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Implementation of a Warming Protocol to Prevent Inadvertent Perioperative Hypothermia in the Ambulatory Surgical Setting

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Clinical Leadership Theme

The implementation of a standardized warming protocol aims to improve postoperative patient outcomes by preventing inadvertent perioperative hypothermia (IPH) and its complications in the ambulatory surgical setting. As a result, the process will attain a decreased incidence rate of IPH in the postanesthesia care unit (PACU). This project is centered on the clinical nurse leader (CNL) curriculum element of *Clinical Outcomes Management*. As the Outcomes manager, the CNL evaluates the microsystem's current process and uses this information to analyze the impact on the environment and patient outcome.

Statement of the Problem

Inadvertent perioperative hypothermia (IPH) frequently occurs in patients undergoing general anesthesia (GA) in both the acute hospital and outpatient surgical settings. In Moola and Lockwood's study (2011), IPH was reported in 50% to 90% of all surgical cases. According to the Association of Perioperative Registered Nurses (Wagner, 2010), hypothermia occurs when the core body temperature reaches below 36° C or 96.8° F.

All patients, regardless of age or gender, are at risk for developing IPH when general anesthesia or regional anesthesia is involved. Even the patient is normothermic prior to surgery, the body core temperature can drop 1-2° C within thirty minutes of receiving anesthesia. Anesthesia causes vasodilation, allowing the warm blood from the body's core to redistribute to the peripheral extremities. This phenomenon is also as redistribution temperature drop and is known as a common risk of anesthesia (Diaz & Becker, 2010).

Inadvertent perioperative hypothermia is linked to several postsurgical morbidities such as impaired wound healing, surgical site infections, altered drug metabolism, cardiovascular effects, and increased respiratory distress. In addition, IPH can lead to immediate postoperative complications such as blood loss, hypoxia, cardiac arrhythmias, shivering, and delayed extubation (Fettes, Mulvaine, & Van Doren, 2013).

When postoperative complications such as these occur, the patient is typically kept in PACU for close monitoring. This can potentially cause a disruption in surgical flow because the patient would be required to be observed longer than the expected time of discharge. In outpatient surgical settings,, it is common for the assigned nurse to complete the recovery care until the patient has reached stability. This has caused many unnecessary overtime hours and staff resources.

An audit of the microsystem was completed to identify any recurrent patterns of IPH. Data was collected on 100 random medical records using the electronic health record system. Results indicated that while patients were normothermic preoperatively, only 28% of postoperative patients were able to maintain normothermia immediately after surgery in the postoperative phase of care. This project seeks to resolve this issue by implementing a warming protocol, ensuring that all patients receiving general anesthesia are warm before, during, and after surgery.

The National Institute for Health and Care Excellence (NICE) and American Society of Perianesthesia Nursing (ASPAN) provided recommendations that could potentially be used as a tool for the implementation of a warming intervention protocol in the ambulatory surgical setting (NICE, 2008). These guidelines outline best practices, such as warming irrigation fluids and keeping the body’s core temperature warm if the patient’s skin is exposed for a long period of time. The purpose of this protocol is to promote normothermia and prevent IPH and its associated complications in patients receiving general anesthesia in the ambulatory surgical setting. Application of this protocol can potentially reduce postsurgical complications, surgical site infections, and costs toward resources and operational expenses if adopted in each phase of surgical care.

Project Overview

This process improvement project is expected to reach several goals and objectives centered on quality and safety. The global aim of this project is to improve postoperative patient outcomes by preventing inadvertent perioperative hypothermia and its complications in the ambulatory surgical setting. The process begins with the development of a standardized warming intervention protocol based on best practice guidelines, and ends with an overall decreased incidence of IPH. By working on the process, it is expected to steady pattern of patient normothermia in the postoperative phase of care, consistent nursing use of warming interventions, and increased patient satisfaction with thermal comfort. It is important to work on this now because the protocol reduces costs from postoperative complications to keep services affordable, promotes best safe practices and quality care, and enhances the patient’s surgical experience and satisfaction. The specific aim of this project is to increase the normothermia rate from 28% to 90% by December 2015. These aim statements fulfill the CNL role as Outcomes Manager by analyzing the impact on a patient-centered outcome, or the incidence of IPH, and the environmental outcome, indicated by the length of PACU stay.

Rationale

This process improvement project is valuable and important to the microsystem due to several aspects. First, it saves the microsystem extra costs associated with the treatment of postoperative IPH complications and ultimately keeps services affordable. Next, the process promotes best safe practices and quality care to all surgical patients in the ambulatory surgical setting. Lastly, the process is patient-centered by improving the patient's surgical experience and promoting proper healing.

Root Cause Analysis

After completing a detailed root cause analysis, several points in the microsystem's current process were identified as contributing factors to the incidence of IPH and prolonged PACU LOS. In the current process, no active warming interventions are initiated in the preoperative and postoperative phases unless the patient verbally complains of thermal discomfort. In the OR, only patients going under general anesthesia for more than 60 minutes receive active warming measures such as forced warm air. Simple passive warming interventions, such providing the patient with socks and warm blankets, are routinely provided for each patient. Nurses rarely document whether warming interventions were provided. Overall, the current process for temperature management is not consistent throughout all phases of care and a standard warming protocol does not exist. A detailed fishbone diagram explaining the causes of IPH and prolonged PACU LOS is provided in Appendix A.

SWOT Analysis

An analysis of the project's strengths, weaknesses, opportunities, and threats is provided in Appendix B. Internally, there are multiple strengths and weaknesses. One of the strengths of this project is that the staff is eager and willing to implement this protocol. The PACU staff has seen the effects of hypothermia and the impact it has on clinical outcomes. In addition, the staff recognizes the extra overtime hours taken out of their scheduled day dedicated toward the recovery of hypothermic patients. The nurses are required to stay until the patient reaches normothermia and is suitable for discharge to home. Managers and directors are also ready to change, as the overtime hours and associated risks of hypothermia amount to excess expenditures. The major weakness is that the money required to purchase more warming devices would be taken out of the capital budget. This requires approval from the organization's Oversight Committee and Board of Directors.

From an external standpoint, this project presents opportunities to deliver a standardized practice in surgical care from a quality and safety perspective. Preventing hypothermia provides multiple benefits beyond saving money and reducing PACU length of stay. The impact of this project can potentially reduce the chance of developing postsurgical complications such as surgical site infections and impaired wound healing. However, a threat to the warming protocol is that other factors, such as patient age or surgery type, can affect the patient's thermoregulatory response. Therefore, a warming protocol will not always guarantee the patients will be normothermic every time.

The contingency plan to address the weaknesses and threats to this project requires the CNL to practice the role of Nurse Educator. In response to the lack of funds, staff can be educated that active and passive warming techniques don't always require new devices. An example of this is actively warming the patient with warm intravenous fluids. Instead of buying new equipment specifically for warming fluids, we could warm the intravenous bags in blanket warmers that already exist in the microsystem. Although the threat of not being able to eliminate hypothermia indefinitely exists, staff education can increase hypothermia awareness and increase team collaboration for an effective prevention plan.

Financial Considerations

The Centers for Medicare and Medicaid Services (CMS) restrict reimbursements and payments to healthcare centers if patients develop hospital acquired infections, including surgical site infections. Inadvertent perioperative hypothermia is known for increasing the risk of surgical site infections due to delayed healing and perfusion to the surrounding tissues. However, a warming protocol, as recommended by NICE and ASPAN, will greatly reduce the risk of surgical site infections. If the organization does not comply with CMS standards and continues to place patients at risk for developing surgical site infections, costs will increase making surgical services unaffordable for our patients (CMS, 2014).

In addition, cost-benefit analysis was conducted to compare the cost of the microsystem's current warming equipment to a more inexpensive brand. Before the implementation of this project, the center was paying $8 per warming blanket using a warm forced air system. However, one vendor allowed the center to keep forced-air warming devices at each beside at no added cost, as long as the compatible Bair Paws gowns were purchased per patient. In other words, the warming equipment did not amount to additional costs, as long as the warming gowns were purchased at $15 per patient. Research has found that the warming gown was more effective than the traditional blanket because the gown disperses heat to cover more skin surface (Diaz & Becker, 2010).

Another benefit was decreasing costs related to laundry services. At this microsystem, laundry is a contracted service that charges based on weight. The heavier the load, the more expensive the costs become. Without a warming protocol, the nursing staff was using an excessive amount of cotton blankets and linen to keep patients warm before and after surgery. When patients complained of feeling cold, the previous linen and cotton blankets were replaced with a freshly warmed blanket. Excessive use of cotton blankets has increased the cost of linen services to $5 and may be expected to increase due to the California drought. A warming protocol will eliminate excessive use of cotton blankets and linens per patient to $1.

Based on the microsystem's historical data and trends, the average PACU and Recovery LOS is 1.5 hours. A patient with IPH can experience several complications leading to a longer PACU LOS and higher costs associated with overtime nursing hours and operational expenses. Without the protocol, there will be a higher incidence rate of IPH, therefore prolonging the LOS and costing $200 per extra hour in PACU.

In summary, the lack of a warming protocol can cost up to $713 per patient, taking in consideration the staff overtime hours, operational and facility costs, and supply and medication used to treat complications of IPH. With the protocol in place, the microsystem would only spend $16 per patient, saving about 98%. The comparison of costs with and without the protocol is presented in Appendix C.

Methodology

An action plan following the PDSA model, as provided in Appendix D, was developed with the approval and collaboration of the Quality Improvement Team. This team meets bi-weekly and involves several members of the interdisciplinary team. This team includes the Director of Nursing, Administrator, Managers of each department, Infection Control Nurse, Quality Improvement Nurse, Safety Officer, Medical Director, and the Surgical Department Head. The following action plan is a framework for the implementation of the protocol using Lewin's theory of change.

Unfreezing. First, an audit was conducted and data was collected to support the need for the change. The purpose of the audit was to monitor postoperative temperatures and detect trends that reveal incidences of IPH and prolonged PACU LOS. The audit also tracked whether warming interventions were initiated, and where in the surgical process it was maintained. Temperature logs were audited to explore whether the operating room ambient temperature was maintained within the American Organization of Perioperative Nursing (AORN) recommendation of 68°-75°F degrees (NICE, 2008). The bulletin board in the nurses' station and break room were used to present IPH rates and any safety issues that have occurred in the unit. In addition, a cost analysis was performed to determine the change's return on investment. The cost analysis also investigated what warming equipment and supplies fit within the organization's budget.

Moving. One of the actions toward this project was to find the best safe warming interventions through credible evidence. The best clinical practice guidelines for warming interventions were recommended by NICE and ASPAN. A new temperature management policy and process workflow were drafted based on these guidelines, and were approved by the Board of Directors and Oversight Committee. The proposed policy and procedure is available in Appendix E and the process workflow is provided in Appendix F. An educational presentation and inservice was held to educate staff about IPH and review the new policy. Post-tests and follow-up meetings with each department were held to assess staff understanding. The learning objectives of this educational module are summarized in Appendix G. A post-test was distributed to evaluate the staff's understanding of IPH, which is provided in Appendix H.

Meetings were held to meet with several medical equipment representatives to compare prices of warm forced air devices. The warming intervention protocol will require several Bair Huggers, Bair Pays, or similar warm forced air devices to be available at each bedside. The purpose of the cost comparison was to find devices and warming blankets that were cheaper than traditionally utilizing cotton blankets. Once the equipment has been ordered and received, equipment-training modules were held with the vendors and staff.

Refreezing. One of the future actions post-implementation of the protocol involves a time where the leadership team offers support and encouragement to the staff. Staff will be recognized for their efforts in improving quality patient care by being invited to a free lunch meeting provided by the quality team. The purpose of this meeting is two-fold: to thank staff for their input and to create constructive criticism to improve future change management. During this lunch meeting, employee satisfaction surveys should be distributed to the nurses. This will allow them to privately express their feelings toward the change process. Members of the nursing staff and interdisciplinary team will be invited to offer feedback and discuss areas of improvement.

Evaluation. According to Bick and Graham (2010), change can be sustained through continuous team evaluation and outcomes measurement. The CNL can evaluate the project's effectiveness by measuring the project's outcomes in the form of a 10-step study, which is the quality tool recommended by the microsystem's accrediting agency. This study will re-evaluate the project and the effectiveness of the change by measuring the following outcomes: hypothermia in the PACU and length of stay in the PACU. This study analyzes the microsystem's initial data to the post-implementation data, and evaluates whether the project positively trends toward the desired goals.

Data Source and Literature Review

Microsystem Assessment

The implementation of the warming protocol was based at a freestanding ambulatory surgery center in the San Francisco Bay Area. The majority of surgical cases performed at this microsystem are elective. Because of this, the patient population's acuity level is fairly low. The facility holds 5 operating rooms, 2 procedure suites, and 12 perioperative beds. The average yearly case volume is approximately 6,500, and approximately 70% of cases receive general anesthesia. Surgical services include orthopedic, endoscopic, urology, gynecology, podiatry, gastroenterology, reconstructive, and eyes, ears, and throat surgery. Nurses and nurse assistants are cross-trained and regularly float among the following departments when necessary: admitting department, operating room, postanesthesia care unit, and endoscopy suite.

Key stakeholders of include executive board members, physician staff, administrator, directors, managers, and employees. Shareholders also comprise of community leaders and patients. The mission of the microsystem is to provide the best possible surgical care to the community and best serve the needs of patients (WOSC, 2014). A patient-centered initiative, such as the implementation of a warming protocol, will help this microsystem continue its culture of quality and safety.

Microsystem Data

An audit of the microsystem was completed to identify hypothermic temperature readings in the preoperative and postoperative phases. The purpose of the audit was to gather data on patient temperature readings and investigate whether warming devices were initiated if the patient was hypothermic. One hundred random medical records were reviewed. The audit focused on adult patients receiving general anesthesia, and did not exclude specific surgery types.

Results indicated that while 95% of patients were normothermic before receiving general anesthesia in the preoperative phase of care, only 28% of postoperative patients were able to maintain normothermia immediately after surgery in the postoperative phase of care. More than

50% of patients did not receive any active warming interventions such as forced warm air or warmed IV fluids, as indicated through an audit of nursing documentation. In addition, the length of stay was calculated by evaluating the time the patient was admitted to PACU to the time of discharge. The audit revealed that patients who presented with hypothermia in PACU stayed an average of 3 hours longer than normothermic patients. The most common contributing factors leading to the lengthened recovery period in the audited hypothermic cases were due to extra care needed to control shivering, increased pain, hemodynamic control, and hypoxia. Based on this data, there is a great need for staff education and the standardization of a warming intervention protocol.

PICO Question

The PICO question used to gather credible evidence stated as follows: In patients receiving general anesthesia, how does the implementation of a warming protocol compared to the current care reduce the average PACU length of stay due to inadvertent perioperative hypothermia complications? The population included patients undergoing surgical procedures with general anesthesia. The patient population with the administration of general anesthesia was especially important to the literature review because general anesthesia lowers the core body temperature by 1-2° C within the first thirty minutes of administration (Butterworth, Mackey, & Wasnick, 2013, p. 1184).

The PICO question was used to search for pertinent evidence in several databases such as CINAHL Complete, PubMed, Joanna Briggs Institute, and Cochrane. The following keywords were used to narrow the search: hypothermia, LOS, PACU, preoperative, warming, anesthesia, and adult. Because the initial search yielded 58 potential studies, the search was refocused to study adult patients who underwent elective surgery with general anesthesia induction in an ambulatory surgical setting. Trauma cases and emergency surgeries were not included in the search. Studies were not limited to gender, surgery type, setting, surgery duration, or type of warming method. Surgeries that deliberately cause hypothermia were excluded. Patients with multiple comorbidities or received an American Society of Anesthesiologists (ASA) score above IV were also eliminated from the search. While the initial search yielded 58 potential studies, the evidence that best represented the clinical PICO question were narrowed down to 6 studies. Three sources were systematic reviews, two were randomized control trials, and one was a case control study. Each study was thoroughly analyzed and several concurrent conclusions were drawn. These conclusions are displayed in an evidence synthesis table found in Appendix I. The findings are explained as follows.

Postanesthesia Care Unit Length of Stay

Two of the six sources of evidence compared and measured the mean PACU LOS. Panagoitis, K., Maria, Argiri, & Panagoitis, S. (2005) studied the PACU LOS in hypothermic and normothermic patients while Fettes et al. (2013) explored whether combined preoperative and intraoperative warming versus intraoperative warming alone affected PACU LOS. A narrative analysis is described below.

Longer PACU LOS in hypothermic vs. normothermic patients. Panagoitis et al. (2005) performed a 2-month case-control study at a University Hospital in Greece. This study aimed to explore whether LOS in the PACU was affected by IPH. Length of stay was classified into two groups: actual and appropriate. Actual LOS represented the time the patient was transported out of the surgical suite until PACU discharge. Appropriate LOS indicated the length of time a PACU patient to reached stability and fulfilled discharge criteria using Aldrete and Kroulik scores. One hundred and fifty adult patients undergoing elective orthopedic surgery with

GA and regional anesthesia were required to meet the following criteria prior to surgery: ASA score of 1 to 3, age 18 or older, and CT of 36° C to 37.5° C (96.8° F to 99.5° F).

Data revealed that postsurgical GA patients (n = 104) were most likely to be hypothermic than normothermic upon PACU arrival (79% vs. 25%, $p = 0.028$). Mean actual and appropriate LOS, measured in minutes, significantly differed in hypothermic (n = 70) and normothermic (n = 25) GA patients. Mean actual LOS was higher in hypothermic than normothermic patients (96.1 ± 12.5 vs. 91.6 ± 14.9, $p = 0.136$). Mean appropriate LOS was also higher in hypothermic than normothermic patients (66.4 ± 10.8 vs. 60.1 ± 11.3, $p = 0.013$). Panagoitis et al. concluded that PACU LOS was consistently longer in patients with IPH.

No change in PACU LOS. Fettes et al. (2013) piloted a randomized control trial at an independently owned community hospital in Michigan. After informed consent and approval from the institutional review board were obtained, the nurses collected a convenience sample. Eighty-eight percent of this sample represented the true sample size of 128 patients. Although a power analysis deemed a sample size of 64 necessary, the authors randomly assigned 54 patients in the experimental group and 74 in the control group. The reason behind the uneven distribution of participants across the two groups was not discussed. Upon admission, there was no significant difference in demographical information such as gender, age, body mass index, and ASA score. Temporal artery scanning thermometers of the same brand were used as the standard form of measurement.

The hospital's current policy on IPH prevention was applied to patients in both groups. This policy included intraoperative warming through forced-air warming and warmed intravenous and irrigation fluids. However, the experimental group additionally received forced-air warming one hour preoperatively while the control group lacked any warming interventions preoperatively. Fettes et al. found that there was no significant difference in the mean PACU LOS between the control and experimental groups (49 min vs. 50 min, Mann-Whitney test, $P = 0.545$). Postoperative temperature differed by 0.1° F between the two groups (*t* test, $P = 0.314$).

Combination of Preoperative Warming and Intraoperative Warming Reduced IPH

The combination of preoperative warming and intraoperative warming to reduce the incidence of IPH postoperatively were commonly concluded in 4 studies. In 2 out of the 4 studies, variations of this conclusion were identified. For example, Moola and Lockwood (2011) compared active versus passive warming interventions while Vanni, Braz, Modolo, Amorim, & Rodrigues (2003) found that preoperative and intraoperative warming were more effective in surgeries lasting more than 2 hours. Further discussions of each study are as follows.

Roberson, Dieckmann, Rodriguez, & Austin (2013). The systematic review by Roberson et al. (2013) sought to gather evidence that addressed whether the application of the forced-air warming system preoperatively and intraoperatively combined was effective in decreasing the occurrence of IPH in the PACU. Evidence was chosen through Cochrane, National Guideline Clearinghouse, MEDLINE, and EBSCOhost. Although the search returned 35 applicable studies, the authors chose 8 sources with evidence strength levels II to IV. The sources comprised of 7 randomized control trials and 1 case control study, with variations in demographics, surgery type, ASA score, and duration of surgery.

Seven sources revealed decreased incidences of IPH when the treatment groups received preoperative and intraoperative warming, while one study found no change. In addition, results presented significant benefits for clinical practice such as operational cost effectiveness, decreased blood loss, increased patient comfort, lower incidences of shivering, and early extubation. On the contrary, two sources cited increased episodes of postoperative nausea and vomiting when preoperative and intraoperative warming was applied.

Moola and Lockwood (2011). This systematic review focused on effective warming methods for prevention and management of IPH. Initially, Moola and Lockwood found 130 eligible studies though databases including Cochrane, MEDLINE, PubMed, DARE, and CINAHL. Only 19 sources matched inclusion criteria and were critically appraised according to Joanna Briggs Institute appraisal standards. The 19 sources comprised of 1,451 patients from assorted surgeries and settings. Surgeries that deliberately caused hypothermia such as cardiac and neurological procedures were excluded.

Results revealed that patients who received preoperative and intraoperative active warming, compared to intraoperatively alone, were less likely to experience IPH after GA induction. Passive warming interventions inconsistently prevented IPH, whether treated preoperatively and intraoperatively, or intraoperatively alone. Examples of active warming included forced warm air and medication administration, while passive warming involved heat reflective blankets, socks, and heated blankets. Moola and Lockwood concluded that the best practice for IPH prevention was the administration of active warming interventions in the preoperative and intraoperative phases of care combined.

Vanni et al. (2003). A randomized control trial was performed at the University of São Paolo, Brazil to study the effectiveness of preoperative warming in preventing IPH, postoperative shivering, and delayed extubation. The sample size was limited to adult female patients undergoing abdominal surgery with GA. All female participants received an ASA score of I to II as determined by the practicing anesthesiologists.

Vanni et al. gathered 30 female patients after obtaining informed consent and approval by the hospital's ethics committee. The patients were randomly assigned to 3 groups of 10. The control group (G1) received no warming interventions or precautions to prevent IPH. Group G2 patients received both preoperative and intraoperative active warming interventions, while group G3 patients received intraoperative active warming interventions only. Upon admission, core temperature and demographical information in all groups did not significantly differ. A hospital-standard tympanic thermometer consistently measured core temperature. Active warming was defined as a forced-air warming blanket set at 42° to 46° C.

As a result, IPH, postoperative shivering, and delayed extubation occurred more frequently in the control group (G1) compared to the groups that received active warming (G2 and G3). All patients in G1 were hypothermic at the end of anesthesia, while 2 patients in G2 and 3 patients in G3 experienced mild hypothermia. In addition, Vanni et al. discovered that the combination of preoperative and intraoperative warming was more effective in surgeries exceeding 120 minutes. At the start of surgery (0 min), the core temperature in G1 < (G2 = G3). When the temperature was measured at the 30, 60, and 90-minute marks, G2 > G3 > G1. However, when the surgery duration reached 120 minutes to the end of GA, (G2 = G3) > G1 ($p < 0.001$).

Poveda, Clark, & Galvao (2012). A systematic review was conducted to analyze which warming solutions were effective in IPH prevention. The sample was chosen through credible electronic medical databases using specific keywords relevant to the research question. While an initial search yielded 730 studies, 14 randomized control trials were selected after applying the following inclusion criteria: adult population and studies conducted from 1990 to 2011. The type of surgeries varied from abdominal, orthopedic, gynecological, and urological procedures. The authors methodically reviewed and critically appraised each study based on its quality of data and credibility.

Poveda and colleagues provided a descriptive and narrative analysis of each study. Four of the fourteen trials found that preoperative warming reduced the intensity of hypothermia prior to surgery. Although the sample size varied among the 4 trials, all concluded that IPH occurred less frequently in patients who were prewarmed with active warming compared to passive warming 60 minutes prior to GA induction. The remaining 10 randomized control trials examined the combination of preoperative and intraoperative warming to reduce the rate of IPH in PACU. Participants in the control group received intraoperative warming only with active warming interventions. Patients in the experimental group were prewarmed with an active warming technique in conjunction with the same active warming technique maintained intraoperatively. The duration of prewarming lasted between 15 to 90 minutes. All trials used different active and passive warming techniques than others, while some trials explored the combination of active and passive techniques preoperatively and intraoperatively.

Summary of Literature Review

Evidence supporting the need of warming interventions was collected and analyzed. One systematic review (Poveda, Clark, & Galvao, 2012) sought to find best warming practices for IPH prevention. Poveda and colleagues found that the combination of active and passive warming techniques were effective in IPH prevention when used in all phases of surgical care. Patients who received these warming interventions reported increased comfort, reduced pain, and overall satisfaction with their care. Another systematic review (Moola & Lockwood, 2011) focused on effective warming methods for prevention and management of IPH. The article revealed that patients who received preoperative and intraoperative active warming interventions, compared to intraoperatively alone, were less likely to experience IPH after surgery. Passive warming interventions inconsistently prevented IPH, whether treated preoperatively and intraoperatively, or intraoperatively alone. Examples of active warming included forced warm air and medication administration, while passive warming involved heat reflective blankets, socks, and heated blankets. Moola and Lockwood concluded that the best practice for IPH prevention was the administration of active warming interventions in the preoperative and intraoperative phases of care combined.

Timeline

The planning phase of this project was initiated in 2014 and was put on hold due to monetary and staff constraints. During this time, a microsystem audit and cost analysis was performed and presented to the Board of Directors and Oversight Committee. At this time, the project was approved to formulate an action plan with the collaboration and teamwork of the Quality Improvement Team. On February 2015, approval was given to carry out the action plan as outlined in the Methodology section.

However, budgetary constraints stalled the purchase of new Bair Huggers in June 2015, as indicated in the provided SWOT analysis. The major setback to the budget was the opening of a new ambulatory surgery center located within a mile of the microsystem. The opening of this new center decreased the case and patient volume by 30%. Many of surgeons at the clinical setting were obligated to bring cases to the new surgery center because they were part of the new center’s medical group. Fortunately, the governing body forecasted this drop in volume, and recruited new surgeons with new specialized services. The case volume is forecasted to increase within the next 3 months, and the purchase hold has been lifted. New equipment is expected to arrive by August 2015, which is the time the next steps are planned to resume. Nevertheless, the warming protocol implemented during this down time because the active and passive warming measures, as outlined in the process workflow, does not necessarily require the use of a forced air device. Full implementation of the warming protocol with the new Bair Paws equipment began in July 2015, and a re-evaluation using post-implementation microsystem data will occur in December 2015. A detailed GANTT chart and timeline is provided in Appendix J.

Expected Results

The expected results of this project align with the goals and objects stated in the Project Overview. One of the desired results is to ensure that all patients receiving general anesthesia are normothermic in the postoperative phase of care. In addition, the protocol hopes to instill a standard nursing practice that utilizes appropriate warming interventions based on best practice guidelines. At the end of this process improvement project, staff is expected to have a deeper understanding of IPH and effective thermal management techniques to provide safe patient care. The protocol is also expected to reduce costs related to unnecessary staff overtime hours and extra laundry services.

Nursing Relevance

Advancements in technology and medicine have allowed complex surgeries, which have historically been done exclusively in the hospital, to be safely performed in the outpatient setting. Less invasive procedures and the development of various anesthetic agents have increased the demand for ambulatory surgery centers (Ambulatory Surgery Center Association, 2013). As a result, there will also be a higher demand for surgeries and procedures to be performed at the outpatient setting rather than in the hospital.

One of the forces behind the change from inpatient to outpatient is driven by costs. Surgeries performed at the outpatient setting have saved the government, patients, and insurance companies an average of $2.6 billion a year in comparison to the costs of the same surgeries performed in the hospital setting (Ambulatory Surgery Center Association, 2013). In order to keep outpatient surgeries in demand, nurses must reduce unnecessary cost and eliminate waste without compromising the quality of care.

When a warming protocol is implemented into nursing practice, the impact can be profound. This project is directly tied to nursing practice, as it changes the traditional use of cotton blankets with sustainable warming interventions such as warm forced air. The warming protocol will be a standardized nursing practice in effort to eliminate IPH and its complications, reduce nursing staff overtime hours, decrease patients' length of stay in PACU, and save costs in laundry services, supplies, and resources. The end result of this protocol does not compromise the quality of care or patient outcomes. On the contrary, the protocol improves patient outcomes by stabilizing the core temperature and prevents postsurgical complications from IPH. As the trend toward cost-reducing efforts continue to intensify, nursing research on IPH warming interventions to reduce PACU LOS cost will be in demand while aiming to achieve the best and safest care for surgical patients.

Conclusion

In the current state, the project is in the process of the "do" phase of the PDSA cycle. The plan is to complete the "study" phase of the PDSA cycle by December 2015. During that time, post-implementation data will be collected and analyzed. The results will aid in reassessing the process change for any modifications or need for a second PDSA cycle. Making modifications and adjustments will strengthen the quality of the warming protocol and maintain sustainability. One factor that influences sustainability is having both nurse and physician champions in the microsystem. The Infection Control and Quality Improvement nurses are considered the champions in this project due to the fact that they will be conducting audits, collecting data, and re-educating staff about IPH regularly. The physician champion is the Medical Director, who is an anesthesiologist and an essential contributor to the development of the warming protocol. Having a physician as a champion is important to the sustainability of this process change because the warming protocol will need the input, cooperation, and buy-in from both anesthesiologists and surgeons.

Next, the goal and purpose of the project aligns with the organization's mission. The mission of my microsystem is to provide the best possible surgical care to the community and best serve the needs of patients (WOSC, 2014). A patient-centered initiative, such as the implementation of a warming protocol, will help continue a culture of quality and safety.

Additionally, the clear patient benefits from this protocol, both physically and financially, are strong factors that influence the project's sustainability. With the warming protocol in place, inadvertent perioperative hypothermia will be avoided causing better patient outcomes and less nurse overtime hours. Lastly, this project has received tremendous support from stakeholders since the beginning. Monthly meetings with involved stakeholders were held to provide updates on the progress of the project and initiate discussions for opportunities of improvement.

Recently, CMS announced that there are plans to add a normothermia measure to the Ambulatory Surgery Center (ASC) Quality Reporting Program and Payment Rule for 2016 (CMS, 2015). Soon, reporting the normothermia rate will be a mandatory requirement for ASCs to receive reimbursement from CMS. This monetary incentive provides a strong reason to standardize a warming protocol, not only in this microsystem, but also across all ASCs.

The nursing profession is constantly pressured to find innovative ways to improve patient care, eliminate waste, and maintain affordability through process improvement projects. I believe standardizing a process improvement project, such as the warming protocol, is both essential and meaningful in all ASCs. The standardization of this protocol relies on the clinical nurse leader's ability to lead as a Clinical Outcomes and Care Environment Manager in the microsystem. In the future, I hope to practice these competencies by being an advocate and disseminating this change in practice at other microsystems.

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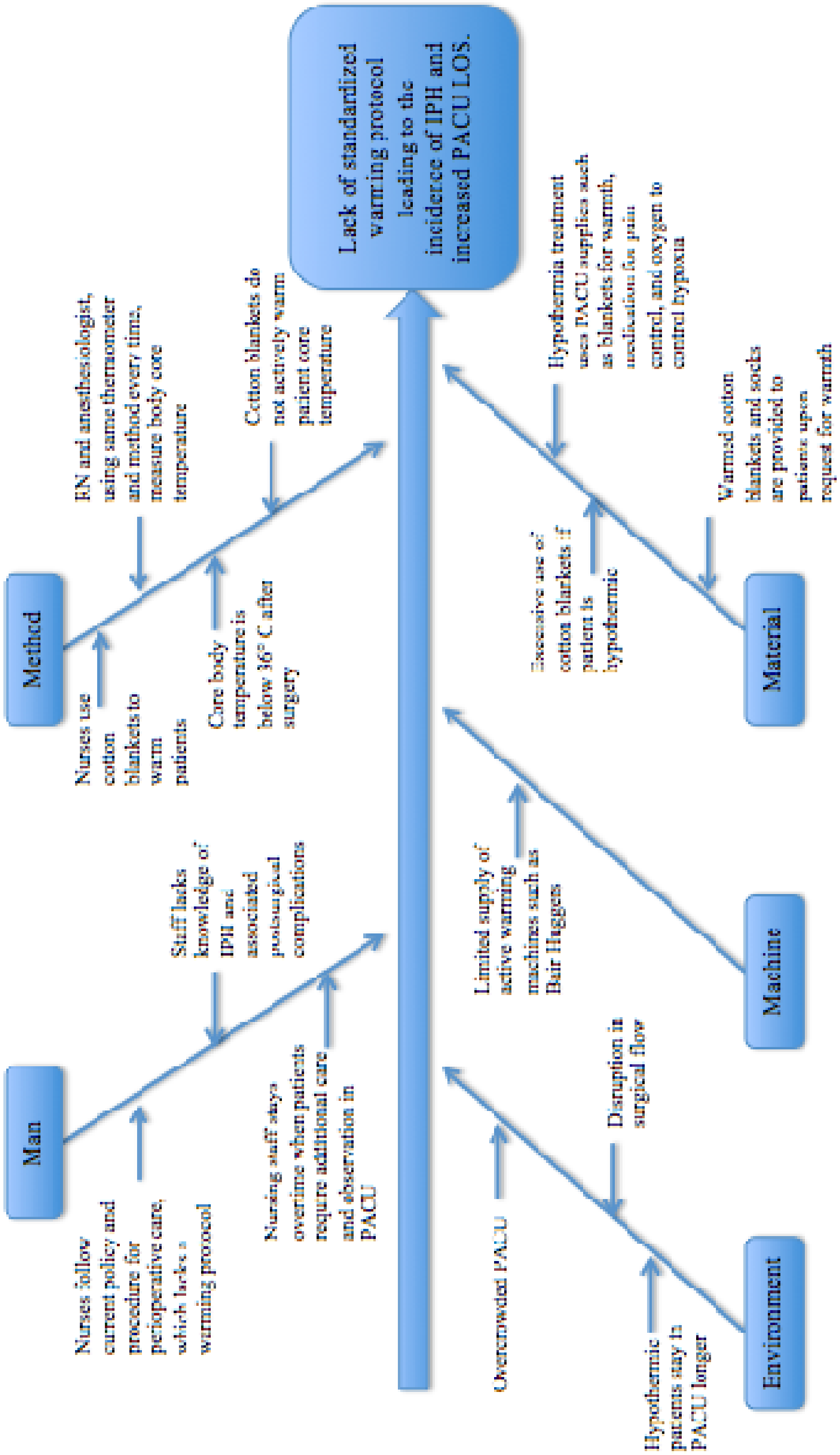
Appendix A

Root Cause Analysis: Fishbone Diagram



Appendix B

SWOT Analysis

Strengths

- Decrease postoperative complications related to IPH (e.g. hypoxia, shivering, delayed extubation)
- Cost effective; reduce costs in laundry services, overtime hours, PACU supplies
- Staff ready for change
- Provides quality and safe care
- Based on credible evidence and best practice guidelines
- Better postsurgical care and promotes healing

Weaknesses

- Nursing staff lacks education regarding potential harmful effects of IPH
- Change in nursing practice difficult for seasoned nurses
- Budgetary constraints; requires purchase of equipment from capital budget

Opportunities

- Creates opportunity to be a leader in standardization of warming interventions in the ambulatory surgical setting
- Opportunity to deliver best practice in surgical care
- Warming protocol requires multidisciplinary collaboration

Threats

- Other contributing factors may prolong PACU LOS such as patient characteristics and surgery type
- Thermoregulatory responses differ among patients due to age and medical conditions

Appendix C

Cost Analysis

Current Cost per Patient with IPH	Warming Blanket	$8.00
	Laundry Costs	$5.00
	PACU LOS per hour*	$200.00
	IPH Treatment	$500.00
	TOTAL (at least)	**$713.00**

Projected Cost per Patient with Warming Protocol	Warming Blanket/Gown	$15.00
	Laundry Costs	$1.00
	PACU LOS per hour*	$0.00
	IPH Treatment	$0.00
	TOTAL (at least)	**$16.00**

* Based on the microsystem's historical data and trends, the average PACU (including Phase II Recovery) LOS is 1.5 hours. This line item is the cost per hour beyond the expected recovery time of 1.5 hours. This also includes additional cost of nursing hours and operational expenses.

Appendix D

PDSA Model

Appendix E

Warming Protocol Policy and Procedure

Policy #: Pending

Subject: Nursing Plan, Peri-Operative; Alteration of Body Temperature: Inadvertent Perioperative Hypothermia

Definition: Potential hypothermia related to low room temperature and anesthetic agents.

1. Expected Outcome: Patient's temperature with temporal thermometer is above 96.8° F

2. Nursing Action:
    a. Assessment
        i. Record temporal thermometer temperature on admission to PACU
        ii. Identify the patient’s risk factors for perioperative hypothermia.
        iii. Document and communicate all risk factor assessment findings to all members of the healthcare team.
    b. If normothermic:
        i. Maintain ambient room temperature at or above 24° C or 75° F.
        ii. Assess patient thermal comfort level on admission, discharge, and more frequently as indicated.

3. Observe for signs and symptoms of hypothermia (eg shivering, piloerection, and/or cold extremities)

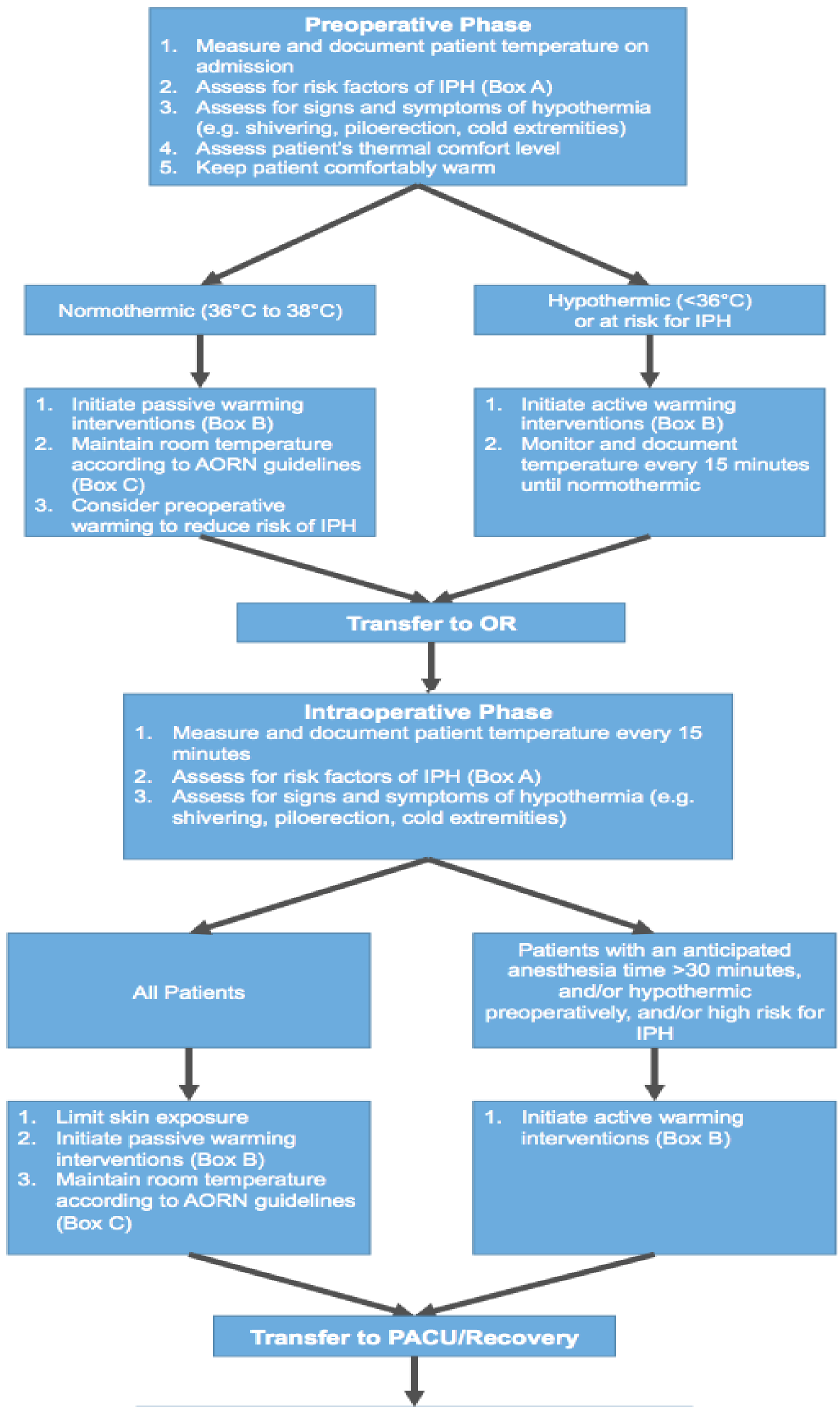
4. Reassess temperature if patient’s thermal comfort level changes and/or signs or symptoms of hypothermia occur.

5. Implement active warming measures as indicated

6. Measure patient temperature prior to discharge.
    a. If hypothermic:
        i. Apply forced air warming system
        ii. Warmed intravenous fluids
        iii. Warm blankets as necessary
        iv. Assess temperature and thermal comfort level every 15 minutes until normothermia is achieved.

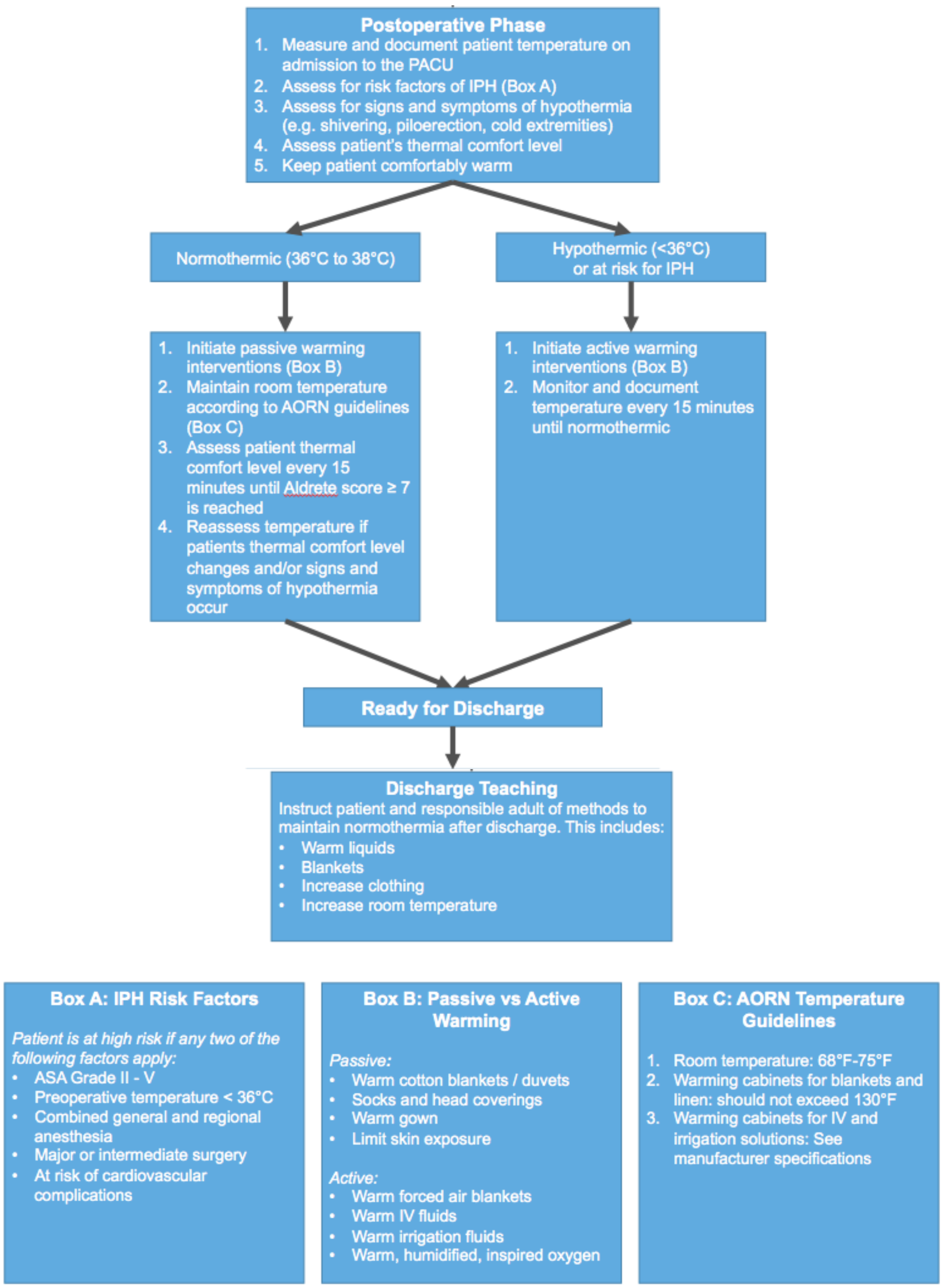
Appendix F

Process Workflow: Warming Protocol



Appendix F

Process Workflow: Warming Protocol (Continued)



Appendix G

Learning Objectives

1. After attending a presentation focusing on hypothermia in post-surgical patients, nursing staff will demonstrate understanding by identifying 3 approaches for preventing hypothermia in the post-assessment test given at the end of the facility wide in-service.

2. Given the instruction on nursing documentation, nursing staff will achieve 100% compliance in documenting the patient's temperature and hypothermia interventions in all 3 phases of the surgical process (pre-op, peri-op, and post-op) by the end of May 2014.

3. After attending a seminar on hypothermia, nursing staff will be able to identify at least 3 potential complications and consequences that may be induced by perioperative hypothermia by taking a post-test upon completion of the seminar.

Appendix H

Department:___________________

Date: ___________________

Inadvertent Peri-operative Hypothermia (IPH)
Post-Test/Evaluation

Studies have shown that effective communication and collaborative teamwork among healthcare professionals can enhance the quality and safety of patient care. As an integrated team (RN's, CNA's, and surgical tech's), work together and discuss the following statements regarding IPH.

1. Name 3 complications that may be induced by IPH.

2. Name 3 interventions that your department can do to prevent IPH.

3. Please sign below, indicating that you have read the IPH PowerPoint and participated in the above discussion.

Appendix I

Evidence Synthesis Table

Author (Year)

Outcome	Panagoitis et al. (2005)	Roberson et al. (2013)	Moola & Lockwood (2011)	Fettes et al. (2013)	Vanni et al. (2003)	Poveda et al. (2012)
The PACU LOS was longer in HT patients than NT patients.	X					
There was no change in PACU LOS when HT patients were compared to NT patients.				X		
The combination of preoperative and intraoperative warming interventions reduced IPH.		X	X		X	X
Active warming interventions were more effective than passive warming interventions in preventing IPH.			X		X	X
The combination of preoperative and intraoperative warming interventions was more effective in preventing IPH if the surgery lasted more than 2 hours.					X	

IPH = inadvertent perioperative hypothermia; HT = hypothermic; LOS = length of stay; NT = normothermic; PACU = postanesthesia care unit

Appendix J

GANTT Chart: Timeline