Prevention of Spinal-Induced Hypothermia in Cesarean Section Patients; a Quality Improvement Project

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Dedication and Acknowledgements

First and foremost, I would like to thank God for allowing me the opportunity to take care of my patients. Next, I would like to thank my parents for their incredible journey in nursing (from the Philippines, Saudi Arabia, and finally America). They laid the foundation that allowed me to be where I am today. Every morning before clinicals, I recite the mantra that I adopted from my mother: Do good and be nice! Their continuous financial and spiritual support has gotten me through the toughest days in this program. Another person that I hold dear to me is Samantha. I do not know how we both got through school without ripping each other's heads off. Kali (our puppy) has been employed as our emotional support animal, unbeknownst to her. I love you both and cannot wait to enjoy the light at the end of the tunnel. A special dedication to a very close friend of mine, Dr. Lisa Spees, for the continued guidance and patience through the grueling doctorate process. I owe you so much through these three years and I appreciate you tremendously. Finally, I would like to thank the UNC-Greensboro faculty (Dr. Shedlick, Dr. Stone, Dr. Korogoda, Dr. Wicks, and Mrs. Mittal) for allowing me the opportunity to practice anesthesia.

Abstract

Background: To provide certified registered nurse anesthetists (CRNAs) an educational intervention on intraoperative multimodal active warming techniques in non-emergent Cesarean section (CS) patients undergoing spinal anesthesia (SA), assess provider utilization, and patient outcomes. **Methods:** This project was a quantitative quality improvement educational intervention with a pre and post-intervention survey. The educational intervention addressed current evidence based research in reducing post-spinal anesthesia hypothermia and improving patient outcomes, while the surveys assessed utilization of multimodal active warming and barriers to change. **Results:** Findings included an increased utilization of multimodal active warming use after the educational intervention ($p = 0.0004$) and decreased reported incidence of parturients feeling cold and shivering ($p = 0.0014$ and $p = 0.0004$, respectively). Provider-reported patient outcomes improved after increased utilization of multimodal active warming. **Conclusion:** An educational intervention is effective in increasing the utilization of multimodal active warming in non-emergent CS patients undergoing SA.

Keywords: *cesarean delivery, spinal anesthesia, obstetric anesthesia, multimodal active warming, forced air warming, intravenous fluid warming*

Background and Significance

Incidences of hypothermia during CS under SA are well documented in the literature and defined as a core temperature of less than 36^{o} C. A study by du Toit et al., using an ingestible temperature probe, determined that at least 50% of parturients were hypothermic after spinal anesthesia during a CS (2018). At present, there are two ways active warming is initiated in patients scheduled for CS; intravenous fluid warming (IVFW) and forced air warming (FAW).

Fluid warming to a temperature of 37^{o} C has been shown to prevent the reduction of core temperature during CS in full term parturients (Cantürk et al., 2019). FAW techniques varied due to the unique circumstance of the patient being aware during the procedure. The best strategy for actively warming parturients remains unclear (Sultan et al., 2015), but recent research favors initiating multimodal active warming (MAW) in parturients receiving SA.

Anesthesia providers are key in the implementation of active warming techniques intraoperatively. There are gaps in the literature with regards to implementing active warming for parturients for scheduled CS. Woolnough et al. (2009) conducted a telephone survey with providers in the UK and found that almost all of the anesthesia providers had the means to initiate active warming, but their decision-making depended on several variables. For example, actual blood loss, the patient stating that they were cold, and length of surgery rated as the highest instances for initiating active warming interventions.

Purpose

The purpose of this quality improvement project was to deliver an educational intervention to certified registered nurse anesthetist (CRNAs) addressing the use of intraoperative MAW techniques (IVFW and FAW) concurrently in non-emergent CS patients, and to evaluate its impact on provider utilization, reducing post-spinal anesthesia hypothermia, and improving patient outcomes. Specific aims of this project were to 1) support evidence-based education among CRNAs regarding use of intraoperative MAW techniques concurrently in non-emergent CS; 2) identify barriers to practice change regarding the use of intraoperative MAW techniques concurrently in non-emergent CS; and 3) evaluate provider-reported efficacy of intraoperative MAW techniques in reducing the incidences of maternal hypothermia and shivering. The project's primary objective was to provide an educational intervention for CRNAs regarding the use of intraoperative MAW techniques concurrently in non-emergent CS. Secondary objectives were to 1) identify trends among CRNAs regarding practice utilization and barriers to change in practice, and 2) develop recommendations for obstetric (OB) anesthesia practice based on project results and current evidence-based literature.

Review of Current Evidence

A review of the literature was conducted to evaluate current evidence-based knowledge regarding post-spinal anesthesia induced hypothermia prevention and ways to improve CS patient outcomes. Databases searched for this review include CINAHL, Ovid, PubMed, Google Scholar, and Cochrane Library. Keywords were searched individually and in multiple combinations, using BOOLEAN search methods, and included: neuraxial, spinal, anesthesia, hypothermia, thermoregulation, fluid warmer, forced air warming (FAW), education, anesthesia providers, and early recovery after cesarean. Search parameters included: articles

published in the English language and between the years 2013 to 2021. A summary of the current literature findings is outlined below.

Spinal Anesthesia-Induced Hypothermia

Because of evolving practices, public perception, anxiety surrounding delivery, a majority of CS are now performed with SA instead of general anesthesia (Juang et al., 2017; Mylonas & Friese, 2015). SA causes vasodilation and promotes the redistribution of heat from the body's core to the periphery below the sensory blockade level. Additionally, SA blunts the body's inherent physiological countermeasures (vasoconstriction and shivering) against hypothermia (Sessler, 2016). Perioperative hypothermia is defined as having a core temperature < 36.0 ºC; whereas physiological temperature is 37.0 ºC (Sultan et al., 2015). After ingestion of a telemetric sensor, du Toit et al. (2018) found that 50% of parturients became hypothermic post-SA and continued to experience decreases in temperature well after leaving the operating room. Burey et al. (2021) found that 45 minutes post-SA, patients' temperature dropped on average by 0.64 ºC to a nadir temperature of 35.9 ºC.

Hypothermic Adverse Outcomes

Adverse effects associated with hypothermia included increased rates of wound infection, myocardial ischemia, blood loss, transfusion requirements due to coagulopathy derangements, length of hospital stay, shivering, and patient discomfort (Allen & Habib, 2018; Canturk et al., 2017; Chebbout et al., 2017). Maternal hypothermia at delivery has been associated with the following negative neonatal outcomes: respiratory depression, apnea, metabolic acidosis, hypoglycemia, carbon dioxide retention, and delayed feeding due to

maternal shivering (Vilinsky-Redmond et al., 2020). Prevention and prompt treatment of SA-induced hypothermia are necessary to decrease poor outcomes for mothers and neonates.

Temperature Monitoring Devices

Accurate core temperature monitoring is well studied but challenging to initiate during CS delivery. Temperature monitoring sites that were not feasible in the awake patient include: nasopharyngeal, distal esophageal, tympanic membrane with contact thermistor, and pulmonary artery temperature (Sessler, 2016). Several peripheral sites can be used as an alternative, including infrared temporal artery, aural/tympanic, oral, and bladder (Burey et al., 2021; Chebbout et al., 2017; Cobb et al., 2016; Jun et al., 2019; Sud et al., 2019). A majority of the researchers performed temperature monitoring using peripheral thermometers which poorly correlate to core temperature and may decrease the rigor of the study's results (Niven et al., 2015). Accuracy of core temperature management is important because hypothermic episodes may be mismanaged, and thermoregulatory interventions cannot be accurately assessed. However, recent studies have found an intra-bladder temperature foley probe to be effective at monitoring intraoperative core temperature (Burey et al., 2021; Hoefnagel et al., 2020). The ability to accurately monitor core temperature may depend on an institution's product/device availability and standard of care practice.

Active Warming Techniques

FAW warms the periphery, preventing heat loss that naturally occurs due to conduction and radiation (Nieh & Su., 2016). The FAW device is comprised of a heating unit with blanket attachments (upper body, lower body, and underbody). The versatility of FAW devices allow providers to initiate warming interventions preoperatively, intraoperatively, and in the post

anesthesia care unit. Barriers to FAW include difficulty applying certain warming blanket attachments, patient discomfort, and delayed bonding between mother and baby (Sultan et al., 2015). Providers noted difficulty implementing upper body warmers specific to the CS population. Unlike CS patients, surgical patients are sedated, allowing for upper warming blanket securement to arm boards. Unrestrained arms facilitate skin-to-skin bonding with baby after delivery; however, at the same time, the effectiveness of the upper body warming blanket is reduced. Mothers perceived the intervention as anxiety provoking during skin-to-skin bonding due to the acoustic intensity emitted by FAW devices and the limited surface area available for skin-to-skin bonding (Sultan et al. 2015). Lower body and underbody warming blankets are alternative options for FAW.

To attenuate heat loss in parturients, fluids for irrigation and infusions are warmed. Clinically, two main devices, intravenous fluid warmers (IVFW) and cabinet warmers, are used to warm fluids to temperatures between 37 ºC – 41ºC. Campbell et al. (2015) found that cabinet warmed fluid irrigation had no significant impact on patients' core temperatures. However, the same study concluded that IVFW had a significant impact on core temperatures throughout the perioperative period. IVFW devices contain a heating element that allows for optimal surface area contact with fluids prior to entering patient circulation (Kowalczyk et al., 2019). An important drawback to IVFW devices is their ability to maintain a constant temperature through various flows. Zoremba et al. (2018) revealed that, at higher flows (75 -100 ml/min), a majority of the IVFW devices could not maintain outlet fluid temperatures greater than 38 ºC. Sultan et al. (2015) and Bameri et al. (2018) found that IVFW can blunt the effects of hypothermia which resulted from an average infusion of 2-3 liters of crystalloid in a short amount of time

(combination of co-loading fluids during SA, and treatment of hemodynamic shifts and blood loss).

Parturient Outcomes

Cobb et al. (2016) demonstrated that the multimodal approach (FAW concurrently with IVFW) helped reduce the incidence of hypothermia in parturients undergoing CS. However, the majority of the women in both the active warming group and control group became hypothermic (64% and 91%, respectively). Possible theories explaining these hypothermic episodes include: FAW employed using only the lower extremities post-SA and co-loading of IV fluids was under 300 mmHg of pressure through a fluid warmer; in other words, output flow temperature may have been compromised. Although SA-induced hypothermia is not fully understood, FAW with an underbody blanket has been shown to be more effective in preventing hypothermia due to increased body surface coverage (Marin et al., 2021).

A prospective randomized control study showed that warming parturients preoperatively via FAW for 30 minutes and via IVFW at 37 ^{o}C intraoperatively blunted the effects of SA induced hypothermia and decreased shivering episodes (Ni et al., 2020). Core temperatures were greater in the intervention group (36.2 ± 0.4 ^{o}C) compared to the control group (35.5 ± 0.3 ^{o}C). Mean temperatures taken at seven different time points during the CS demonstrated consistently higher temperatures in the intervention group than in the control group. Compared to a similar study conducted by Munday et al. (2013) that utilized prewarming FAW techniques, Ni et al. reduced the time delay between prewarming to SA induction, which could account for the ineffectiveness of other FAW studies (2020). Shivering instances were still present in both groups but less prominent in the intervention group compared to the control group (respectively, 19.1% and 56.3%, $p < 0.001$).

A retrospective observational cohort study conducted by Hoefnagel et al. (2020) demonstrated that 30 to 60 minutes of FAW prewarming, continued FAW intraoperatively, and intraoperative IVFW decreased the incidence of inadvertent perioperative hypothermia. There were significant differences ($p < 0.005$) between the FAW group and control group in the following categories: preoperative temperature (most likely due to the 30 to 60 minutes of FAW prewarming), lowest foley core temperatures, final foley core temperatures, intraoperative hypothermia, and recovery room temperatures. At the end of the CS and transfer to PACU, some parturients (n = 13/60) in the control group had persistent hypothermia (< 35 ^{o}C) compared to the active warming group (n = 0/60). Despite the short CS procedure, normothermic recovery may take hours after SA administration (du Toit et al., 2018; Hoefnagel et al., 2020).

A study comparing the impact of FAW alone versus the multimodal approach (IVFW and FAW) on CS parturients was conducted by Meghana et al. (2020). Compared to Cobb et al. (2016), this study implemented 15 minutes of lower body warming prior to SA and throughout the case. Intraoperative core body temperatures at 35, 45, and 55 minutes after SA placement were significantly higher using the multimodal warming approach ($p < 0.001$, $p = 0.0$, and $p = 0.0$ respectively) compared to using only FAW. The core body temperatures at 0, 15, and 30 minutes were higher in the multimodal warming approach as well ($p = 0$ for all three variables). Prewarming the patients' periphery before SA and throughout the procedure may decrease hypothermic incidences.

Neonatal Outcomes

MAW interventions have not led to significant differences in neonatal outcomes (Cobb et al., 2016; Hoefnagel et al., 2020; Ni et al., 2020). However, there have been inconsistencies

in variables measured to accurately assess neonatal outcomes (Apgar scores, neonatal umbilical artery and vein pH, and temperature). Meghana et al. (2020) found significant differences in the 1 minute Apgar score and umbilical artery/venous vein pH between the intervention (IVFW and FAW) and control (FAW only) group. Further research is needed on the impact of active warming on neonatal outcomes.

Theoretical Model

The theoretical model that was used for this project is Lippitt's Change Theory. This theory involved seven total steps that place additional emphasis on the role of the change agent (Lippitt et al., 1958). Step one involved diagnosing the problem, which was the current temperature management interventions by CRNAs on parturients with scheduled CS. The possible consequences of ineffective temperature management of parturients undergoing CS under spinal anesthesia can lead to an increased incidence of hypothermia (du Toit et al., 2018). Hypothermia can have deleterious effects when combined with anesthesia. CRNAs are the primary population that will be affected by this intervention. Step two involved the motivation and capacity for change by CRNAs and their practice. Step three involved the resources and motivation of the private investigator (PI). An action plan that addressed the primary issue, with the least amount of disruption to the institution's workflow was key in step four. An educational intervention was implemented for CRNAs with regards to concurrent MAW strategies. Step five involved the role of the change agent. The PI's role was to educate CRNAs on the importance of using evidence-based practice (EBP) temperature management techniques for parturients undergoing an elective CS. Data was collected using a pre and post-intervention survey. The PI continued reinforcing the EBP recommendations in order to transition to step six, which emphasized communication and feedback between interdisciplinary teams and the

PI. By the end of the project, CRNAs had established EBP regarding parturients undergoing CS and the PI withdrew their influence over time and completed step seven.

Methodology

Evidence Based Practice Framework

The Iowa Model was used as the EBP framework for its emphasis on a multimodal team approach to address health care problems. The Iowa model guidelines include: identifying a problem, determining if the topic is a priority, forming a team, appraising the literature, assessing efficaciousness of the design, piloting the intervention, determining if change is appropriate for adoption in practice, and sustaining practice change (Iowa Model Collaborative, 2017).

The practice guidelines for OB anesthesia mentioned the use of active warming techniques only during volume resuscitation and administration of blood products, but not during stable processes, where hypothermia is still a significant risk (Apfelbaum et al., 2016; AASA, 2017). After a review of the literature was conducted, the researcher determined that SA-induced hypothermia in stable CS parturients needed to be addressed and sought the support of surgical staff and anesthesia providers to impact change in a suburban hospital. The feasibility of this project was highly likely due to the hospital's availability of FAW and IVFW devices. Anesthesia providers' clinical tendency to employ MAW interventions was the challenge addressed in this study. An educational presentation was used to increase the use of MAW techniques in stable CS. Results were gathered a month after the intervention to assess outcomes and practice change. To integrate and sustain practice changes in the hospital, updates to their "early recovery after cesarean section" protocol were recommended.

Study Design

This project was a quantitative QI educational intervention with a pre and post survey. The project evaluated the effect of a multimodal warming educational intervention on anesthesia providers' practice with the concurrent use of FAW and IVFW in the non-emergent CS patient. The educational intervention began in the month of October, when anesthesia providers were provided the information sheet, survey, and an online in-service presentation.

Setting and Sample Recruitment

The setting for this project was a suburban hospital in North Carolina that has an OB emergency department, labor and delivery (L&D, 20 beds), post-partum, NICU, and three ORs dedicated to L&D. A convenience sample of OB practicing CRNAs was recruited by sending a system-wide email to all CRNAs in the healthcare system. CRNAs were informed that participation was voluntary, and no financial detriments will occur.

Data Collection and Intervention

The information sheet and pre-intervention survey were distributed prior to the educational presentation. Participants were provided ample time to complete the pre-intervention survey that consisted of dichotomous, multiple-choice, and Likert-scale responses, and open ended questions. Demographic data gathered from the survey included: age, gender, and years of experience. The survey also assessed the CRNA's current practices of active warming during a stable CS, general knowledge of SA-induced hypothermia, willingness to try new evidence-based active warming techniques, and perceived barriers to changes in practice. Results were decoded and de-identified to protect participant identities. The post-intervention survey was distributed via email a month after the educational intervention was implemented. It

was modeled after the pre-intervention survey and included dichotomous, multiple-choice, Likert-scale responses, and open-ended questions to ascertain qualitative and quantitative data. Participants were given two weeks to complete the follow-up survey. Pre and post-intervention surveys were linked with the participant's mother's birthday.

An educational intervention was developed and presented by the PI. The intervention consisted of a 10-15 minute pre-recorded PowerPoint presentation on the benefits of MAW for non-emergent CS patients and the hospital costs associated with hypothermic consequences. The presentation content was reviewed by two content experts from UNC-Greensboro. Following the presentation, participants were encouraged to ask questions via email.

Data Analysis

Descriptive statistics were used to analyze the responses on the pre and post-intervention surveys. Paired sample t-tests were used to analyze the data between pre-intervention and post-intervention survey results concerning CRNA's barriers to practice change and implementation regarding the use of MAW in parturients undergoing elective CS with SA. Data points were analyzed with Statistical Package for Social Science (SPSS) version 26. Content analysis was performed on qualitative data collected through the open-ended questions on the post-intervention survey to assess for common themes.

Results

Demographics

The pre-intervention survey included 18 participants, while 12 participants completed the post-intervention survey. All of the post-intervention surveys were linked to pre-intervention surveys using the participants mother's birthday. Demographic data including sex,

age, degree, and years in practice were collected (Table 1). Assessment of the participant's current frequency of OB practice and CS cases per month were also summarized in Table 1. Most of the participants very rarely practiced OB anesthesia (67%) and conducted "0-5" cases under spinal anesthesia (75%).

OB Anesthesia Guidelines Used in Practice

Currently, there are three guidelines for facilitating OB anesthesia, i.e., "Practice Guidelines for Obstetric Anesthesia" from the American Society of Anesthesiologist (ASA), "Practice Guidelines for Analgesia and Anesthesia for the Obstetric Patient" from the American Association of Nurse Anesthetists (AANA), and the guidelines provided by the facility where the participants are employed. Participants were asked how each guideline influenced their current OB anesthesia practice (Table 2). Most of the participants did not have an opinion when asked about ASA or AANA guidelines (74.9 and 66.6%, respectively). However, participants "somewhat and strongly agreed" that practice guidelines outlined by the facility were used 91.6% of the time.

Background and Knowledge

The pre-intervention survey assessed the participant's current knowledge of hypothermic rates in non-emergent CS patients undergoing spinal anesthesia. The responses had a wide range of answers; 41.7% "strongly disagree" and "somewhat disagree", 25% "neither agree nor disagree", and 33.3% "somewhat agree" (Table 3). A Likert scale format was used to assess the participants' pre and post-educational intervention knowledge of the rates, negative effects, cost, and evidence-based management of spinal-induced hypothermia in stable CS (Table 4). Based on the pre-intervention survey, 75% of the respondents said that

they “somewhat agree” that they were aware of negative effects of spinal-induced hypothermia, whereas the post-intervention survey demonstrated that 100% of participants “strongly agreed” ($p = 0.0001$). The familiarity of the cost and recent EBP were split relatively evenly in the pre-intervention survey (“disagree” = 50%, “agree” = 41.6% and “disagree” = 41.6%, “agree” = 50%, respectively). In both topics, 100% of participants responded that they “strongly agreed” in the post-intervention survey ($p = 0.0004$ and $p = 0.0002$, respectively). All 12 participants responded that they “strongly agreed” that the material covered in the presentation was relevant to their patient’s care. A majority of the participants (83.3%) also responded that they “somewhat agree” and “strongly agree” that they would want to educate other anesthesia providers about MAW to prevent spinal-induced hypothermia (Table 3).

Frequency of Use in Practice

On the pre-intervention survey, when asked about the use of modalities discussed in the educational intervention, a majority of participants (66.7%) did not initiate MAW post-spinal placement. However, of the participants that did not initiate MAW, 87.5% initiated intraoperative IVFW in their patients. MAW was already being utilized in 33.3% of participants. A paired t-test analysis was performed to compare the utilization of MAW in pre and post-intervention surveys (Table 5). There was a significant increase for the response, “I currently initiate intraoperative multimodal active warming for non-emergent CS” ($p = 0.0004$). The percentage of participants who said they felt comfortable utilizing MAW in their current practice was 58.3% (Table 6). Participants responded that 83.3% of the time their colleagues would support and encourage the use of MAW. The continued use of MAW in the future was welcomed with unanimous approval (100%).

Patient Outcomes

Patient outcomes for spinal-induced hypothermia including shivering, and subjective maternal reports of feeling cold during surgery were evaluated using paired t-test analysis in pre and post-intervention surveys (Table 7). There was a significant decrease in participant reported shivering and feeling cold ($p = 0.0004$ and $p = 0.0014$, respectively). The response for, "My CS patients' temperature falls below 36 ºC/96.8 ºF during surgery" did not yield significant results ($p = 0.096$). Awareness of the parturient's core temperature throughout the CS was also addressed in the post-intervention survey (Table 8). A majority of the participants "somewhat agreed" that they were actively aware of their patient's temperature (66.7%).

Barriers to Practice

Barriers to practice change and implementation regarding the use of MAW in parturients undergoing non-emergent CS with spinal anesthesia were assessed in the post-intervention via Likert scale survey items (Table 9). Factors that were not significant barriers to practice change included: not having enough time to initiate IVFW and FAW, being unfamiliar with operating IVFW and FAW, and supplies for IVFW being unavailable in the OB suite. The participants' responses were widely spread when asked about FAW supplies being readily available; 25% "strongly disagree", 41.7% "somewhat disagree", 8.3% "neither agree nor disagree", and 25% "somewhat agree".

Free-text responses to the open-ended questions asking CRNAs to describe any other barriers they face to the utilization of MAW in their clinical practice were found to have two main themes: unavailability of underbody warmers and negative perceptions of upper body FAW. Other free-text responses included: uncertainty of parturient's core temperature and discontinuing active warming interventions completely due to the patient feeling too hot.

Discussion

This DNP project was developed and utilized Lippitt's Change Theory as a foundation. To foster enduring change in CRNA practice, the PI followed Lippitt's seven stages. CRNAs responded that their practice is more likely influenced by their hospital's OB anesthesia guidelines, as opposed to the practice guidelines from the ASA or the AANA. Although the hospital guidelines are derived from both the ASA and the AANA, and the national guidelines are typically more regularly updated, CRNAs should participate in development of anesthetic protocols and recommendations to frequently update hospital policy. Based on the facility's latest OB protocol (last updated: 06/18/20), MAW was not specifically mentioned as an option. Instead, their pathway listed increasing ambient room temperature to 68 – 73º F and FAW or IVFW. The free-text response section in the pre-intervention survey revealed that a majority of participants who did not implement MAW, implemented IVFW instead. Healthcare professionals are more likely to follow recommended practice, therefore, an educational intervention was implemented (Forsetlund et al., 2021). Project findings showed an increase in CRNA knowledge and utilization of MAW to prevent spinal induced hypothermia ($p = 0.0002$ and $p = 0.0004$, respectively). These clinical findings, which also aligned with the PI's hypothesis, support the effectiveness of an educational training intervention in increasing CRNAs' knowledge and use of EBP.

Puja (2018) found that the perception of a mother's experiences in the OR leads to better physical and psychological outcomes. Parturients complaints included: nausea/vomiting, shivering, and feeling cold. In this project, CRNAs reported that parturients felt cold and shivered significantly less after project implementation ($p = 0.0004$ and $p = 0.0014$, respectively). Results of provider-reported efficacy of MAW during CS are supported in the

literature including reduction in incidences of feeling cold and shivering (Cobb et al., 2016; Hoefnagel et al., 2020; Meghana et al., 2020; Ni et al., 2020). While this project could not accurately quantify parturient's temperature through an EHR chart review, it is nonetheless clinically essential and therapeutically meaningful that providers reported a noticeable reduction in parturients shivering and feeling cold when using the MAW approach.

Statistically significant findings from the barriers assessment revealed that neither time nor operating issues were a factor in implementing both IVFW and FAW. CRNAs felt that supplies for IVF warmers were readily available, whereas, FAW had a varied distribution on the Likert scale. The free-text response section on the post-intervention survey showed that upper/lower body warmers were adequately supplied in most cases, but underbody warmers were scarce in the OB suites. Underbody warmers are preferred in warming CS patients because of the increased surface area warmed and decreased interference with mother and baby (Hoefnagel et al., 2020; Marin et al., 2021). The Iowa Model, which emphasized a multimodal team approach to a problem was used in preparation for possible barriers during implementation. Unfortunately, the lack of underbody blankets could not be pinpointed to a single cause. There may have been a disconnect between suppliers and the hospital or anesthesia techs may not have known to stock underbody warmers in the OB suite. Nonetheless, communication between groups may have increased the implementation of underbody warmers.

Another common theme among the free-text response section was the upper body FAW being perceived negatively among parturients. A CRNA noted that the upper body FAW interfered with the mom-baby bonding during skin to skin. Another CRNA noted that a parturient's anxiety was augmented by the upper body FAW, enough so that the upper body

was converted to a lower body warmer. These comments are supported by findings in the literature regarding upper body warmers (Sultan et al., 2015; Hoefnagel et al., 2020). Interestingly, even when faced with a lack of underbody warmers, CRNAs still implemented FAW and used their ingenuity to convert upper body warmers to lower body warmers or used lower body warmers as underbody warmers (despite Bair Hugger's overheating alarm).

One CRNA's free-text response mentioned that they had to discontinue all their active warming interventions completely due to the patient feeling too hot. Due to the lack of patient demographic information gathered from the free-text response, one could speculate administration of intrathecal morphine or an increased BMI to be the cause. The precise mechanism through which intrathecal morphine leads to hypothermia remains unknown. The hypothalamus keeps the core temperature within narrow margins at all times. The cephalic distribution of morphine is hypothesized to contribute to prolonged hypothermia by changing the temperature set point, with the new upper temperature threshold being below the typical inter-threshold range. As a result, at a hypothermic temperature, perspiration is observed (Munday et al., 2013). Typically, most of the MAW studies in the literature placed exclusion criteria for patients with an increased BMI due to associated endogenous heat production that protects against hypothermia (Okoue et al., 2018). Unfortunately, analysis of patient medical charts was not a part of this study but could be beneficial for future research.

Although the paired t-test findings revealed no significant results for parturient temperature falling below 36 ºC ($p = 0.096$), only 66.7% of CRNAs "somewhat agreed" that they were actively aware of their patient's temperature during the CS. These results may have been due to the type of temperature monitoring devices the CRNAs were using. To the researcher's best knowledge of facility practices, the most frequently used temperature monitor

is the skin probe (axillary). The limited efficacy of peripheral temperature monitors is well documented in the literature (Burey et al., 2021; Chebbout et al., 2017; Cobb et al., 2016; Jun et al., 2019; Niven et al., 2015; Sud et al., 2019). To properly manage intraoperative hypothermia, OB team members and anesthesia providers should explore the intraoperative use of a foley catheter temperature sensor. While anesthesia providers are limited to using non-invasive means for monitoring temperature, accurate core temperature is important in managing spinal induced hypothermia.

Limitations

There were several limitations that affected this DNP project. The COVID-19 pandemic was a serious limitation that had a negative impact on our DNP project data results. The facility required all meetings to be virtual which was not the preferred delivery method for the educational intervention. A recorded presentation limited the sample size and resulted in a total of 18 participants for the pre-intervention survey and 12 for the post-intervention survey. The educational intervention was a pre-recorded PowerPoint presentation which also limited the interaction between presenter and participants. Although the presenter's contact information was available, the likelihood of participants reaching out for clarification or questions was minimized compared to a face-to-face interaction. The surveys were created by the PI, and they were not tested for reliability or validity. Lastly, barriers were assessed with fill-in-the blank questions, but responses were limited.

Recommendations for Future

Despite having a positive result for this project's purpose, more research could be done to understand anesthesia providers' attitudes towards MAW implementation in non-emergent

CS. As previously mentioned, a qualitative approach based on personal interviews into CRNA practice could provide further insight into the opinions and thought processes when addressing spinal-induced hypothermia. Repeating the project, in person, while incorporating multiple educational sessions is another recommendation for a future project. A qualitative study with focus groups would increase data about barriers to practice change. Another possible avenue to explore includes utilizing a longitudinal component to provide CRNAs more time to develop, execute, and sustain their practices. Furthermore, a retrospective EHR review to assess patient outcomes in relation to the efficacy of this practice adoption would have provided patient data to correlate with the literature.

An ongoing issue with OB anesthesia is the method of monitoring accurate core temperature in parturients and conflicting findings. It may be necessary to investigate the possibility of using foley catheter temperature sensors in this facility, instead of skin temperature probes. Addressing the OB suites' shortage of underbody FAW may increase the initiation of MAW in parturients in the future.

Conclusion

The aim of this DNP project was to educate CRNAs on the use of MAW in parturients receiving non-emergent CS with SA, as well as to assess its influence on provider use, hypothermic rates, and patient outcomes. In the one month post-intervention survey, anesthesia providers reported an increase in knowledge regarding post-spinal hypothermia management, MAW implementation increased, and there was a decrease in parturient shivering and hypothermia noted. The current research on MAW's effectiveness in reducing spinal induced hypothermia supports its usage in improving outcomes in women undergoing elective CS, resulting in a better perioperative experience and quality of care. Future practices will require

the development of an effective OB anesthetic protocol based on ongoing education and effective interdisciplinary communication.

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Table 1

Demographic Characteristics of CRNA Participants

		Frequency	Percent	Cumulative Percent
Sex	**Female**	9	75	75
	Male	3	25	100
	Total	12	100	
Age (years)	**25-35**	6	50	50
	36-45	3	25	75
	46-55	3	25	100
	Total	12	100	
Degree	**Master's**	5	41.6	41.6
	Doctorate	7	58.3	100
	Total	12	100	
Years in practice as a CRNA	**1-5**	3	25	25
	6-10	7	58.3	83.3
	11-15	2	16.7	100
	Total	12	100	
How often do you practice OB anesthesia?	**Very Rarely**	8	66.7	66.7
	Rarely	4	33.3	100
	Total	12	100	
Number of cases per month, spinal is administered for CS	**0-5**	9	75	75
	6-10	3	25	100
	Total	12	100	

Table 2

Current Use of OB Anesthesia Guidelines by Participants

		Frequency	Percent	Cumulative Percent
I currently use the "Practice Guidelines for Obstetric Anesthesia" from American Society of Anesthesiologist (ASA).	**Strongly disagree**	4	33.3	33.3
	Somewhat disagree	1	8.3	41.6
	Neither agree nor disagree	4	33.3	74.9
	Somewhat agree	3	25	100
	Strongly agree	0	0	100
	Total	12		
I currently use the Practice Guidelines for "Analgesia and Anesthesia for the Obstetric Patient" from American Association of Nurse Anesthetists (AANA).	**Strongly disagree**	4	33.3	33.3
	Somewhat disagree	1	8.3	41.6
	Neither agree nor disagree	3	25	66.6
	Somewhat agree	3	25	91.6
	Strongly agree	1	8.3	100
	Total	12		
I currently use the guidelines from my practice facility for temperature management of spinal-induced hypothermia	**Strongly disagree**	0	0	0
	Somewhat disagree	0	0	0
	Neither agree nor disagree	1	8.3	8.3
	Somewhat agree	6	50	58.3
	Strongly agree	5	41.6	100
	Total	12		

Table 3

Pre-Intervention Educational Assessment of Participants and Evaluation of the Educational Intervention

		Frequency	Percent	Cumulative Percent
I am aware of the hypothermic rates in non-emergent CS patients undergoing spinal anesthesia.	**Strongly disagree**	2	16.7	16.7
	Somewhat disagree	3	25	41.7
	Neither agree nor disagree	3	25	66.7
	Somewhat agree	4	33.3	100
	Strongly agree	0	0	
	Total	12		
The material covered in the educational presentation is relevant to the needs of my patients.	**Strongly disagree**	0	0	0
	Somewhat disagree	0	0	0
	Neither agree nor disagree	0	0	0
	Somewhat agree	0	0	0
	Strongly agree	12	100	100
	Total	12		
I want to educate other anesthesia providers about this material	**Strongly disagree**	0	0	0
	Somewhat disagree	0	0	0
	Neither agree nor disagree	2	16.7	16.7
	Somewhat agree	9	75	91.7
	Strongly agree	1	8.3	100
	Total	12		

Table 4

Paired Samples t-test of Educational Assessment of Participants

		N	*M*	*Variance*	*t*	*df*	*p (2-tailed)*
Pair 1	I am aware of the negative effects spinal-induced hypothermia causes my CS patients.	12	4.25	0.205	6.47E-05	11	0.0001 *
	I am aware of the negative effects spinal-induced hypothermia causes my CS patients. (post)	12	5	0			
Pair 2	I understand the cost of preventable hospital acquired complications regarding hypothermia.	12	2.917	2.083	0.0002	11	0.0004 *
	I understand the cost of preventable hospital acquired complications regarding hypothermia. (post)	12	5	0			
Pair 3	I am familiar with the most recent evidence for managing spinal-induced hypothermia in OB anesthesia.	12	3.083	1.538	0.0001	11	0.0002 *
	I am familiar with the most recent evidence for managing spinal-induced hypothermia in OB anesthesia. (post)	12	5	0			

*$p < 0.05$

Table 5

Paired Sample t-test of Frequency of Using MAW Post-Spinal Anesthesia

		N	*M*	*Variance*	*t*	*df*	*p (2-tailed)*
Pair 1	I currently initiate intraoperative multimodal active warming (IVFW concurrently with FAW) for non-emergent CS.	12	2.75	2.568	0.0002	11	0.0004 *
	I currently initiate intraoperative multimodal active warming (IVFW concurrently with FAW) for non-emergent CS. (post)	12	4.42	0.265			

*$p < 0.05$

Table 6

Participant Comfort and Future Use of MAW for CS

		Frequency	Percent	Cumulative Percent
I feel comfortable utilizing multimodal active warming (IVFW concurrently with FAW) in my practice	**Strongly disagree**	0	0	0
	Somewhat disagree	0	0	0
	Neither agree nor disagree	5	41.7	41.7
	Somewhat agree	6	50	91.7
	Strongly agree	1	8.3	100
	Total	12		
My colleagues would support and encourage the use of this intervention.	**Strongly disagree**	0	0	0
	Somewhat disagree	0	0	0
	Neither agree nor disagree	2	16.7	16.7
	Somewhat agree	10	83.3	100
	Strongly agree	0	0	100
	Total	12		

I will continue to use FAW and IVFW for my elective CS.	**Strongly disagree**	0	0	0
	Somewhat disagree	0	0	0
	Neither agree nor disagree	0	0	0
	Somewhat agree	7	58.3	58.3
	Strongly agree	5	41.7	100
	Total	12		

Table 7

Paired Sample t-test of Patient Outcomes

		N	*M*	*Variance*	*t*	*df*	*p (2-tailed)*
Pair 1	**My CS patients' temperature falls below 36C/96.8F during surgery.**	12	2.17	0.879	0.048	11	0.096
	My CS patients' temperature falls below 36C/96.8F during surgery. (post)	12	1.75	0.386			
Pair 2	**My CS patients shiver during surgery.**	12	2.75	1.477	0.0002	11	0.0004 *
	My CS patients shiver during surgery. (post)	12	1.33	0.242			
Pair 3	**My CS patients report feeling cold during surgery.**	12	2.75	1.477	0.0007	11	0.0014 *
	My CS patients report feeling cold during surgery. (post)	12	1.33	0.242			

*$p < 0.05$

Table 8

Participants' Awareness of Patient's Temperature During CS

		Frequency	Percent	Cumulative Percent
I am actively aware of the patient's temperature in non-emergent CS patients undergoing spinal anesthesia.	**Strongly disagree**	0	0	0
	Somewhat disagree	1	8.3	8.3
	Neither agree nor disagree	3	25	33.3
	Somewhat agree	8	66.7	100
	Strongly agree	0	0	100
	Total	12		

Table 9

Barrier Assessment of Participants

		Frequency	Percent	Cumulative Percent
I do not have enough time to initiate FAW.	**Strongly disagree**	7	58.3	58.3
	Somewhat disagree	5	41.7	100
	Neither agree nor disagree	0	0	100
	Somewhat agree	0	0	100
	Strongly agree	0	0	100
	Total	12		
FAW supplies are not readily available to me in the OB suite.	**Strongly disagree**	3	25	25
	Somewhat disagree	5	41.7	66.7
	Neither agree nor disagree	1	8.3	75

	Somewhat agree	3	25	100
	Strongly agree	0	0	100
	Total	12		
I do not have enough time to initiate IVFW.	**Strongly disagree**	12	100	100
	Somewhat disagree	0	0	100
	Neither agree nor disagree	0	0	100
	Somewhat agree	0	0	100
	Strongly agree	0	0	100
	Total	12		

IVFW supplies are not readily available to me in the OB suite.	**Strongly disagree**	12	100	100
	Somewhat disagree	0	0	100
	Neither agree nor disagree	0	0	100
	Somewhat agree	0	0	100
	Strongly agree	0	0	100
	Total	12		
I am unfamiliar with the use of IVFW	**Strongly disagree**	12	100	100
	Somewhat disagree	0	0	100
	Neither agree nor disagree	0	0	100
	Somewhat agree	0	0	100
	Strongly agree	0	0	100
	Total	12		

I am unfamiliar with the use of FAW.	**Strongly disagree**	12	100	100
	Somewhat disagree	0	0	100
	Neither agree nor disagree	0	0	100
	Somewhat agree	0	0	100
	Strongly agree	0	0	100
	Total	12		

Appendix A

Pre-Intervention Survey

For pre and post-survey linking purposes, what is your mother's date of birth (MM/DD/YYYY)? _____

General Demographic Information

Sex	☐ Male ☐ Female ☐ Other
Age	☐ <25 ☐ 25 – 35 ☐ 36 – 45 ☐ 46 – 55 ☐ 56 – 65 ☐ >65
Degree	☐ Masters ☐ Doctorate ☐ Other
Number of years in practice as a CRNA	☐ <1 ☐ 1 – 5 ☐ 6 – 10 ☐ 11 – 15 ☐ 16 – 20 ☐ >20
How often do you practice obstetric anesthesia?	☐ Never ☐ Very Rarely (1-20% of overall caseload) ☐ Rarely (21-40% of overall caseload) ☐ Occasionally (41 - 60% of overall caseload) ☐ Frequently (61 - 80% of overall caseload) ☐ Very Frequently (81 - 100% of overall caseload)

Approximately, how many cases per month do you administer spinal anesthesia for cesarean sections?	☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ >20

Active Warming for Cesarean Section

Please read each statement as related to your beliefs and personal experiences that influence your clinical practice and indicate how strongly you agree or disagree with each statement below.	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree	Not Applicable
I currently use the "Practice Guidelines for Obstetric Anesthesia" from American Society of Anesthesiologists (ASA).	☐	☐	☐	☐	☐	☐
I currently use the Practice Guidelines for "Analgesia and Anesthesia for the Obstetric Patient" from American Association of Nurse Anesthetists (AANA).	☐	☐	☐	☐	☐	☐
I currently use the guidelines from my practice facility for temperature management of spinal-induced hypothermia.	☐	☐	☐	☐	☐	☐
I am aware of the hypothermic rates in non-emergent CS patients undergoing spinal anesthesia.	☐	☐	☐	☐	☐	☐
I am aware of the negative effects spinal-induced hypothermia causes my c-section patients.	☐	☐	☐	☐	☐	☐
I understand the costs of preventable hospital acquired complications regarding hypothermia.	☐	☐	☐	☐	☐	☐
I am familiar with the most recent evidence for managing spinal-induced hypothermia in obstetric anesthesia	☐	☐	☐	☐	☐	☐

I currently initiate intraoperative MAW (IVFW concurrently with FAW) for non-emergent CS.	☐	☐	☐	☐	☐	☐
My CS patients' temperature falls below 36 C/ 98.6 F during surgery.	☐	☐	☐	☐	☐	☐
My CS patients shiver during surgery.	☐	☐	☐	☐	☐	☐
My CS patients report feeling cold during surgery.	☐	☐	☐	☐	☐	☐
What intervention(s) do you currently use for *prophylactic* management of spinal-induced hypothermia? (check all that apply)	☐ No warming interventions ☐ Warm blankets ☐ Intraoperative FAW only ☐ Intraoperative IVFW only ☐ Both intraoperative FAW and IVFW ☐ Other (specify any of the above or describe any other interventions):					

Appendix B

Post-Intervention Survey: One Month Follow-Up

For pre and post-survey linking purposes, what is your mother's date of birth

(MM/DD/YYYY)? _____

Evaluation of Educational Presentation

After viewing the educational presentation, please rate your level of agreement with each statement:	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Utilization					
I feel comfortable utilizing MAW (IVFW concurrently with FAW) in my practice.	☐	☐	☐	☐	☐
The material covered in the educational presentation is *relevant* to the needs of my patients	☐	☐	☐	☐	☐
I was *already using* multimodal in my practice prior to this education	☐	☐	☐	☐	☐
Training / Support					
I want to *educate other anesthesia providers* about this material	☐	☐	☐	☐	☐
My colleagues would *support and encourage* the use of this intervention	☐	☐	☐	☐	☐

Utilization of MAW for Cesarean Section

Please read each statement as related to your beliefs and personal experiences that influence your clinical practice and indicate how strongly you agree or disagree with each statement below.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Not Applicable
I am actively aware of the patient's temperature in non-emergent CS patients undergoing spinal anesthesia.	☐	☐	☐	☐	☐	☐
I am aware of the negative implications of spinal-induced hypothermia to the patient.	☐	☐	☐	☐	☐	☐
I understand the costs of preventable hospital acquired complications regarding hypothermia.	☐	☐	☐	☐	☐	☐
I am familiar with the most recent evidence for managing spinal-induced hypothermia in obstetric anesthesia.	☐	☐	☐	☐	☐	☐
I initiate intraoperative MAW (IVFW concurrently with FAW) for non-emergent CS.	☐	☐	☐	☐	☐	☐
My c-section patients' temperature falls below 36 C/ 98.6 F during surgery.	☐	☐	☐	☐	☐	☐
My c-section patients shiver during surgery.	☐	☐	☐	☐	☐	☐
My c-section patients report feeling cold during surgery.	☐	☐	☐	☐	☐	☐
I will continue to use FAW and IVFW for my elective c-sections.	☐	☐	☐	☐	☐	☐
I do not have enough time to initiate FAW.	☐	☐	☐	☐	☐	☐

I do not have enough time to initiate IVFW.	☐	☐	☐	☐	☐	☐
IVFW supplies are not readily available to me in the OB suite.	☐	☐	☐	☐	☐	☐
FAW supplies are not readily available to me in the OB suite.	☐	☐	☐	☐	☐	☐
I am unfamiliar with the use of IVFW.	☐	☐	☐	☐	☐	☐
I am unfamiliar with the use of FAW.	☐	☐	☐	☐	☐	☐

Please describe any barriers you faced when utilizing interventions for preventing spinal-induced hypothermia in your clinical practice

Thank you for your participation!

Appendix C

Educational Intervention Slide Deck

Educational Intervention:

Prevention of Spinal-Induced Hypothermia in Cesarean Section Patients; a Quality Improvement Project

Vincent Pareja, RN, SRNA

1

About this DNP Project:

Purpose:

To deliver an educational presentation for CRNAs to address the use of intraoperative multimodal active warming (intravenous fluid warming concurrently with forced air warming) in preventing spinal-induced hypothermia in non-emergent cesarean sections (CS).

Aim:

1) To support evidence-based education among CRNAs
2) To identify barriers to practice change
3) To evaluate for reported reductions in the incidence of spinal-induced hypothermia, shivering, and maternal discomfort

2

Introduction

Childbirth is a momentous event in a woman's life – the perception of the event is influenced by the process and outcomes.

1. Improved CS experiences in the OR = better physical and psychological outcomes

Spinal Anesthesia (SAB) > General Anesthesia for elective CS

1. Due to evolving practices, public perception, anxiety surrounding delivery
2. Main drawback in focus: maternal hypothermia

Recent studies have examined the benefits of multimodal active warming techniques in attenuating spinal-induced hypothermia.

(Juang et al., 2017; Puia, 2018)

3

Background & Significance

Spinal anesthesia-induced hypothermia:
1. Sympathectomy → redistribution of body heat from central to peripheral → hypothermia
2. Physiological countermeasures blunted: vasoconstriction & shivering
3. Addition of opioids into intrathecal space may intensify hypothermia

Deleterious physiological effects:
1. ↑: O2 consumption, blood loss, rate of infection, coagulopathy, hospital stay, myocardial ischemia, patient discomfort

Current active warming techniques:
1. Intravenous fluid warming
2. Forced air warming

Ultimately, the goal is to effectively PREVENT (rather than reactively treat) spinal-induced hypothermia.

(Allen & Habib, 2018; Canturk et al., 2017; Chebbout et al., 2017; Hui, et al., 2006; Kurz, et al., 1993; Sessler, 2016)

4

UNCG

Review of Current Literature

Active warming techniques to prevent spinal-induced hypothermia and other outcomes in patients undergoing elective cesarean section

5

Active Warming Techniques

Forced Air Warming
1. Highest contributor to heat loss = RADIATION
2. Lower body / under body > upper body warming blanket
   - Upper body warming blanket: loud & limits surface area for skin-to-skin
   - Ideal goal: to cover as much surface area as possible to decrease core-peripheral temperature gradient

Intravenous Fluid Warmer
1. IVFW > Cabinet warmer
2. Average infusion of crystalloid during CS = 2 – 3L
   - Co-loading fluids to attenuate spinal-induced hypotension, hemodynamic shifts, & blood loss contribute to hypothermia

(Bameri et al., 2018; Campbell et al., 2015; Nieh & Su, 2016; Sultan et al., 2015)

6

Parturient Outcomes

Double Blind RCT:
1. Multimodal active warming increased maternal temperature on arrival at the PACU, minimized perioperative temperature drop, decreased incidence of perioperative hypothermia, improved maternal thermal comfort score compared to no intervention
2. Patients still got hypothermic in both intervention and control groups (64% and 91%, respectively)
   - To prevent maternal hypotension, IV fluids infused under 300 mmHg of pressure → output flow temperature compromised
   - Use of only a lower extremity FAW
3. **Recommendations:**
   - **Avoid IV infusion of crystalloids under pressure to maintain output temperature flow of IV fluid warmer**
   - **Maximize surface area coverage while maintaining maternal comfort and skin-to-skin time with an underbody forced air warmer.**

(Cobb et al., 2016)

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Parturient Outcomes

Prospective RCT:
1. Prewarming for 30 min in preop and initiating intraoperative fluid warming helped reduce perioperative hypothermia, shivering, and improved maternal comfort
2. Increased gap time (> 20 minutes) in between getting patients from the preoperative area to the OR for spinal anesthetic → increased incidence of hypothermia

RCT and Retrospective Observational Cohort Study:
1. Prewarming for 30-60 minutes with FAW + continued FAW intraoperatively + intraoperative IVFW → decreased incidence of perioperative hypothermia
2. Significant differences in temperature between multimodal active warming and control group in: preoperative phase, lowest foley core temperatures, intraoperative hypothermia, and recovery room temperatures ($p < 0.005$).

Recommendation:
1. **Decrease time between leaving preoperative area and initiating spinal in the OR under 20 minutes**
2. **FAW preoperatively and intraoperatively + IVFW intraoperatively → warm and comfortable mothers**

(Hoefnagel et al., 2020; Meghana et al., 2020; Ni et al., 2020)

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Neonatal Outcomes

Multimodal active warming interventions have not led to significant differences in neonatal outcomes.

1. Umbilical artery blood pH tends to be higher in groups receiving active warming interventions
   - Decreased maternal blood pH d/t hypothermia → decreased neonatal umbilical artery blood pH
   - Exact physiological mechanism still unknown

Inconsistencies arise in the variables measured to assess neonatal outcomes. Current literature focuses more on maternal outcomes compared to neonates.

In short… Further research is needed on the impact of multimodal active warming in neonatal outcomes.

(Cobb et al. 2016; Hoefnagel et al., 2020; Jun et al., 2019; Meghana et al., 2020; Ni et al., 2020)

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In Conclusion …

Implementing multimodal active warming techniques (preoperative and intraoperative FAW + IVFW) is a safe and effective method in attenuating the incidence of spinal-induced hypothermia & related adverse effects in patients undergoing spinal anesthesia for elective CS → positive patient outcomes & increased patient satisfaction.

1. Reduced incidence of hypothermia
2. Reduced incidence of shivering
3. Increased maternal comfort
4. Increased child birthing experience

It is critical for anesthesia providers to have the most updated evidence-based information on spinal-induced hypothermia interventions, and to apply our knowledge to clinical practice to provide quality care for parturients undergoing CS.

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THANK YOU!

In 1 month, you will receive (via email) a link to complete a follow-up survey to assess for your utilization of intraoperative multimodal active warming, perceived barriers to its utilization, and to evaluate self-reported efficacy in patient outcomes.

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