that surgical patients should receive some form of active warming or have a temperature recording of greater than 36 degrees Celsius or 96.8 degrees Fahrenheit 30 minutes before anesthesia stop time or 15 minutes after ("SCIP-Inf-10," 2014, p. 1). The authors utilized a list of references to provide evidence

for the risks of hypothermia; however, no other details or statistic measured are produced.

Preventing Intraoperative Hypothermia

Marcario and Dexter based their study on a review of literature about the risk factors of hypothermia prior to surgery, and they also surveyed providers and physician researchers to identify the highest risks for a patient developing hypothermia intraoperatively (2002). In the research, Marcario and Dexter (2002) found that “neonates, a low ambient OR temperature, burn patients, and general anesthesia with neuraxial anesthesia were believed to be (by researchers and clinicians) the four factors most likely to result in hypothermia” (p. 217). First, the increased risk for neonates is the large surface area of the head in relation to the rest of the body, and second, low OR temperatures of <21°C frequently causes hypothermia. Next, both general and neuraxial anesthesia combined increases the incidence of hypothermia and have diminished thermoregulation and hypothalamic response (Macario & Dexter, 2002).

Aiming to compare peri-operative core temperatures, Fernandes, L. G. Braz, Koga, Kakuda, Modolo, Carvalho, Vianna, and J. R. C. Braz (2012) reviewed two groups of females, obese and non-obese, undergoing open abdominal surgery for the incidence of perioperative hypothermia. Included in the study were “22 female patients (ASA physical status 1-2) aged from 26 to 55 years, and who were scheduled for elective open abdominal gynecological surgery (hysterectomy or oophorosalpingectomy) of at least 120 min duration”

(Fernandes et al., 2012, p. 1345). Variables that fell outside of the set parameters were excluded. The results of the study showed:

> The mean (SD) core temperatures were 36.7 (0.5) °C in the obese group and 36.0 (0.6) °C in the non-obese group (p< 0.001). Only in the non-obese group was here a significant decrease in the intra-operative core temperature values (p <0.001). The incidences of intra-operative hypothermia were lower in the obese group (10%) compared with non-obese group (60%; p=0.019) (Fernandes et al., 2012, p. 1364).

Ultimately, this study showed the vast significant difference between the obese and non-obese patients throughout the operative phases.

Moola and Lockwood conducted a literature review of relevant articles and studies to determine which method is the most effective in preventing intraoperative hypothermia. Inclusions in this study consisted of patients of the age of 18, undergoing any surgery, and the types of warming interventions were cotton or linen blankets, forced- air warming devices, radiant warmers, fluid warmers, or aluminum foil wraps (Moola & Lockwood, 2011). The results of the study showed that forced-air warming in pregnant women had a reduced incidence of hypothermia. Intravenous or irrigation fluids warmed to a temperature greater than room temperature demonstrated favorable outcomes with patients having a higher core body temperature at the end of surgery (Moola & Lockwood, 2011). Of the devices, the “water garment warmer was significantly ($p<0.05$) effective than forced-air warming in maintaining intraoperative normothermia in orthotopic liver transplantation patients” (Moola & Lockwood,

2011, p. 337). Passive warming devices showed to be not effective in reducing the incidence of hypothermia (Moola & Lockwood, 2011).

Tanaka, Ohno, Hori, Utada, and Suzuki compared a resistive heating blanket (RH) to a convection warming system (CW) in patients undergoing abdominal surgery. Inclusions consisted of a BMI of 20-36, age between 20-80, an ASA score of 1-3, and the supine position (Tanaka et al., 2012). The patients were randomly selected to receive either a CW or a RH. The temperature was measured using an esophageal temperature probe, and the anesthetic technique consisted of placement of an epidural between T8 and L1 vertebra. Then, general anesthesia was induced with endotracheal intubation (Tanaka et al., 2012). According to Tanaka et al. (2012), "the effect of the RH (31 patients) was compared with that of upper-body CW (33 patients) in patients undergoing major abdominal surgery. The effect of RH was not inferior to that of CW regarding time-weighted average intraoperative temperature (p=0.80)" (p. 85).

Roder, Sessler, Roth, Schopper, Mascha, and Plattner conducted a study using 28 adults undergoing a major maxillary-facial reconstructive surgery to last 5 hours, excluding patients with vascular or metabolic disorders such as Reynaud's, thyroid disease, insulin dependent diabetes, or a ASA classification over 3 (Roder et al., 2011). After the study, the "Hot Dog resistive heating rewarmed at half the rate as Bair Hugger lower-body forced-air warming. Forced-air is thus preferable for rewarming surgical patients" (Roder et al., 2011, p. 672). In the two-tailed t-test, the hour by hour comparison of the Bair Hugger compared

to the Hot Dog showed a significant p- value ($p<0.05$), except for in the first hour of surgery which showed a p-value of ($p<0.087$).

In a randomized control trial Brandt, Oguz, Huttner, Waglechner, Chiari, Greif, Kurz, and Kimberger studied 80 patients having elective orthopedic surgery after gaining written consent on the day of surgery (2009). Core body temperature was measured using an esophageal temperature probe. They also measured various skin temperatures on the body. The following concluded from the study:

> After induction of anesthesia, core temperature decreased similarly for a period of approximately 30 minutes in both groups. Subsequently, core temperature increased at comparable rates in both groups (0.33°C/h±0.34°C/h and 0.29°C/h±0.35C/h for groups FA and RP, respectively; P = 0.6). There were also no differences between the 2 groups in the course for core temperature (Fig. 1, Table 1; P =0.12), mean body temperature (Table 1; P = 0.11), and mean skin temperature (Fig.2, Table 1; P = 0.48; all P values for comparison of normalized AUCs). We did not find significant intragroup core temperature differences between patients with esophageal and bladder core temperature probes (Brandt et al., 2009, p. 836).

John, Ford, and Harper (2014) conducted a literature review selecting randomized controlled trials and clinical studies for this study. After reviewing the various studies, the forced-air warming device outperformed the water mattress, passive warming, and negative pressure warming; however, the forced air

warmer in six of the nine trials showed no significant difference in comparison with the resistive heating (John, Ford, & Harper, 2014). The last three trials did show a significant difference of p-values ($p < 0.001$ and $p < 0.01$), outperforming the resistive heating device, and in no incidence or study did the resistive heating device outperform the forced-air warmer.

Comparison of Evidenced based Articles

When comparing the articles, each presents a different focus on temperature modalities. For instance, Hart et al. (2011) and Marcario and Dexter (2002) both focus on the importance of identifying risk factors for hypothermia prior to surgery, whether environmental or patient specific. Whereas, Fernandes et al. (2012) study focused on the obese and non-obese population, identifying that obese patients have higher temperatures in the operative phases in comparison to non-obese patients.

Two of the articles concentrated on abiding by the SCIP measures. Both Sappenfield et al. (2013) and Scott et al. (2015) emphasized the importance of following and implementing the SCIP measures on patients undergoing anesthesia Their studies showed that patients whose anesthesia providers who followed the SCIP measures had significantly higher temperatures entering the postoperative period in comparison to patients who had not received SCIP measures.

The remaining articles focus on warming interventions used. Sandeep Moola et al. (2011) and Roder et al. (2011) studies showed that forced air warmers outperformed the resistive heating device, but in the studies performed

by Tanaka et al. (2012) and John et al. (2014), the forced air warmer did not outperform the resistive heating device. The article by Brandt, et al. (2009) focuses on which temperature device shows the most accurate core temperature measurement, but between the esophageal temperature probe and the bladder temperature probe the study did not show any significance between the two.

Theoretical Framework

From the beginning, nursing has been based on theory. Florence Nightingale noticed that consistent attributes needed to be met and developed to regain the health of the patient, and as years past, the number of other theories on the wellbeing of the patient also increased. Despite the many number of technological innovations, it remains difficult to meet the simple needs of a patient in certain settings. For example, in the surgical setting, the operating room is kept at a very cool temperature and most facilities go below the recommended target range. Due to this, patients in the intraoperative setting are at an increased risk for developing hypothermia. Thus, the 14 components of basic nursing care developed by Virginia Henderson best encompasses this issue of temperature regulation.

Like Florence Nightingale, Virginia Henderson expounded on the necessity of meeting the basic needs of a patient. These 14 basic needs range from breathing normally to an adequate diet, to eradicating wastes, to maintain stance, to adequate sleep, to wearing appropriate clothing, to retaining temperature, cleanliness, to avoiding harming, to adequate communication, to meeting spiritual needs, to feeling proficient, to participate in activities, and to

maintaining an education about his or her health (Henderson, 1991). Many assumptions were also made about Henderson's 14 component of nursing care. Some of these components consist of the nurse being in a distinctive position to help the patient, the nurse being a member of the health team, the nurse protecting the patient from his or her environment, etc. (Butts & Rich, 2015). Henderson's 14 needs were intended to encompass the entire continuity of patient care and nursing itself and her novel idea that "nursing care should be based on evidence rather than tradition, an idea that was novel at the time, is currently foundational to the discipline of nursing, including advanced practice nursing" (Butts & Rich, 2015, p. 390).

Although the surgical environment of the operating room is meant to facilitate sterility and the needs of the patient, many facilities have a deficit on maintaining an adequate operating room temperature, and most of the time the temperature is adjusted and used to facilitate the comfort of the operating room staff versus the patient. This cold environment can have harmful effects on the anesthetized patient, and "hypothermia can lead to various complications such as shivering, longer postoperative wakeup times, compromised coagulation, ischemic heart events, and lowered immune defenses against surgical wound infections" (Costanzo, Cusumano, Ciaconia, & Massacane, 2014, p. 1). The part of Henderson's 14 basic needs that closely relates to this project is maintenance of an adequate temperature whether by changing clothes or the environment, and when a patient undergoes surgery, he or she is under the responsibility of multiple providers. The goal of this project was to provide the anesthetic provider

with a guideline to implement when the patient's temperature falls below 36° C or prevent the patient from reaching a hypothermic state and encourages using the most effective warming devices to maintain or increase the patient's body temperature.

The anesthetist is ultimately responsible for the patient's temperature when he or she undergoes surgery, and as previously stated, many times the ambient room temperature is adjusted to the comfort level of the surgical team versus the patient. Thus, on top of the heat lost to an open surgical site, the ambient room temperature effects the patient's ability to maintain a normal temperature while under anesthesia. Therefore, the anesthetist intervenes with various heat saving devices such as fluid warmers, humidity moisture exchangers, forced air warming blankets, and convection warming blankets. Henderson's basic need of maintaining adequate body temperature correlates well with this project, but in the surgical environment, the anesthesia provider is responsible for changing the environment to maintain the patient's temperature.

Implementing Henderson's basic needs, my project focused on implementing a hypothermia guideline and then through a retrospective chart review determined if the guideline reduced the number of patients with hypothermia during the intraoperative period. Practice implications for this project and theory were for anesthesia providers to utilize the best warming methods that are inexpensive yet efficient during the intraoperative period. Along with a multimodal approach to warming, the anesthesia provider must choose the most efficient warming method according to a set guideline.

Model

Over the years, several evidence-based practice models have been developed for various setting and healthcare professionals. The Iowa model of evidence-based practice are used to promote change in practice in an organization. The Iowa model is “based on the problem-solving steps in the scientific process and is widely recognized for its applicability and ease of use by multidisciplinary healthcare teams” (Malnyk & Fineout-Overholt, 2015, p. 283). This model encourages practitioners to identify practice problems from either clinically based knowledge or new evidence. With a newly discovered practice problem, the Iowa model helps identify a solution to the problem through clinical application. However, not every problem will be addressed with evidence-based practice. Instead the organizational method is used to prioritize certain problems according to cost, risk, and size. Next, a team is formed to help apply and assess the practice change. The team can consist of staff nurses, physicians, managers, and advanced practice nurses. The next steps are providing a pilot for practice change, and reviewing the pre-pilot data with the post-pilot data will show whether the pilot was an accomplishment (Malnyk & Fineout-Overholt, 2015). From the comparison of the data, it is then determined if the facility will adopt the practice, and even if the practice is adopted, the change needs to be continually evaluated and assess for accuracy and successfulness.

The Iowa model, however, is more applicable and can be easily utilized by nurses and other clinicians, which is one of the strengths of this model. Its greatest strength of a team work approach can also be a weakness and threat to

credible evidence. The feedback loops in the Iowa model can be unorganized when coming from many different individuals; therefore, to improve this practice, one needs to keep the team to a small number so the feedback goes through fewer individuals.

The Iowa model of evidence-based practice would coincide better with the study of implementing a warming guideline. For example, at the proposed practice site, the practice problem was anesthesia personnel not following a set guideline for patients with hypothermia or near hypothermia. With this practice model, the formation of a team to implement this practice change was essential and consisted of communication between surgeons, circulating nurses, surgical technologists, anesthesiologists, or advanced practice. The anesthesia technologists provided and supplied the anesthesia carts with the variety of warming devices and accessories, and then, the anesthesiologists and nurse anesthetists used the devices available correctly to elevate and maintain temperature. The providers then recalled from memory previous patient's temperatures, and the data collected via the survey was evaluated to determine if the use of the temperature protocol reveals less noticeable incidences of hypothermia by anesthesia providers. After the initial evaluation process, the study was continually reassessed to determine if the intervention was successful.

DNP Essentials

Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care

Technology has crept its way into many aspects of health care. With this project and at this facility, technology plays an important role in providing the anesthesia personnel with continuous temperature monitoring throughout a case, so minute by minute, the monitor provides a current trending temperature and allows them to quickly identify a downward trend in temperatures to prevent hypothermia. However, occasionally technology fails, and one comes across a faulty temperature probe. Also with technology, new warming devices are created trying to compete and improve on older designs. Through technology, anesthesia providers can combat hypothermia instead of strictly relying on blankets and ambient temperatures.

Healthcare Policy for Advocacy in Healthcare

This project's purpose was to provide a guideline to reduce the incidence of accidental perioperative hypothermia. The anesthesia providers were able to identify at risk patients and implement appropriate warming measures. The use of this guideline prevented hypothermia and its negative side effects.

Clinical Prevention and Population Health for Improving the Nation's Health

Anesthesia providers battle hypothermia in a variety of settings and would benefit with a set system and guidelines in place to prevent hypothermia and its harmful effects. With clinical prevention of hypothermia, the patient and hospital with benefit from reduced length of stay due to preventing hypothermia's deleterious effects. These values could also impact patient satisfaction.

Scientific Underpinnings for Practice

Hypothermia during the intraoperative period can cause harmful effects, such as coagulopathy issues, altering drug metabolism, increasing infection and immune suppression. For this reason, it is important to keep the patient warm and choose the best method. Implementing a hypothermia guideline into practice could help eliminate the issues associated with hypothermia.

Organizational and Systems Leadership for Quality

By determining whether the protocol improves the incidence of hypothermia, the anesthesia providers and physicians can then determine which method to use consistently on a larger patient population to prevent hypothermia. If no major improvement is made, then the guideline will not be used. However, this information will also provide how well the CRNAs follow the set guideline.

Improvement and Systems Thinking

Many anesthesia providers simply do whatever is necessary to warm the patient without any specific guideline. This project either clarified or deterred their opinions of implementing a guideline to follow and decreased the number of patients who get hypothermia during the intraoperative period. At the end of the project, the provider had the necessary information to adequately warm a patient in special circumstances.

Clinical Scholarship and Analytical Methods for Evidenced-Based Practice

A survey and analysis was conducted on the anesthesia providers after the implementation of a warming guideline in patients who underwent and general anesthesia. After the guideline is utilized by the CRNAs, an analysis of the data was performed to determine if there was a decrease in patients with

hypothermia. Also, this project showed how well the CRNAs followed the guideline.

Interprofessional Collaboration for Improving Patient and Population Health Outcomes

The determined outcomes of the project helped the collaboration between the surgeons and the anesthesia providers on deciding which warming method will best benefit the patient. Everyone on the surgical team can contribute in temperature management by providing a suitable ambient room temperature of 21°C and warmed irrigation fluids. Ultimately, it takes a mutual effort from everyone impacting the patient to have a positive effect on patient outcomes. Utilizing a hypothermia guideline can only be accomplished through collaboration with other healthcare providers.

Advanced Nursing Practice

The nurse anesthetist is an advanced practice nurse. The hypothermia guideline will benefit the nurse anesthetist during the surgical setting and prevent inadvertent perioperative hypothermia through implementing a warming protocol. Therefore, it is vital to have a device that can efficiently sustain the patient's temperature to prevent the harmful effects of temperature fluctuations intraoperatively.

If a patient is hypothermic during surgery, he or she metabolizes the medication more slowly thus taking longer to wake up and increases the possibility of postoperative shivering, along with other deleterious effects. Previously, an introduction to hypothermia prevention was thoroughly described,

and the literature was reviewed and compared to determine the most recent data and temperature management methods. Next, the methodology for this project is reviewed.

CHAPTER II- METHODOLOGY

Design: Part 1

The design for this project was a descriptive study with a pre-survey/post-survey that "looks at the outcomes of interest before the application of an intervention and then after an intervention" (Terry, 2015, p. 85) and a worksheet to be filled out after each case. First, a pre-survey was conducted via surveying the anesthesia providers on their current knowledge and interest on implementing current hypothermia guidelines in the intraoperative period. Second, an educational handout was developed by author from the NICE 2016 clinical practice guidelines. Current evidence based information about hypothermia clinical practice guidelines was provided on a handout and distributed to the anesthesia providers. After presentation of this information to the providers, an opportunity for questions and answers followed. Third, post survey was offered 30 days later and was available to the participants for 24 hours.

Participants created a four-digit personal identifier to place on both pre-survey, post survey, and case worksheet. To remain anonymous, the surveys were submitted to a sealed box in the break room within 24 hours of the information handout. After 30 days, a post-survey was collected from the anesthesia providers to determine (1) if they implemented the current guideline, (2) if they saw any reduction in the number of patients with hypothermia, and (3) submitted via a sealed box in the break room. Descriptive statistics was used to

evaluate and summarize the data collected from the pre- survey, post survey, and case by case worksheet.

Design: Part 2

After education of the anesthesia providers on the current clinical practice guidelines, they implemented these recommendations in their practice on the described patient population. The anesthesia providers were encouraged to follow and implement the warming guideline as needed on patients who general anesthesia. A case by case worksheet was left in the Post Anesthesia Care Unit (PACU) to be filled out after each case and submitted in a sealed box within 24 hours of the work day.

Setting

The primary facility is a 512-bed hospital, level 2 trauma center in the southeastern region of the United States that services a 19-county area. It has 17 ORs serviced by 45 CRNAs and 12 anesthesiologists. Although students were facilitated at the site, they were excluded from this project.

Time

After The University of Southern Mississippi (USM) Institutional Review Board (IRB) approval (Protocol number 17082206) is received, the time frame for the intervention was 30 days. A pre-survey and educational handout was provided prior to the implementation of the hypothermia guideline by the nurse anesthetists. After the 30-day period, a post survey was collected.

Population and Sample

The population being evaluated for this project was the anesthesia providers at facility found in the southeastern portion of the United States. In this sample, participants were greater than 18 years of age. The provider specifically being included were CRNAs. All other anesthesia providers were excluded from the project, including anesthesiologists or Student Registered Nurse Anesthetists (SRNA). All CRNAs included were from the main campus 512 bed level 2 trauma center hospital in Southeast Mississippi.

Limitations

Limitations of this project included the limited number of providers and having them to participate in this project. Ethical considerations were maintaining patient confidentiality in discussing cases with anesthesia providers. While the CRNAs were known to this SRNA, the responses of the CRNAs remained anonymous.

Risks

The project being proposed did not pose any physical, psychological, or sociological risk. No identifying information was collected from the participants. A pre-presentation survey was given to participants and collected for 24 hours. The author kept them sealed in a locked box only accessible by the author. The pre-survey, case by case worksheet, and post survey contained self-selected identifiers, and to avoid the same numbers from being selected, the author had a deck of cards for the providers to randomly select a single card. The provider

kept this card and used it as a personal identifier throughout the project and use abbreviations such as QHT, QDI, QCL, and QSP for queen of hearts, diamonds, clubs, and spades. After the data was collected, it was reported as aggregate data and was not paired.

Next, an evidenced-based presentation for the temperature protocol guidelines was offered. The case by case worksheet was collected weekly from a sealed box placed in PACU. No identifying information was placed on the case by case worksheet, only the self-selected personal identifier was used from a deck of cards.

After a month, the participants completed a post-intervention survey and place it in a locked box at the OR desk. The author has the only key to the lock box. The author asked the participants to complete the post-presentation surveys and asked them to return the surveys to the sealed, secured box within 24 hours. After the 24 hours, the post surveys were collected.

Variables

To determine if the validity of this project, the design provided a basis to show if the independent variables did or did not cause a change in the dependent variable. Dependent variables included the anesthesia providers who remain the constant in the project. Each provider received the same information and surveys to complete. Independent variables included the different experience each provider experienced when implementing the protocol.

Data Collection

The data collection used for this project consisted of a pre-survey and post survey conducted on the CRNAs collected prior to their education on the hypothermia guideline. After the CRNAs utilized the guideline into their practice, it was determined if the use of the guideline reduced the incidence of hypothermia through specific survey questions and the case by case worksheets.

End Data Collection

The information gathered throughout the project is gathered through personal computers that were password protected. Data was stored on electronic files on a personal computer. The information and data gathered throughout this project will be disposed of within 6 months after graduation in December 2017 after all requirements have been met.

Data Analysis Plan

A collection and summary of the survey responses were done by hand, and every response was kept anonymous. The results of this project focused on the anesthesia provider's responses to the survey on the hypothermia guideline and if the patients were hypothermic or normothermic with the use of the hypothermia protocol. The case by case worksheets will show which parts of the guideline were initiated and which were not.

Conclusion

The design, setting, and variables are reviewed in the third chapter, explaining in detail how the project will be conducted. The next chapter contains

the data gathered and analyzed from the pre-survey and post survey within the time frame specified.

CHAPTER III– ANALYSIS OF DATA

The CRNAs were provided with a pre-survey questionnaire to complete in the break room. After completing the survey, a handout was provided and explanation of the importance of preventing hypothermia along with the hypothermia guideline. The hypothermia guideline was explained to each provider. They were informed about the case by case worksheets to be completed daily for 30 days and submitted in a drop box in PACU after each case. After the completion of the data collection period, the case by case worksheets were collected and kept in a secure location for analysis. After 30 days, a post-survey was provided to the CRNAs.

Statistical Analysis

Nine of the anesthesia providers completed the questionnaires and were involved in the presentation of the information. Descriptive statistics were used to determine the mean of each question on the pre-survey and the case by case worksheet. The pre-survey was available on August 25, 2017, and the post survey was available September 24, 2017. Each provider was allotted 24 hours to complete the pre/post surveys. The case by case worksheet was filled out daily. Nine CRNAs were surveyed and participated in the project. The final sample size was 9 out of a population of 45 CRNAs employed at the facility. Eighty-eight percent (88.8%) of the participants were male (n=8) and 11.1% were female (n= 1).

Survey results indicated that CRNAs did not have a decrease in the number of hypothermic patients in the intraoperative period after using the guideline in practice. The surveys and case by case worksheet asked a sequence of questions to determine if the CRNAs utilized the hypothermia guideline and if they had a reduction in the number of hypothermic patients, as well as other pertinent questions. The pre-survey was attached as Appendix F.

CRNA Response to Pre-Survey

Of the responders, the majority have been practicing less than 5 years or between 11 – 15 years. This was illustrated in Figure 1. The responses to Figure 2 indicate that the CRNAs believed their current techniques are adequate to prevent hypothermia.

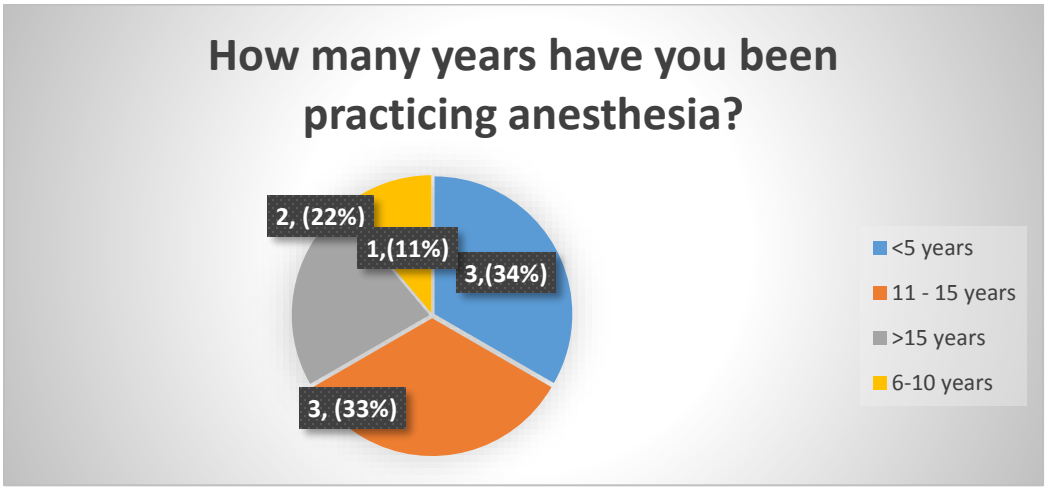

Figure 1. How many years have you been practicing anesthesia?

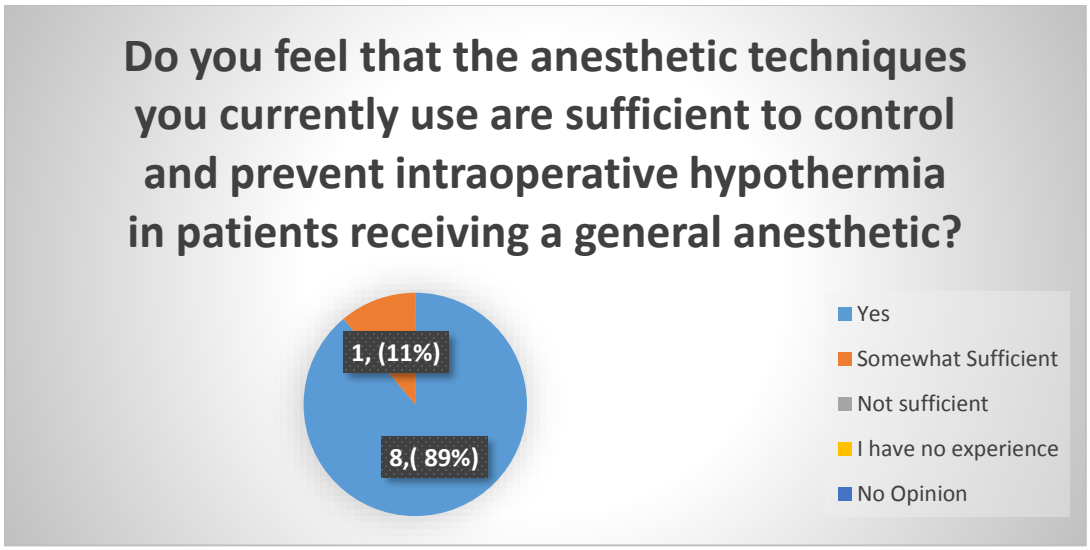

Figure 2. Do you feel that the anesthetic techniques you currently use are sufficient to control and prevent intraoperative hypothermia in patients receiving a general anesthetic?

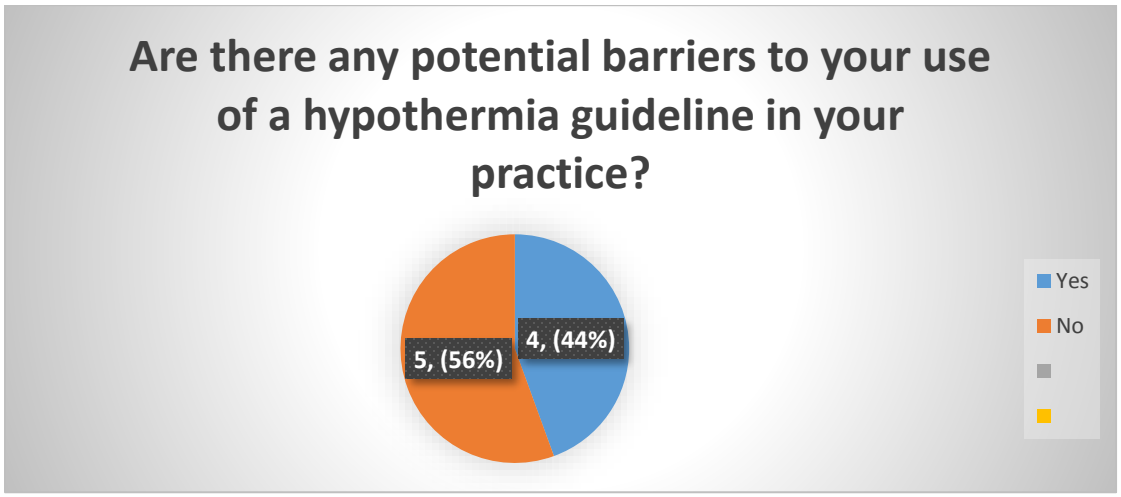

Figure 3. Are there any potential barriers to your use of a hypothermia guideline in your practice?

Although a majority (56%) of the participants believed there were no barriers to implementing a hypothermia protocol, 44% of the participants stated there were barriers to using a hypothermia guideline. Figure 3 showed the results of the barriers stated by the CRNAs. Such barriers were list as multiple operation

sites, surgeons refusing to use forced air warmer or to warm the room, certain sites do not have forced air warmers, and freezing rooms.

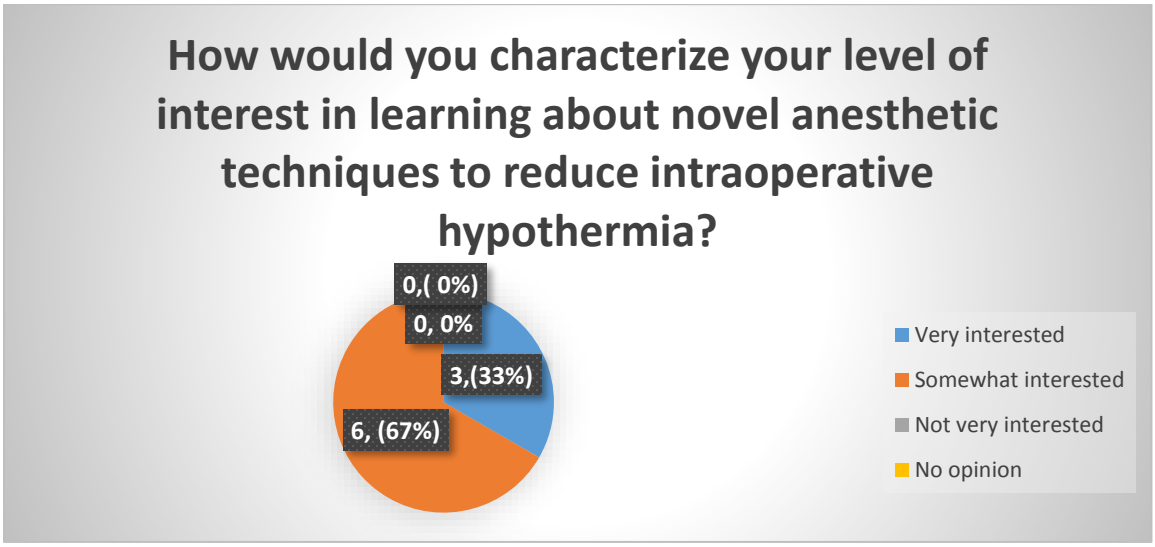

Figure 4. How would you characterize your level of interest in learning about novel anesthetic techniques to reduce intraoperative hypothermia?

In Figure 4, everyone indicated they had some interest in learning techniques to reduce hypothermia. Every participant considered implementing this hypothermia guideline in their practice with 8 out of 9 responses. With this willingness to implement the hypothermia guideline, each provider was asked to fill out case by case worksheets daily for a 30-day period. The results are as listed in Figure 6.

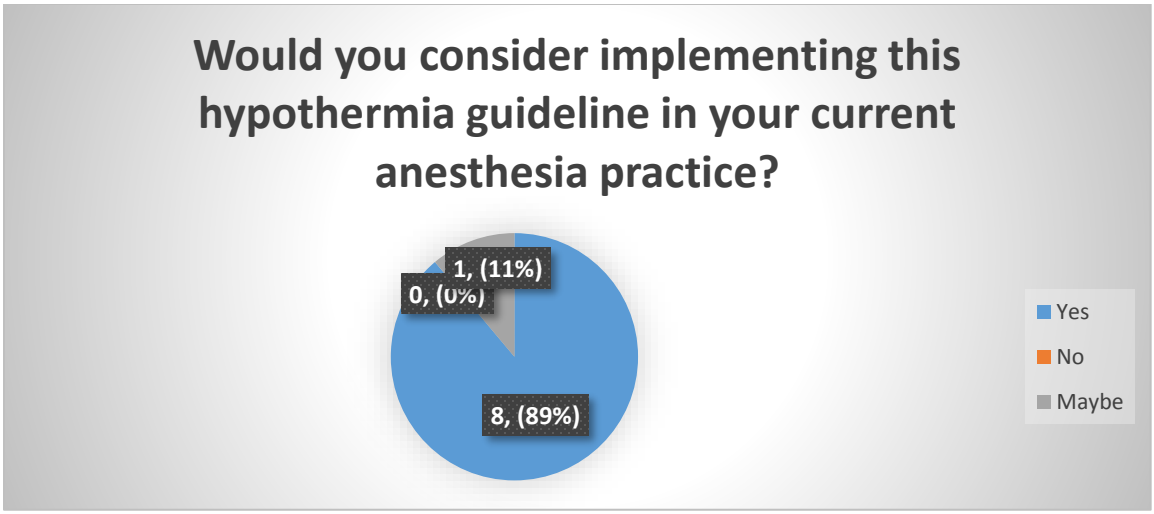

Figure 5. Would you consider implementing this hypothermia guideline in your current anesthesia practice?

Case by Case Worksheet Response

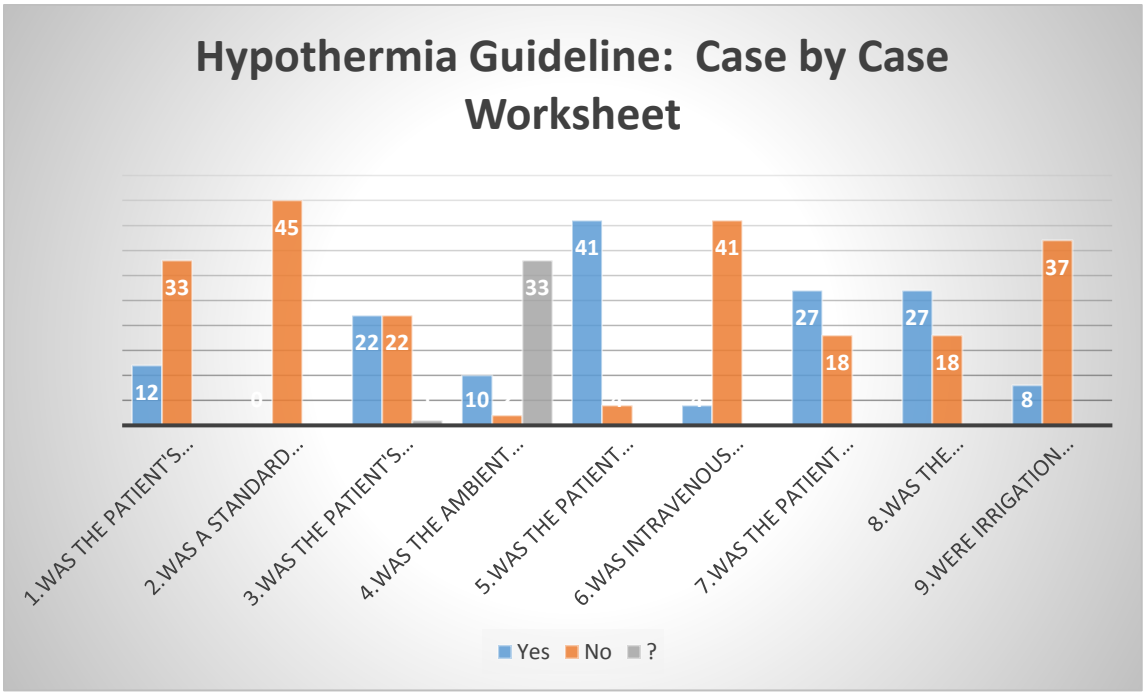

Figure 6. Hypothermia Guideline: Case by Case Worksheet

After the 30-day period, the secure box and worksheets were collected and brought to a secure location for analysis. A total of 45 worksheets were

submitted, and of the 9 participants in the pre-survey, only 4 completed the case by case worksheets. The initial question of the survey asked if the patient's temperature was measured prior to induction 33/45 (73%) answered no. With such a majority answering no, there must have been some confusion when reading the question. Every patient upon admission has a temperature recorded with their vital signs in the preoperative area, and this information is accessible in the patient's electronic chart. For future purposes, this question should be altered for a better understanding. Question 2 of the worksheet revealed that every patient (100%) arrived in the operating room with a temperature greater than 36°C, and one must consider that this data was achieved in the Deep South during the month of September with temperatures averaging in the 90s.

When asked if the patient's temperature was above 36°C 22/45 (48.8%), responses answered yes and 22/45 (48.8%) responses answered no. Ambient temperature is not well accounted for by the CRNAs, 33/45 (73.3%) participants not knowing what the room temperature is while in the operating room. A large majority of responses 41/45 (91.1%) stated the patient was adequately covered. However, 41/45 (91.1%) did not use a fluid warmer during the intraoperative phase. Questions 7 and 8 of the worksheet both had 27 participants (60%) answer yes to using a forced air warmer and turning it to the highest setting, and when asked about warm irrigation fluids, 82% answered no.

CRNA Response to Post Survey

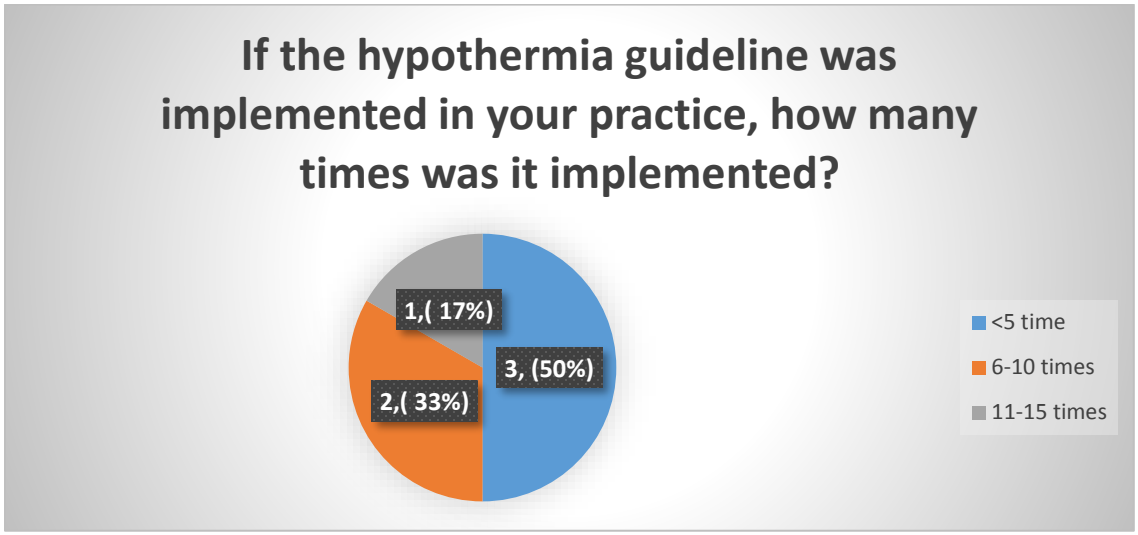

Figure 7. If the hypothermia guideline was implemented in your practice, how many times was it implemented?

After the post survey, 6 providers participated in the post survey. The analysis of the data showed that the participants implemented the protocol less than 5 times (50%), 6-10 times (33%), and 11-15 times (17%). Figure 7 showed the results. Despite implementing the hypothermia guideline, as shown in Figure 8, 50% of the CRNAs stated that hypothermia was still observed; however, 50% stated they did not observe hypothermia.

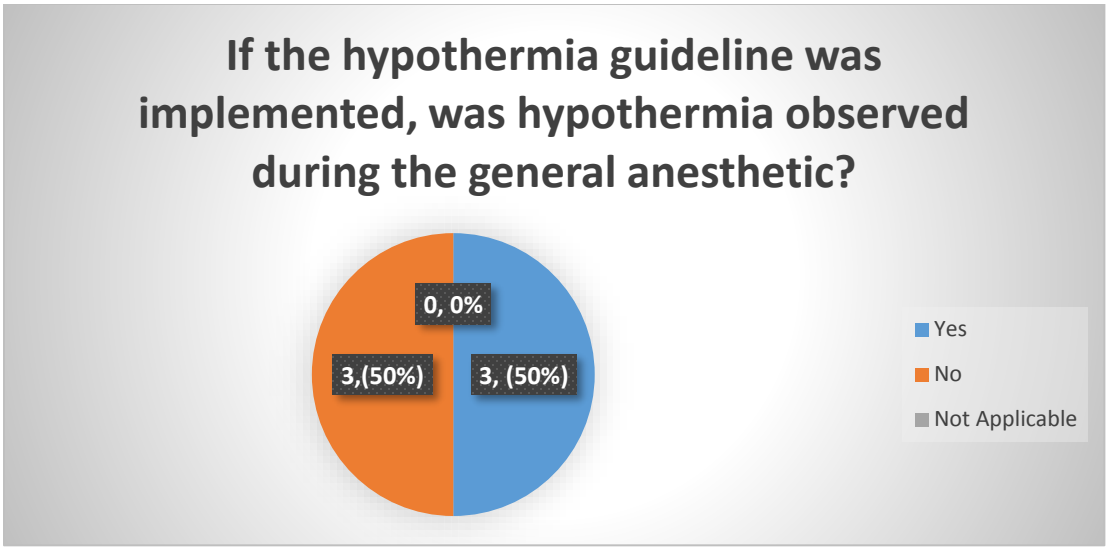

Figure 8. If the hypothermia guideline was implemented, was hypothermia observed during the general anesthetic?

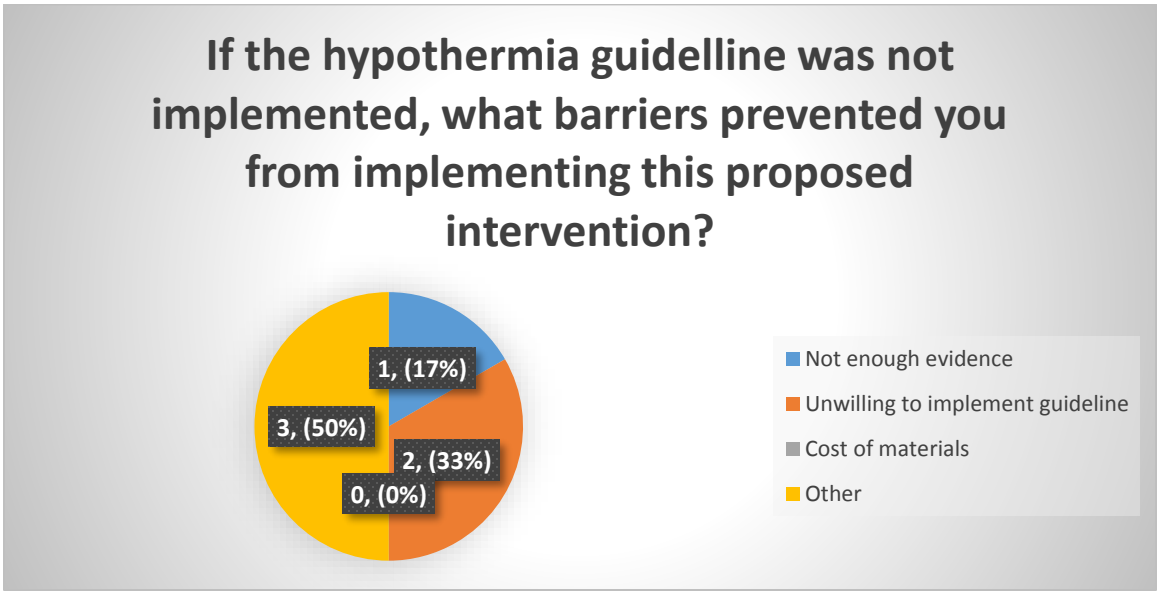

Figure 9. If the hypothermia guideline was not implemented, what barriers prevented you from implementing this proposed intervention?

In Figure 9, the barriers to implementing the hypothermia guideline was reassessed. In the post survey, barriers listed by the participants were surgeons not allowing the temperature to be increased and failure to follow the guidelines.

After the project, all the CRNAs (100%) considered implementing the hypothermia guideline into their future practice. This is illustrated in Figure 10.

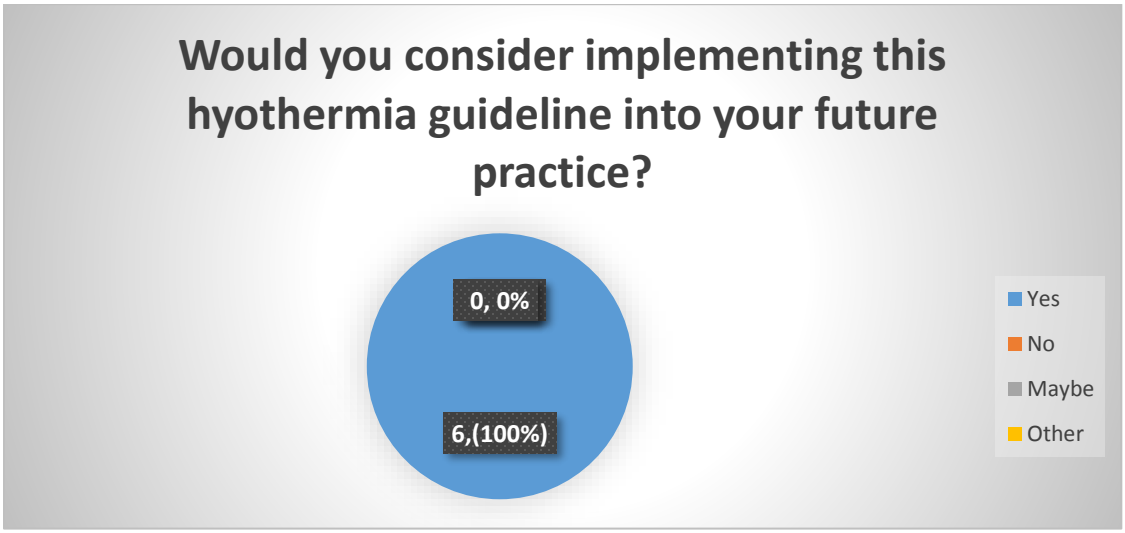

Figure 10. Would you consider implementing this hypothermia guideline into your future practice?

Outcome related to following guideline

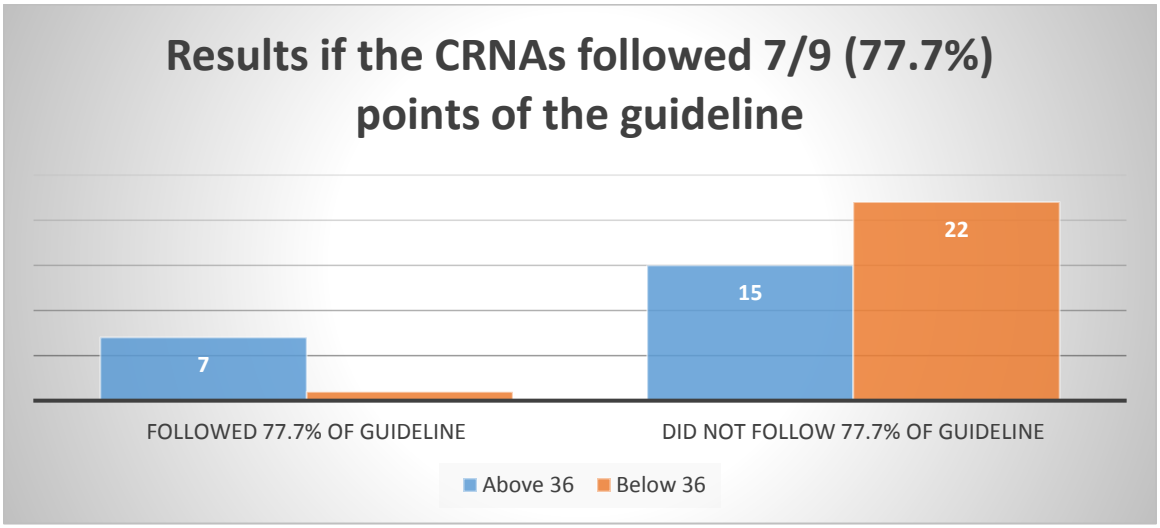

Figure 11. Results if the CRNAs followed 7/9 (77.7%) points of the guideline

A total of 8 worksheets followed the guideline within 77.7%. Of the responses, 7/8 (87.5%) had patients with temperatures above 36°C. Thirty-seven worksheets did not follow 77.7% of the guideline. Of these responses, 15/37 (40.5%) stated their patients were above 36°C. The difference between the two groups was 47% who did follow the guideline and who did not follow the guideline.

Clinical Question Response

Reviewing the clinical question, “Do anesthesia providers, implementing a temperature guideline compared to not using a temperature guideline affect the incidence of hypothermia within the intraoperative period in patients undergoing general anesthesia?” This question was answered during the survey. The question addressed in Figure 8 suggests that 50% still observed hypothermia despite using the hypothermia guideline. The results of this project tie back into

the theory set forth by Virginia Henderson, which precludes that anesthesia providers alter the environment to affect the patient's temperature in the operating room.

Summary

After reviewing the collected data and determining the results, the implications for future practice and further recommendations were determined. The recommendations were based from barriers stated by the CRNAs and clarifying questions on the questionnaires. Any futures implications made were altering the size and type of project involving the data collected on the hypothermia guideline.

CHAPTER IV– DISCUSSION

Recommendations

Recommendations for this project would be for anesthesia providers to be cognizant of the ambient temperature. Repeating this study with a larger sample size could provide better incite. Reflecting on the data collected from the pre-surveys, barriers to using a hypothermia guideline are freezing rooms, surgeon reluctance to warm rooms or use Bair Huggers, certain sites do not have Bair huggers, and multiple operation sites. Barriers mentioned in the post surveys were surgeons refusing to raise room temperatures or failure to implement the guideline. Other limitations and barriers observed in the study is the small sample size, lack of information on case types, provider reliability, and low participation of practicing CRNAs.

Implications for Future Practice

A descriptive project with a larger sample size would be beneficial to collect and measure direct temperature measurements of patients. Educating the entire OR staff and surgeons on the importance of preventing hypothermia to gain the involvement of multiple providers would be beneficial in preventing hypothermia. Clarification of question 1 in the case by case worksheet is recommended to prevent any further confusion. Questions should be added to the questionnaire to explain why the CRNAs did not use certain aspects of the hypothermia guideline. For example, was the case less than 30 minutes? What case type was the procedure (obstetrics, orthopedic, general, gastric, thoracic,

and urology)? An area to write in responses in the surveys would offer further clarification on why they chose a certain response. These questions would further explain why a forced air warmer would or would not be used. Repeating this project with a larger sample size would be beneficial and would determine if there are different results in the outcomes of hypothermia.

Conclusion

When abolishing the patient's innate physiologic ability to self-regulate his or her own temperature, the CRNA must act according to the patient's best interest. Despite the outcomes of the survey showing that 50% of the CRNAs still had patient's experience hypothermia despite using the guideline, a multimodal use of heat saving strategies and utilizing the guideline to its entirety is still beneficial in preventing the harmful effects of hypothermia in the intraoperative period. Acceptance of a universal guideline could still be beneficial to the facility to reduce this risk and improve healthcare outcomes and patient satisfaction.

[redacted]

Date 6/19/2017

RE: Letter of Support letter for Ashley Rigdon

Attn: IRB Application Process-DNP NAP Student

To: IRB Chair and Committee

This letter is in reference for Ashley Rigdon who is full-time a SRNA in the Doctor of Nursing Practice-Nurse Anesthesia Graduate Program at the University of Southern Mississippi, Hattiesburg campus. She is planning on graduating in December 2017.

I am the Chief Anesthesiologist a[redacted]n Hattiesburg, MS. I am offering this letter of support of the SRNA doctoral student, Ashley Rigdon, in her doctoral project titled *Implementing a Temperature Protocol to Decrease the Incidence of Intraoperative Hypothermia in Patients Undergoing General Anesthesia.* I understand that letter of support will be included in the University of Southern Mississippi Institutional Review Board (IRB) application.

I understand that that time frame of this project intervention is the early summer to fall 2017 and the dates will be fully known after proposal and IRB process is completed. As the Chief Anesthesiologist, I support Ashley Rigdon in this clinical practice endeavor. Her Chair is Dr. Cathy Hughes and may be reached at cathy.hughes@usm.edu or cell 601-550-7357.

I look forward to hearing the results of this study and the implications for clinical practice. If there is any other information you should need, please do not hesitate to contact me.

Sincerely,

[redacted]

APPENDIX B – Nursing Research Committee Approval [redacted]

Patient Care Services—Research Committee

RESEARCH PROPOSAL LETTER OF AGREEMENT

TO: Ashley Rigdon

FROM: Research Committee

RE: Proposed project/study entitled: CLINICAL PRACTICE UPDATE ON A TEMPERATURE GUIDELINE TO DECREASE INTRAOPERATIVE HYPOTHERMIA IN PATIENTS UNDERGOING GENERAL ANESTHESIA

On August 8, 2017 your research project/study proposal was approved by the Nurse Practice Council to be conducted within Patient Care Services at [redacted]. You are free to proceed with your project/study within the following guidelines:

1. You are required to complete an online non-employee orientation that is administered though our Education Department (601-288-2677).
2. A *Non-Employee Confidentiality and Nondisclosure Agreement* must be signed during the online orientation process.
3. Any modifications to this approved study must be re-routed to the Research Committee. All activity on this project must stop until you are notified by the Research Committee Chair of Committee's decision regarding proposed changes
4. Data Collection Period:
5. Inform Research Chair when data collection is initiated and when completed (via e-mail)
6. Provide results of study to committee (may provide presentation or written documentation of findings)

Sincerely,

Linda Holmes, MSN, RN-BC

Chair, [redacted] Research Committee

[redacted]

I, _____, have reviewed the above guidelines and agree to comply with the terms of this *Research Proposal Letter of Agreement.*

Signature:_____ Date:_____

Facility/School/Other Association: _____

APPENDIX C – Cover Letter

THE UNIVERSITY OF
SOUTHERN MISSISSIPPI

COLLEGE OF NURSING

118 College Drive #5095 | Hattiesburg, MS 39406-0001
Phone: 601.266.5445 | Fax: 601.266.5927 | nursing@usm.edu | www.usm.edu/nursing

Dear Sir or Madam:

I am a doctoral student in the Nurse Anesthesia Program (NAP/DNP) at the University of Southern Mississippi. I am conducting my clinical doctoral project on IMPLEMENTING A TEMPERATURE GUIDELINE TO DECREASE THE INCIDENCE OF INTRAOPERATIVE HYPOTHERMIA IN PATIENTS UNDERGOING GENERAL ANESTHESIA.

Thank you for taking the time to complete this survey. Your feedback is important in helping to gather information on clinical practice guidelines update on temperature regulation to reduce incidence of hypothermia. This survey should take approximately 5 to 10 minutes of your time to complete.

Your participation is completely anonymous and voluntary. If you choose not to participate or withdraw from the study at any time, there will be no penalty. By participating you are confirming that you are 18 year old or older.

The researcher may use the results of this study at scientific conferences or in publications. Please answer the questions the best you can. Please return the survey the provided sealed box in the break room. Please complete the provided per case worksheet about implementing the temperature clinical practice guideline and deposit it in the provided sealed box in PACU within 24 hours of your work day. If you have any questions concerning the research study, please contact me.

This project has been reviewed by the USM Institutional Review Board, which ensures research projects involving human subjects follow federal regulations. Any questions or concerns about rights as a research participant should be directed to the Chair of the Institutional Review Board at (601) 266-5997. If you have any questions about this research you may contact my Chair, Dr. Cathy Hughes at cathy.hughes@usm.edu

Sincerely,

Ashley Rigdon

APPENDIX D – USM IRB Approval Letter

THE UNIVERSITY OF
SOUTHERN MISSISSIPPI

INSTITUTIONAL REVIEW BOARD
118 College Drive #5147 | Hattiesburg, MS 39406-0001
Phone: 601.266.5997 | Fax: 601.266.4377 | www.usm.edu/research/institutional.review.board

NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months.
  Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: 17082206
PROJECT TITLE: Clinical Pracitce Update on a Temperature Guideline to Decrease Intraoperative Hypothermia in Patients Undergoing General Anesthesia
PROJECT TYPE: New Project
RESEARCHER(S): Ashley Rigdon
COLLEGE/DIVISION: College of Nursing
DEPARTMENT: Advanced Practice
FUNDING AGENCY/SPONSOR: N/A
IRB COMMITTEE ACTION: Exempt Review Approval
PERIOD OF APPROVAL: 08/22/2017 to 08/21/2018
Lawrence A. Hosman, Ph.D.
Institutional Review Board

APPENDIX E – Pre-Survey

Hypothermia Guideline: Pre- Survey

Please create a 4-digit numerical **personal ID**: _____

1. Do you give your consent for the results of this survey to be used in an educational research project?
    a. Yes
    b. No
2. Are you over the age of 18?
    a. Yes
    b. No
3. What is your gender?
    a. Male
    b. Female
4. How many years have you been practicing anesthesia? _____
5. Do you feel that the anesthetic techniques you currently use are sufficient to control and prevent intraoperative hypothermia in patients receiving a general anesthetic?
    a. Yes
    b. Somewhat sufficient
    c. Not sufficient
    d. I have no experience
    e. No opinion
6. Are there any potential barriers to your use of a hypothermia guideline in your practice?
    a. Yes
    b. No
    c. If yes, please explain:_____
    _____
7. How would you characterize your level of interest in learning about novel anesthetic techniques to reduce intraoperative hypothermia?
    a. Very interested
    b. Somewhat interested
    c. Not very interested
    d. I have no experience
    e. No opinion
8. Would you consider implementing this hypothermia guideline in your current anesthesia practice?
    a. Yes
    b. No
    c. Maybe

APPENDIX F – Post Survey

Hypothermia Guideline: Post Survey

Numerical **personal ID**: _____

1. If the hypothermia guideline was implemented in your practice, how many times was it implemented? _____

2. If the hypothermia guideline was implemented, was hypothermia observed during the general anesthetic?
    a. Yes
    b. No
    c. Not applicable

3. If the hypothermia guideline was not implemented, what barriers prevented you from implementing this proposed intervention?
    a. Not enough evidence
    b. Unwilling to implement guideline
    c. Cost of materials (Fluid warmer, Bair Hugger, Hot Dog warmer, HME)
    d. Other (Please state below)

    _____
    _____
    _____

4. Would you consider implementing this hypothermia guideline into your future practice?
    a. Yes
    b. No
    c. Maybe
    d. Other (Please state below)

    _____
    _____

APPENDIX G – Case by Case Worksheet

Hypothermia Guideline: Case by Case Worksheet		
To be completed after each case within 24 hours Provide your numerical personal ID: _____		
1. Was patient's temperature measured prior to induction and then taken every thirty minutes until the end of surgery?	Yes	No
2. Was a standard critical incident reporting considered for any patient arriving at the theatre suite with a temperature below 36.0°C (96.8°F)?	Yes	No
3. Was the patient's temperature 36.0°C or above?	Yes	No
4. Was the ambient temperature at least 21°C (69.8°F) while the patient was exposed?	Yes	No
5. Was the patient adequately covered throughout the intraoperative phase to conserve heat, and exposed only during surgical preparation?	Yes	No
6. Were intravenous fluids (500 ml or more) and blood products warmed to 37°C using a fluid warming device?	Yes	No
7. Was the patient warmed intraoperatively from induction of anesthesia, using a forced-air warming device	Yes	No
8. Was the temperature setting on forced-air warming devices set at maximum and then adjusted to maintain a patient temperature of at least 36.5°C?	Yes	No
9. Were irrigation fluids used intraoperatively warmed in a thermostatically controlled cabinet to a temperature of 38°C to 40°C?	Yes	No

Adverse Effects of Hypothermia

- Surgical site infection
- Myocardial ischemia
- Prolonged drug effects
- Increased bleeding
- Shivering
- Increased length of stay/cost
- Decreased patient satisfaction

For the next month, the goal is to implement this guideline into practice and see if the incidence of hypothermia below 36°C is decreased in patients undergoing general anesthesia.

Are Your Patients Warm?

PREVENTING HYPOTHERMIA IN THE INTRAOPERATIVE PHASE

The intraoperative phase is defined as total anesthesia time, from the first anesthetic intervention through to patient transfer to the recovery area of the theatre suite.

- The patient's temperature is measured prior to induction and then taken every thirty minutes until the end of surgery.
- Standard critical incident reporting should be considered for any patient arriving at the theatre suite with a temperature below 36.0°C.
- Induction of anesthesia should not begin unless the patient's temperature is 36.0°C or above (unless there is a need to expedite surgery because of clinical urgency, for example bleeding or critical limb ischemia).
- In the theatre suite:
  - the ambient temperature should be at least 21°C (69.8°F) while the patient is exposed
  - once active warming is established, the ambient temperature may be reduced to allow better working conditions
  - using equipment to cool the surgical team should also be considered.
- The patient should be adequately covered throughout the intraoperative phase to conserve heat, and exposed only during surgical preparation.
- Intravenous fluids (500 ml or more) and blood products should be warmed to 37°C using a fluid warming device.
- Warm patients intraoperatively from induction of anesthesia, using a forced-air warming device, if they are:
  - having anesthesia for more than 30 minutes or
  - having anesthesia for less than 30 minutes and are at higher risk of inadvertent perioperative hypothermia
  - Consider a resistive heating mattress or resistive heating blanket if a forced-air warming device is unsuitable.
- The temperature setting on forced-air warming devices should be set at maximum and then adjusted to maintain a patient temperature of at least 36.5°C.
- All irrigation fluids used intraoperatively should be warmed in a thermostatically controlled cabinet to a temperature of 38°C to 40°C.

(National Institute for Clinical Excellence 2016, Para. 3)

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