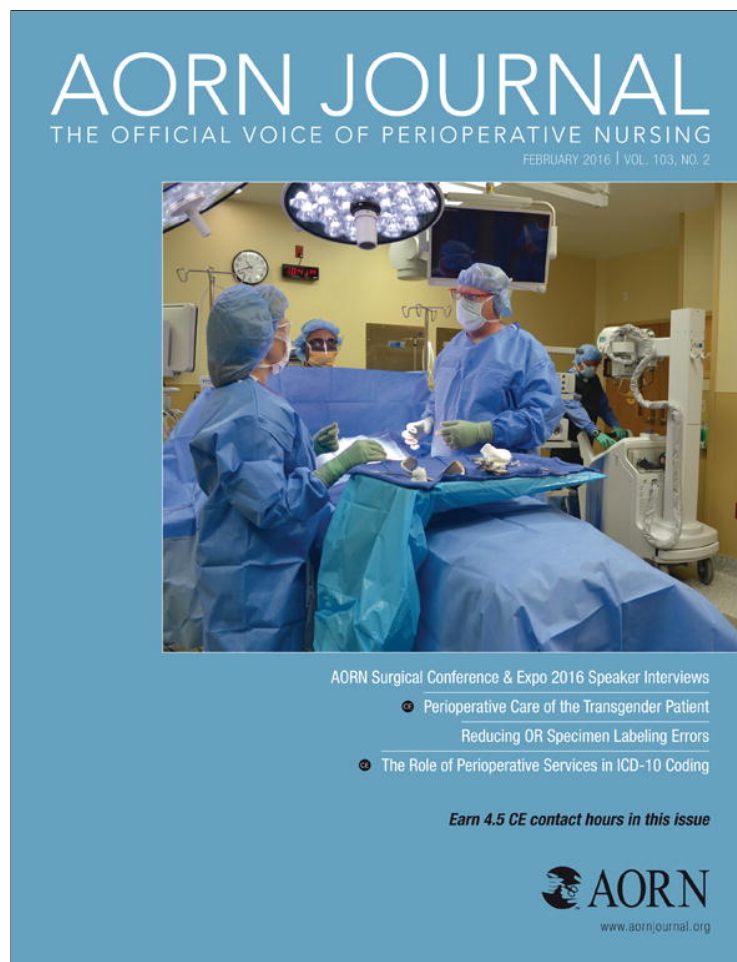


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Maintaining Perioperative Normothermia: Sustaining an Evidence-Based Practice Improvement Project

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ABSTRACT

Unintentional perioperative hypothermia has been shown to cause serious patient complications and, thus, to increase health care costs. In 2009, an evidence-based practice improvement project produced a significant decrease in unintentional perioperative hypothermia in colorectal surgical patients through monitoring of OR ambient room temperature. Project leaders engaged all interdisciplinary stakeholders in the original project, which facilitated the sustainability of the intervention method. An important aspect of sustainability is ongoing monitoring and evaluation of a new intervention method. Therefore, continued evaluation of outcomes of the protocol developed in 2009 was scheduled at specific time points after the initial small test of change with colorectal patients. This article focuses on how attention to sustainability factors during implementation of an improvement project led to the sustainability of a protocol for monitoring OR ambient room temperature with all types of surgical patients five years after the initial project. *AORN J* 103 (February 2016) 213.e1-213.e13. © AORN, Inc, 2016. <http://dx.doi.org/10.1016/j.aorn.2015.12.020>

Key words: normothermia, quality improvement, evidence-based practice, unintentional hypothermia, sustainability project.

Although several authors previously have discussed factors related to the sustainability of improvement initiatives,¹⁻⁵ there are few published accounts of projects that have attained sustainability. At the outset of any improvement project, four important factors are necessary to promote its sustainability: strong leadership, support of stakeholders, nurse champions, and modifiable projects that are in alignment with the organization's vision, mission, and goals.³ The project described in this article addresses each of these components. The administrative nursing leadership supported the implementation of this project by providing expert mentors for the staff nurses, time to work on the project, and travel funding for the

nurses to disseminate project outcomes. Stakeholders were involved in the project's development and implementation from the beginning, and the project was related to one of the organization's priorities for improvement. In this article, we

- present a brief overview of the initial evidence-based practice improvement (EBPI) project⁶ that was designed to test the effectiveness of an intervention to promote perioperative normothermia in patients undergoing colorectal surgery,
- present the check-in points at which data were collected to determine whether implementation protocols continued to be followed,

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- identify the actions taken to promote the sustainability of the interventions implemented in 2009, and
- present the final results of a five-year follow-up to demonstrate the sustainability of the intervention after application to all types of surgical patients.

DESCRIPTION OF THE PROBLEM

Unintentional perioperative hypothermia resulting in a core body temperature lower than 37° C (98.6° F) has been shown to cause serious patient complications and to significantly increase health care costs.⁷ Adverse events caused by mild unintentional hypothermia include surgical site infections, decreased incision-site healing, increased blood transfusions, myocardial infarction, and death.⁷ As previously described,⁶ our EBPI project decreased the occurrence of unintentional perioperative hypothermia among colorectal surgical patients at a community hospital. Our long-term goals were to decrease unintentional perioperative hypothermia in all surgical patient populations and to promote the sustainability of the new EBPI protocol. This project had significance for the hospital as well as for the larger health care community.

Our initial project implemented evidence-based recommendations from the American Society of PeriAnesthesia Nurses (ASPAN) and AORN: “ASPAN’s evidence-based clinical practice guideline for the promotion of perioperative normothermia”^{8,9} and “Recommended practices for the prevention of unplanned perioperative hypothermia,”^{10,11} respectively. Only colorectal surgical patients were included in the project, because the surgical care improvement project (SCIP)¹² goal when the original project was started was to decrease unintentional perioperative hypothermia in this population. Over the subsequent five years, the project’s intervention protocol was applied to all types of surgical patients to decrease their rates of unintentional perioperative hypothermia. Although the EBPI protocol reduced perioperative normothermia at each stage of the project, sustainability of the positive patient outcomes required the Perioperative Normothermia Project (PNP) team to continually monitor the intervention and to determine adherence to the protocol developed for the original project. The sustainability of positive outcomes from EBPI interventions depends on the development of well-designed and supported implementation projects.³

STATEMENT OF GOALS

The goals of the initial EBPI project were to decrease the occurrence of unessential perioperative hypothermia in colorectal surgical patients by maintaining OR temperature between 20° C to 23.9° C (68° F to 75° F) and to build a team

(ie, the PNP team) to support sustainability. We developed a perioperative normothermia protocol based on the best available evidence (Table 1).

After successfully implementing this protocol for monitoring OR ambient room temperature during colorectal surgery,⁶ our goal was to expand the protocol to include all surgical patients and ensure adherence to the protocol by periodic monitoring of processes and outcomes. Building on the success of the initial EBPI with colorectal surgical patients, project leaders continued to engage stakeholders through re-education regarding the best evidence-based practices (EBPs), with a goal of sustaining the decreased rate of unintentional perioperative hypothermia in all surgical patients.

Project Setting

This project was carried out at a northeastern community hospital (NCH) between March 2009 and December 2014. The hospital is a 233-bed community hospital. The surgical suite consists of nine main ORs, which are fully staffed Monday through Friday from 6:40 AM to 5 PM, with fewer than nine rooms running past 5 PM. Depending on predicted need, from 7 to 11 PM, one or two teams staff the OR, along with a call team from 7 PM to 7 AM on weeknights. On weekends, the ORs are staffed with one call team from 7 AM on Saturday until 7 AM Monday. A team consists of one scrub technologist (or licensed practical nurse [LPN]), one RN circulator, and one anesthesiologist (MD) or certified RN anesthetist (CRNA). Two surgical nurse practitioners and several RN first assistants are also available to assist surgeons, if needed.

SUMMARY OF THE INITIAL EBPI PROJECT

The initial EBPI project asked the following question: In colorectal surgical patients, does maintaining OR temperature between 20° C and 23.9° C (between 68° F and 75° F) until the patient is totally draped and the forced-air warming blanket is in place maintain intraoperative normothermia better than routine care (routine care included all ASPAN and AORN guideline recommendations except the maintenance of OR temperatures at optimal levels)?

Routine monitoring of the SCIP goals by the hospital’s quality management department had identified that 50% of colorectal patients experienced unintentional postoperative hypothermia between January and May 2009. This metric was below the minimum target. Further, nurses in the OR observed that many patients complained of cold temperatures in the OR before anesthesia, and nurses in the post-anesthesia care unit (PACU) noted that patients’ skin felt

Table 1. Perioperative Normothermia Protocol^{1,2}

Northern Westchester Hospital	
Patient Care Services	
Subject: Maintenance of Ambient OR Temperatures and Humidity Control	
Policy Number:	Page 1 of 2
Effective Date: 1/2010	Issued By: Perioperative Normothermia EBP Project Team
Reviewed: Revised: Supersedes: N/A	Distribution: Surgical Services
<p>POLICY: The operating rooms in the Main OR and Labor and Delivery will be maintained at acceptable ranges for humidity and temperature. No patient will be allowed to enter an OR suite unless the temperature and humidity of that room is within acceptable range.</p> <p>PURPOSE: To ensure temperature and humidity are within required ranges prior to the start of any surgical procedure.</p> <p>DEFINITION OF RANGES: Acceptable range for humidity is 30% to 60%. Acceptable range for temperature is 68° F to 77° F.</p> <p>PROCEDURE:</p> <ol style="list-style-type: none"> 1. Each morning before the start of any surgical procedures, the Activity Coordinator will log the temperature and humidity of each OR suite. 2. Prior to the setup of each subsequent case throughout the day, the temperature and humidity will be checked by the Circulating Nurse and documented on a log sheet in the individual OR suites. <ol style="list-style-type: none"> a. This documentation will be placed in the temperature and humidity log book, located at the OR Control Desk, each morning from the previous day. 3. Any temperature or humidity reading out of range is immediately called to the power plant personnel who will assist with correction. 4. For every surgical patient the OR staff will: <ol style="list-style-type: none"> a. Limit skin exposure. b. Initiate passive warming measures: warmed cotton blankets; foot and head covers. c. Initiate active warming measure: forced-warm-air blanket. d. Utilize warm IV and irrigation fluids. 	
<ol style="list-style-type: none"> 1. Berry D, Wick C, Magons P. A clinical evaluation of the cost and time effectiveness of the ASPAN Hypothermia Guideline. <i>J Perianesth Nurs.</i> 2008;23(1):24-35. http://dx.doi.org/10.1016/j.jopan.2007.09.010 2. Burns SM, Wojnakowski M, Piotrowski K, Caraffa G. Unintentional hypothermia: implications for perianesthesia nurses. <i>J Perianesth Nurs.</i> 2009;24(3):167-176. 	

cold postoperatively. Before the EBPI project, OR nurses were already attempting to improve patient comfort by warming the OR beds; providing warm cotton blankets, hats, and socks preoperatively; and applying a forced-air warming device

intraoperatively. These interventions were recommended by both the ASPAN^{8,9} and the AORN^{10,11} guidelines.

The OR staff nurse who was the project lead for the PNP developed a tool to collect baseline temperature data on every patient who was undergoing colorectal surgery. The baseline temperature was assessed using tympanic thermometers as the patient entered the OR. The project team was interested in determining which of the interventions from the guidelines⁹⁻¹¹ were consistently being followed at NCH and what the frequency of normothermia was for colorectal surgical patients (Table 2). The data showed that all of the guideline recommendations were being followed consistently, except that warm ambient OR temperatures were not consistently being maintained.

REVIEW OF RELEVANT EVIDENCE

Before implementing the EBPI in colorectal surgical procedures, we reviewed the evidence to formulate our strategy and inform the development of the protocol.

Search Strategy

Before the initial EBPI project, we performed a literature search in PubMed using the following medical subject heading (MeSH) terms: *hypothermia OR hypothermia/surgery*. Limits set were: publication date from 2000-2009, humans, meta-analysis, practice guideline, and English. Search results yielded 12 documents, only one of which was directly related to our clinical question regarding perioperative hypothermia: “Recommended practices for the prevention of unplanned perioperative hypothermia.”¹¹ A search of articles related to the AORN reference yielded 253 results, only one of which was directly related to our topic and was chosen for review: “A clinical evaluation of the cost and time effectiveness of the ASPAN hypothermia guideline.”¹³ Two additional pertinent articles were selected for review: “Unintentional hypothermia: Implications for perianesthesia nurses”¹⁴ and “Maintaining intraoperative normothermia: A meta-analysis of outcomes with costs.”⁷

In 2014, at the culmination of our sustainability project, two additional searches of the Cumulative Index to Nursing and Allied Health Literature (CINAHL) and PubMed did not reveal any new evidence on the relationship between OR ambient room temperature and postoperative hypothermia (or normothermia). The original ASPAN and AORN guidelines^{8,11} had been updated,^{9,10} but they retained the substance of the original clinical recommendations to prevent unplanned hypothermia. All of the evidence was read, discussed, and evaluated by the PNP team for quality and relevance.

Table 2. Original EBPI Project Internal Data to Determine Baseline Guideline Adherence, December 2008 (n = 5)

OR Procedure	Patient Characteristics			ASPAN Guideline					OR Ambient Temperature Above 20° C (68° F)?
	Preoperative Temperature	Temperature On Arrival in PACU	Warm IV Fluids Used?	Warm Irrigation Fluids Used?	Forced-Warm-Air Blanket Intraoperatively?	Passive Warming Measures Applied?	Warm IV Fluids Used?	Warm Irrigation Fluids Used?	
Open Laparotomy	36.5° C (97.7° F)	35.9° C (96.6° F)	Yes	Yes	Yes	Yes	Yes	Yes	No 17.2° C (63.0° F)
Colon Resection	37.0° C (98.6° F)	35.8° C (96.4° F)	Yes	Yes	Yes	Yes	Yes	Yes	No 17.2° C (63.0° F)
Colon Resection	36.5° C (97.7° F)	35.7° C (96.3° F)	Yes	Yes	Yes	Yes	Yes	Yes	No 18.1° C (64.6° F)
Colon Resection	36.7° C (98.1° F)	35.8° C (96.4° F)	Yes	Yes	Yes	Yes	Yes	Yes	No 15.5° C (59.9° F)
Colon Resection	36.7° C (98.1° F)	35.8° C (96.4° F)	Yes	Yes	Yes	Yes	Yes	Yes	No 16.1° C (61.0° F)

EBPI = evidence-based practice improvement; PACU = postanesthesia care unit.
Note: Passive warming measures include head cover, socks, and heated blanket.

Evidence Review

At the time of the original evidence review, the only available clinical practice guideline that addressed maintaining normothermia through preoperative, perioperative, and postoperative areas was the 2009 ASPAN guideline.⁸ The ASPAN guideline was a key piece of evidence guiding our internal data collection to identify gaps in best practice for perioperative nursing. The guideline recommended the following:

- Limit skin exposure to low ambient room temperatures.
- Start passive warming measures.
- Maintain an ambient room temperature between 20° C and 23.9° C (between 68° F and 75° F).
- Use active warming measures.
- Use warm IV and irrigation fluids in the abdomen, pelvis, and thorax.
- Monitor intraoperative temperature every 30 minutes.⁸

In their follow-up review, the PNP team compared the 2009 guideline with the updated 2010 ASPAN guideline⁹ and the AORN guidelines.¹¹ The updated ASPAN and the AORN guidelines recommended elevated OR temperatures as one measure to prevent unplanned hypothermia, especially for patients at high risk of hypothermia, such as those from elderly or pediatric populations.

In a study by Berry et al,¹³ the ASPAN guideline was followed, with the goal of achieving normal core body temperature by the time of discharge from the PACU. The authors also supported the ASPAN guideline recommendation to obtain or maintain continuous normothermia of 36° C to 38° C (96.8° F to 100.4° F) throughout the perioperative and intraoperative phases of surgical care.¹³ Berry et al implemented the ASPAN guideline interventions only during preoperative and postoperative phases, and they observed that the most significant temperature loss occurred in the OR. The authors did not include recommendations for the intraoperative phase of the project, because the implementation of these recommendations could not be monitored. This important exception was made because of staff resistance in the operating areas.¹³

According to Burns et al, “Ambient room temperature remains the primary intraoperative variable influencing whether patients will become hypothermic. Landmark studies found that all patients entering OR’s with ambient room temperatures of less than 70° F (21° C) became hypothermic.”^{14(p169)}

One article concluded that a focus on maintaining ambient room temperature in the OR is not a reasonable approach to

determine practice.¹⁵ The author stated, however, that the variable of OR temperature was not addressed in most studies reviewed; this observation validates the dearth of evidence on this relationship.

Project Goals Based on Evidence Review

The challenge of staff resistance identified in the literature was also noted at the community hospital. A major barrier to keeping our surgical patients warm was the traditional belief held by health care practitioners at the hospital that maintenance of cold OR temperatures is necessary to suppress microbial growth. Given these challenges, one of the goals of the EBPI project was to address and gain interdisciplinary collaboration and buy-in to perform interventions during the intraoperative phase before the implementation of the project. As Berry et al emphasized, any change to improve the quality of the perioperative patient experience requires an interdisciplinary approach to train all involved staff members,¹³ and this approach is what the perioperative nurses at the hospital set out to adopt—to build, through collaboration and coordination with OR staff members, a sustainable project based on the ASPAN and AORN guidelines for controlling the ambient OR temperature.

Based on the review and appraisal of the external evidence and analysis of the agency's internal quality metrics and baseline data to define the problem, the PNP team put forth the following practice recommendations for the initial project:

- Provide warm cotton blankets, hats, and socks preoperatively.
- Apply a forced-air warming device intraoperatively.
- Adjust the ambient OR temperature to between 20° C and 23.9° C (between 68° F and 75° F) for each colorectal surgical patient during the surgical phase.

PROJECT METHODS

Strong leadership, administrative support, and a sound framework for implementation are essential to sustain practice improvements.³ The methodology chosen for this project reflects these components through integration of the community hospital's nursing shared governance structure and the use of the EBPI model previously developed by Levin and colleagues (Figure 1).⁶ As part of nursing shared governance, the Evidence-Based Practice/Nursing Research Council (EBPRC) coordinates the unit-based work that identifies clinical concerns, facilitates identification of the focused clinical problem, helps lead nurses in the review of evidence, and provides guidance in the development of protocols to test and evaluate evidence-based interventions.

EBPI Model

The EBPI model combines the best of the EBP and performance-improvement paradigms by merging the steps of EBP with aspects of practice/quality-improvement processes.⁶ Although the EBP paradigm begins with asking a focused

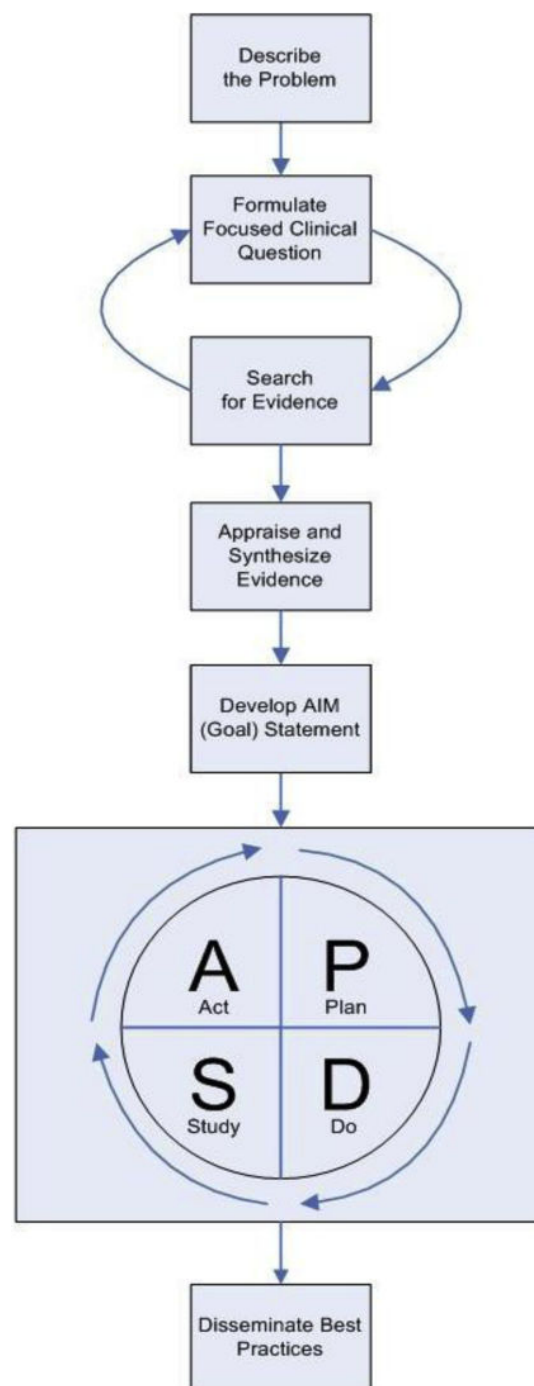


Figure 1. The Evidence-Based Practice Improvement (EBPI) model. Reprinted with permission from the Visiting Nurse Service of New York and Rona F. Levin. © 2007 Visiting Nurse Service of New York and Rona F. Levin.

clinical or PICO (P = population, I = intervention, C = comparison group or current standard of care, and O = outcome[s]) question, the first step in the EBPI model is to describe the clinical or systemic problem using clinicians' observations, background information on the topic, and agency quality metrics to support the significance of the problem or issue. Until one has all of this baseline information, forming a focused question about the theme for improvement is not possible. The focused question or project purpose then guides an evidence search to answer the question. After the best relevant evidence is found, the project team summarizes and critically appraises the evidence to support the project innovation. The team then sets goals (ie, AIM statements) for desired outcomes. Another important aspect of the model is the integration of plan, do, study, act (PDSA) cycles or small tests of change from the practice/quality improvement paradigm.¹⁶ These cycles are intended to perfect the processes for implementation before measuring desired outcomes and implementing an innovation on a larger scale.

Design of the EBPI Project to Ensure Sustainability

A sustainable improvement in perioperative practice requires an interdisciplinary partnership between the nursing staff members, surgeons, anesthesia professionals, ambulatory surgery unit (ASU) personnel, and PACU staff members. Sustainability cannot be accomplished without communication and collaboration across units and disciplines in the hospital setting to effect successful improvements in patient care. Initial design of the project to ensure collaboration and buy-in was essential to sustainability.¹⁷ The importance of identifying all staff members affected by the intended practice change should not be minimized. When all stakeholders are involved in developing an improvement project, specific challenges may be confronted by identifying and addressing stakeholder concerns and helping to assuage any beliefs that may contradict the evidence. As we designed the initial project, we educated the stakeholders about the importance of maintaining perioperative normothermia, to promote their collaboration and acceptance of our intended project. Involving stakeholders from the beginning of a project is a key factor that leads to sustainability of a practice improvement.^{17,18}

A Key Component: Stakeholder Education

The PNP team developed a slide presentation that included information about the definition of *perioperative hypothermia*,

the harmful effects of hypothermia, what can be done to prevent hypothermia in the surgical patient, how we obtained the evidence we were using to support our project, and what the evidence told us about the positive effects of controlling the ambient room temperature in the OR. We engaged key stakeholders in one-on-one or group education sessions to deliver the presentation and elicit their feedback. In addition, the PNP team leader presented the initial project protocol at a weekly OR staff meeting. Although some team members were skeptical that raising the ambient room temperature would not increase infections, the PNP team's outreach and collaborative approach achieved buy-in for the small test of change.⁶

The team leader next presented to the entire anesthesia team. The chief of anesthesiology was a strong supporter of our educational efforts and was also supportive throughout the entire project. All members of the anesthesia team were as engaged and interested as the OR staff members.

Even though we met with the chief of surgery and he supported the project, gathering surgeons proved more complicated. The director of surgical services arranged for us to have time during the general surgeon's monthly quality improvement meeting to deliver the slide presentation. A small percentage of the general surgeons were present. They were receptive to the information presented. The PNP team met to discuss the evidence individually with each of the general surgeons not in attendance at the quality improvement meeting. Copies of the slide presentation and a summary of the project were sent to each surgeon by e-mail. The support of the chief of surgery was key in achieving buy-in from the surgeons to participate in the intervention.

After sharing the evidence and engaging in conversations with all stakeholders, the team identified that a key compromise was needed in the design of the intervention. The surgeons identified personal concerns that they would be "too warm" during the procedures because of the warmer ambient room temperatures. The PNP team designed a specific protocol to reflect the concerns of the surgeons. First, the OR would be warm when the patient entered the room. After the patient was draped and covered with the forced-air warming blanket, the room temperature could be adjusted for staff comfort. By keeping the OR room warmer (ie, at least 20° C [68° F] until the patient was draped and covered, we limited the patient's exposure to cold room air that could lower his or her body temperature.

The initial collaboration and EBPI education set the stage for a process by which to re-educate and re-engage stakeholders when expanding the initial project. Staff turnover and a

change in OR leadership meant that the initial project education was repeated to re-engage the stakeholders.

Measurement Techniques

To measure patient temperature, the same type of tympanic thermometer was used at the community hospital from the initial project through the sustainability evaluation. Consistently throughout the project, the ambient OR temperature was measured by the thermostat in each OR. The circulating nurse was responsible for documenting the room temperature at the start of the surgical procedure.

Neither the ASPAN⁹ nor AORN¹¹ guidelines provide definitive recommendations on the type of equipment to use to assess core temperature. They recommend only that the availability, accuracy, and reliability of the temperature assessment method be ensured.¹⁰ During the education sessions for both the PACU and ASU nurses, one consistent question was, "How accurate is the thermometer we use?" Through our discussions with the PACU staff members, we realized that until we addressed this concern, the staff members would doubt the accuracy of the patient-temperature assessments.

The nursing staff members noted inconsistencies in the measure from one thermometer to another, from one ear to another, and from one PACU or ASU nurse to another. During the immediate postoperative period, multiple tympanic temperatures were taken on patients as the anesthesia professional often believed the patients "should not be that cold," because the patients were not shivering and their skin was warm from the recently placed heated blankets. The anesthesia professional's belief that the patient's temperature was closer to normothermic than the tympanic temperature indicated necessitated that nurses repeat temperature assessment in both ears to verify the reading. How would the PNP team determine whether the practice change improved patient care if the anesthesia professionals and the nursing staff members did not trust the accuracy of the thermometer measurement? Without confidence in the measurements, acceptance of the practice change would be difficult to achieve. Thus, the PNP team started with an informal assessment of each nurse's technique in taking temperatures with a tympanic thermometer. Finding inconsistencies in practice (ie, some nurses pulled the ear backward and up during the insertion of the thermometer, whereas others did not), we reviewed correct technique with return demonstration of temperature assessment with each PACU nurse.

While the PNP team worked on this project, the EBPRC was asked to answer the question regarding the most valid method of taking temperature based on the best available evidence. The community hospital used a tympanic thermometer. The EBPRC completed a literature search using a systematic approach to find the highest levels of evidence available to answer this question. Search findings revealed that there was no high-level evidence to support any one type of thermometer measurement over another. Based on this literature review, the PNP team developed specific recommendations for temperature assessment in the PACU. Our recommendation consisted of the following:

- continue using the tympanic thermometer that was in current use;
- pull the adult patient's ear up and backward to straighten out the ear canal while taking the temperature measurement (to provide an unobstructed view of the tympanic membrane); and
- take the temperature in both ears at the time of PACU admission, documenting the higher temperature and in which ear that temperature was taken.

Additionally, we worked with the hospital's medical device team to develop a consistent calibration evaluation routine to ensure the accuracy of each thermometer. The PACU nursing staff members accepted our recommendations and demonstrated consistent technique for temperature assessment based on our demonstrations and review. The process regarding taking temperature in both ears was incorporated into policy, and this measure is now a required part of the PACU admission documentation.

Sample and Sampling Technique

The EBPI methodology includes small tests of change in which enough data are collected to determine whether the protocol for implementation of the new innovation is being followed as designed. This evaluation may take one or several PDSA cycles and requires from two to six weeks, depending on how much adjustment is needed to perfect the implementation process. After project staff members are satisfied that the protocol is being implemented as designed, outcomes are evaluated with a small number of patients and staff members to determine whether the project should be implemented on a wider scale.⁶ Using this methodology, the initial project evaluated the thermic outcomes of five colorectal surgical patients to determine the effectiveness of monitoring OR ambient room temperature.

Institutional Review Board Approval

Before implementing the initial small test of change, the project proposal was submitted to the hospital's institutional review board and was approved with exempt status.

DATA COLLECTION

Original Small Test of Change

Before beginning the project in October 2009, baseline data obtained from the quality department indicated that there was only a 72.7% (8 of 11 colorectal patients) compliance rate with the SCIP goal for perioperative normothermia. A tool was created to capture the data important to our initial small test of change. These data included the patients' preoperative temperature, which was measured in the OR holding area; whether the irrigation and/or IV fluids were warmed; the ambient OR temperature; and the immediate postoperative temperature of patients, which was measured within five minutes of admission to the PACU. The lead staff nurses in the OR and PACU used the tool.

Before the small test of change, the circulating nurses in each OR at the community hospital were responsible for room temperature monitoring and maintenance. They used the room thermostat to monitor the room temperature. During the small test of change, we used the current NCH standard of practice to evaluate the increase in ambient room temperature. The patient's temperature during the OR procedure was monitored by the anesthesia professional using distal esophageal measurement according to the NCH standard of practice.

Snapshot Evaluation

After implementing the normothermia protocol, the circulating nurses in each OR monitored the room thermostat to determine the OR ambient room temperature. The OR ambient room temperature at the completion of the time out was documented on a log that was then reviewed daily by the OR coordinator. The immediate postoperative temperature of each patient, measured within five minutes of admission to the PACU, was documented in the electronic medical record and then transcribed to a log by the PACU coordinator. One day's data were reviewed for the snapshot evaluation. A snapshot (periodic monitoring of protocol implementation) of surgical patients' temperature was evaluated one year after the initial implementation of the protocol to determine the rates of unintentional perioperative hypothermia. This snapshot evaluation was conducted by reviewing postoperative temperatures on one day's census of 26 patients who had undergone the

following surgical procedures: colorectal ($n = 2$), orthopedic ($n = 10$), ophthalmic ($n = 10$), and urologic ($n = 4$).

Sustainability Evaluation

A sustainability evaluation was completed on 263 patients who underwent various surgical procedures during January and February 2014. The PACU logs containing one month of ambient room temperature data from the OR and the postoperative temperature of patients within five minutes of admission to the PACU were evaluated.

Data Analysis Methods

Simple descriptive statistics were used to describe the sample and evaluate the occurrences of unintentional perioperative hypothermia during the original small test of change, the snapshot evaluation, and the sustainability evaluation. The data collected during the small test of change in October 2009 were used to calculate the frequency of the OR ambient room temperatures between 20° C and 23.9° C (between 68° F and 75° F) and the occurrence of unintentional perioperative hypothermia in colorectal patients compared with baseline data.

Throughout the snapshot and sustainability evaluations, adherence to the protocol was evaluated by counting the frequency in which the OR ambient room temperatures and the patients' immediate postoperative temperatures were within the prescribed range of the protocol. The percentage of patients who were normothermic was calculated. At each time point, the data were compared with the results of the prior evaluation. We then evaluated the effectiveness and sustainability of our practice change (ie, increasing the OR temperature to at least 20° C [68° F]) to maintain normothermia for all types of surgical patients ($n = 263$); we evaluated patient temperature by measuring the immediate postoperative temperature of patients within five minutes of admission to the PACU.

RESULTS

Results from the original small test of change and the sustainability evaluation revealed an increase in the number of normothermic patients. The results of the snapshot evaluation, conducted after the wider implementation of the original normothermia protocol, showed that the wider protocol was being inaccurately implemented. This planned monitoring and evaluation of the manner in which the initial protocol was implemented allowed us to make corrections and thus foster the sustainability of the improvement.

Table 3. Data From the Original Small Test of Change, October 2009

OR Procedure	Patient Characteristic		ASPAN Guideline					OR Ambient Temperature Above 20° C (68° F)?
	Preoperative Temperature	Temperature on Arrival in PACU	Warm IV Fluids Used?	Warm Irrigation Fluids Used?	Forced-Warm-Air Blanket Intraoperatively?	Passive Warming Measures Applied?		
Colon Resection	36.0° C (96.8° F)	36.5° C (97.7° F)	Yes	Yes	Yes	Yes	No	18.6° C (65.5° F)
Colon Resection	37.1° C (98.8° F)	37.1° C (98.8° F)	Yes	Yes	Yes	Yes	No	18.0° C (64.4° F)
Colon Resection	37.1° C (98.8° F)	36.5° C (97.7° F)	Yes	Yes	Yes	Yes	No	19.1° C (66.4° F)
Colon Resection	36.4° C (97.5° F)	36.6° C (97.9° F)	Yes	Yes	Yes	Yes	Yes	20.6° C (69.1° F)
Colon Resection	36.1° C (97.0° F)	36.6° C (97.9° F)	Yes	Yes	Yes	Yes	Yes	20.0° C (68.0° F)

ASPAN = American Society of PeriAnesthesia Nurses; PACU = postanesthesia care unit.
 Note: Passive warming measures include head cover, socks, and heated blanket.

Initial Small Test of Change

The small test of change data from the original project revealed 100% postoperative normothermia in all colorectal patients (n = 5) in October 2009 (Table 3). The ambient room temperatures did not consistently reach the recommended level (20° C [68° F]). The room temperatures, however, were consistently warmer (ie, 18.0° C [64.4° F] or greater) than before the practice change (ie, 15.5° C to 17.7° C [59.9° F to 63.9° F]). As a positive unintended consequence of the PNP project, we noted that compliance with the SCIP goal of anesthesiologist management of surgical patients' perioperative temperature rose to 100% from 95.5% during the baseline period because of their increased awareness of hypothermia.

Snapshot Evaluation

The results of the snapshot evaluation conducted in February 2010 revealed that of the 26 patient records reviewed, only five patients (18%) were normothermic (Figure 2). The PNP team attended the OR staff meeting and spoke with individual OR nurses and the anesthesia team to determine their understanding of the normothermia protocol. Interestingly, the staff members did not understand that the protocol was accepted as policy for all surgical procedures and thus were only consistently raising the ambient room temperature for the colorectal surgical patients. The PNP team identified that a mechanism should be developed to ensure adherence to the EBPI practice change. At our institution, adherence to standardized, evidence-based protocols, policies, and procedures is maintained through periodic evaluation of clinical competencies. Following usual hospital practice, the PNP team incorporated the maintenance of OR ambient room temperature intervention into a clinical competency for the entire OR staff. The PNP team collaborated with the OR clinical educators to develop the clinical competency. After the clinical competency was developed, it was integrated as an annual requirement for RNs, LPNs, and surgical technologists. The normothermia policy was updated to include education for all of the OR staff members, anesthesia team members, surgeons, ASU staff members, and PACU staff members to reinforce the EBP normothermia procedure for consistent practice.

Sustainability Protocol

Four years after the initial EBP change, data were collected to determine the sustainability of the innovation of regulating OR ambient room temperature. Of the 263 patients evaluated in this sustainability evaluation, 252 (96%) were

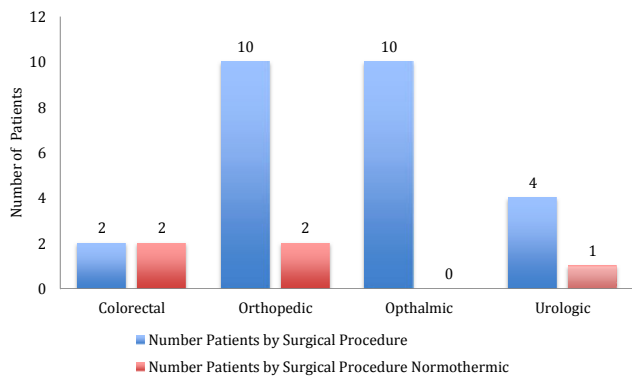


Figure 2. Snapshot evaluation of perioperative normothermia policy adherence, February 2010 (n = 26).

normothermic (Figure 3). Implementing an annual competency evaluation for all of the OR staff members had hardwired the evidence-based practice change regarding ambient OR temperature. The staff nurse members of the PNP team continue to serve as resources for any questions or concerns about the normothermia policy. As active full-time clinicians, they monitor and explain the policy and continue to support the translation of this evidence-based policy into practice. Working together, the anesthesia team members and nursing staff members have developed a collaborative routine that follows the EBPI intervention to improve patient outcomes.

DISCUSSION

Nurses at the community hospital continuously evaluate and improve their practice by questioning current practice, observing practice issues, and searching for best practices to improve the quality and safety of patient care. The normothermia improvement project was started by nurses who first observed patients' hypothermic responses to surgery, questioned why this outcome was happening, and searched for answers. We then developed, implemented, and evaluated an EBPI project that was evaluated and sustained over five years (2009 to 2014). The snapshot evaluation demonstrated the lack of consistent implementation of the new protocol for adjusting ambient room temperature in the OR, and the PNP team had the opportunity to take corrective action in promoting the consistent implementation of regulating OR ambient room temperature for all types of surgeries. Thus, an important component of any EBPI project is the plan for continued evaluation of an innovation after initial outcome data from small tests of change have been analyzed.⁶

Stakeholders in the project were engaged in its development and implementation through group educational sessions and one-on-one discussions. In addition, their concerns and opinions were encouraged through scholarly dialogue, and their feedback was encouraged. The project leaders—staff nurse champions from the OR and PACU—believed in this project and were committed to its success. Finally, the initial project was modified to include all surgeries beyond its initial focus on patients undergoing colorectal surgery.

In our attempts to hardwire this innovation, we had challenges regarding colleagues' perceptions of what constituted best evidence. Some members of the team presented anecdotal clinical expertise to support ambient room temperatures colder than those recommended by the evidence.⁸⁻¹¹ For example, an orthopedic surgeon identified that "bone cement would take longer to set in temperatures over 20° C [68° F]." Product recommendations, however, identified more effective bone cement setting at temperatures greater than 20° C (68° F). The team shared this evidence with the surgeon, who then incorporated this information into his practice. As another example, one of the RNs shared that she had been taught in nursing school that ORs should be kept cold to decrease infection. This traditional knowledge was updated with evidence from the ASPAN and AORN clinical practice guidelines⁸⁻¹¹ that debunked that myth. As the active implementation portion of the project transitioned to building sustainable practices, the PNP team always used their evidence-based knowledge to refute the reluctance to change that was based on erroneous assumptions or outdated knowledge, and they provided educational updates and supported best practice.

We used a structured, systematic approach to our EBPI project, including attention to factors that promote

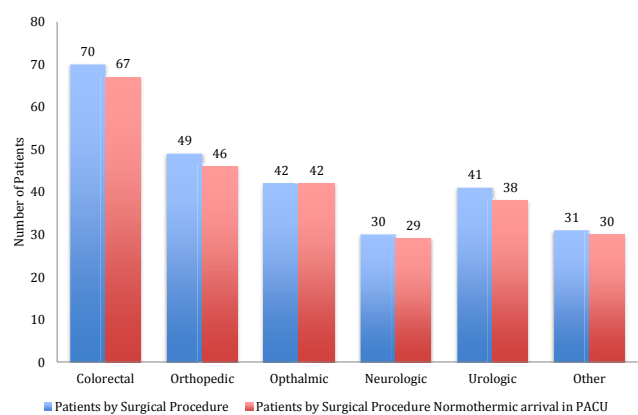


Figure 3. Sustainability evaluation of perioperative normothermia policy adherence, February 2014 (n = 26).

KEY TAKEAWAYS FOR CLINICAL PRACTICE

Maintaining Perioperative Normothermia: Sustaining an Evidence-Based Practice Improvement Project

WHY DID WE DO THIS PROJECT?

- This evidence-based quality improvement project was undertaken to improve the rates of postoperative normothermia in a community hospital by raising OR temperatures until the patient is draped and warming strategies are in place.

WHAT DID WE FIND?

- Initially, we found that all recommended guidelines for maintaining normothermia in surgical patients were being followed except for adjusting ambient OR temperature to recommended levels (20° C to 23.9° C [68° F to 75° F]).
- We raised ambient OR temperatures in a small test of change for patients undergoing colorectal procedures. The rate of normothermia improved from approximately 72% to 100%. Following this success, adjusting and monitoring ambient OR temperatures for all operative procedures was subsequently implemented.
- Clinicians resisted these changes for multiple reasons, including staff comfort, belief in inaccuracy of temperature measurement, and belief that elevated OR temperatures increase microbial growth. Addressing each issue allowed us to increase postoperative patient normothermia rates.

HOW CAN HEALTH CARE PROFESSIONALS USE THESE RESULTS?

- **Clinician:** Clinicians should be aware that normothermia recommendations include elevating ambient OR temperatures to between 20° C and 23.9° C [between 68° F and 75° F], though the temperature can be adjusted downward when patient-warming strategies are in place.
- **Manager:** Managers should establish processes in which ambient OR temperature is raised before the procedure begins to reduce the rate of patient hypothermia.
- **Educator:** Educators should ensure that staff members and students understand the dangers of hypothermia and the recommendations that are in place to prevent hypothermia in surgical patients.

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sustainability, and the project described was successful and sustainable. The project could not have begun without the first crucial factor of administrative support of the efforts to improve practice, which included experienced mentors in EBP for frontline staff members. Attention to the second crucial step of stakeholder buy-in and support created an interprofessional team that was committed to the success of the project. The motivation and commitment of the staff nurses

on the PNP team as EBP champions provided the frontline push for the implementation of the project. Finally, the plan for continued data collection to assess the sustainability of the innovation and make necessary corrections was key to the success of this project.

Another important outcome of this project was the demonstrated utility of the EBPI model as a framework to guide

practice improvement projects. Quality improvement models are abundant, and in our project we used a merger of two approaches to evidence-based improvement. The EBPI model,⁸ which couples two extant models (ie, EBP and performance improvement) with sustainability strategies, provided a robust framework to guide this improvement effort.

CONCLUSION

An observation by frontline nurses in the OR and PACU provided the impetus for engaging in an EBPI project that improved the quality of patient care and led to the spread and sustainability of a relatively simple and cost-effective innovation—maintaining optimal ambient temperatures in the OR to maintain perioperative normothermia. The original protocol has been implemented by the hospital as standard practice for all surgical patients. In addition, all OR personnel need to pass an annual competency performance appraisal, which now includes attention to all evidence-based perioperative warming procedures, such as adjusting ambient OR temperatures according to recommended practices. Key factors that supported the sustainability of the intervention were involving frontline nurses in the original change process, building in checkpoints to evaluate consistent implementation of the change, and reinforcing the protocol during routine education. The present project, although it is not generalizable in research terms, does add clinical evidence to support the positive influence of regulating OR temperature on maintaining patient normothermia during the perioperative experience. This project revealed that although change is not easy, with staff commitment, a useful model to guide the process, and a plan for monitoring the implementation of the change or improvement, we can change practice for the better, thus improving the quality and safety of patient care. ●

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