ASPAN’s Evidence-Based Clinical Practice Guideline for the Promotion of Perioperative Normothermia: Second Edition

Vallire D. Hooper, PhD, RN, CPAN, FAAN, Robin Cbard, PhD, RN, CNOR, Theresa Clifford, MSN, RN, CPAN, Susan Fetzer, PhD, RN, Susan Fossum, BSN, RN, CPAN, Barbara Godden, MHS, RN, CPAN, CAPA, Elizabeth A. Martinez, MD, MHS, Kim A. Noble, PhD, RN, CPAN, Denise O’Brien, MSN, RN, ACNS-BC, CPAN, CAPA, FAAN, Jan Odom-Forren, PhD, RN, CPAN, FAAN, Corey Peterson, MSN, CRNA, Jacqueline Ross, MSN, RN, CPAN, Linda Wilson, PhD, RN, CPAN, CAPA, BC

CLINICAL PRACTICE GUIDELINES are systematically developed guidelines or statements designed to assist the practitioner and/or patient in making appropriate health care decisions in specific clinical circumstances.1-3 Guideline development involves a deliberate process of problem identification and validation; exploration and retrieval of literature; rigorous review, critique, and synthesis of the evidence; and design and recommendation of a practice change.4-6 Guideline recommendations are based on a body of evidence that can arise from multiple sources including meta-analysis, systematic reviews, randomized controlled trials (RCTs), and expert opinion.7-9 Characteristics common to quality clinical practice guidelines include development by, or in conjunction with, a professional organization; use of reliable methods to integrate appropriate evidence; and comprehensive and specific clinical coverage based on current information.10,11 Guidelines are not intended to serve as standards or absolute requirements, but may be adopted, modified, or rejected according to specific clinical needs and constraints. Care based on evidence-based clinical practice guidelines has been recognized by the Agency for Healthcare Research and Quality (AHRQ) and the Institute of Medicine (IOM) as a key component in improving the quality, safety, efficiency, and effectiveness of health care,1,12 and has been shown to positively impact clinical practice and patient outcomes across a wide variety of specialties.8,13-22

ASPAN is committed to the promotion of the welfare, health, well-being, and safety of patients, and recognizes evidence-based practice (EBP) as the critical link to improving nursing practice and patient outcomes. To this end, ASPAN convened an EBP Strategic Work Team in June 2004 to develop an organizational model for the development, dissemination, and translation of evidence-based clinical practice guidelines for all peri-anesthesia practice settings. This model was further refined by the team in October 2005 and includes specific guidelines for problem identification and prioritization, evaluation of evidence quality and strength, and development and quality ranking of practice recommendations.23,24

Quality and Strength of Evidence and Guideline Recommendations

Evidence-rating scales guide the clinician in evaluating the adequacy and sufficiency of research and other types of evidence as they apply to a particular clinical problem. Criteria of interest include the consistency of findings, type and quality of studies, clinical relevance of findings, number of sample characteristics similar to the situation in which the findings will be applied, feasibility of use in practice, and the risk versus benefit.23-25 Stetler and colleagues9,26 evidence rating scale has been identified as the preferred instrument for evaluation of the strength and quality of evidence for all ASPAN evidence-based clinical practice guidelines. This tool ranks the strength...
Supportive evidence for ASPAN evidence-based clinical practice guideline recommendations is gathered via a structured, systematic search strategy. On the basis of the type, amount, and quality of available evidence obtained via a systematic search strategy, assessment, intervention, and/or outcome recommendations specific to the clinical problem of interest are made. The recommendations are then ranked to allow clinicians to make informed decisions regarding incorporation of the guidelines into practice. Recommendations in these guidelines are ranked using a modified version of the American College of Cardiology/American Heart Association (ACC/AHA) classifications (modified with permission of the ACC/AHA), which address the risk/benefit ratio, and amount and quality of evidence supporting the recommendation. Recommendation classes are ranked from I to III, based on the clinical indication of the recommendation and consideration of its risk versus benefit. These classes are defined as follows:

- **Class I:** The benefit far outweighs the risk and the recommendation should be performed or administered.
- **Class IIa:** The benefit outweighs the risk and it is reasonable to perform or administer the recommendation.
- **Class IIb:** The benefit is equal to the risk and it is not unreasonable to perform or administer the recommendation.
- **Class III:** The risk outweighs the benefit and the recommendation should not be performed or administered.

The above classes can be supported by 3 levels of evidence (Level A-C) which are defined as follows:

- **Level A:** Evidence from multiple randomized trials or meta-analysis evaluating multiple populations (3-5) with general consistency of direction and magnitude of effect.
- **Level B:** Evidence from single randomized trials or non-randomized studies evaluating limited (2-3) populations.
- **Level C:** Evidence from case studies, standards of care, or expert opinion involving very limited (1-2) populations.

### Table 1. Stetler Evidence Hierarchy

<table>
<thead>
<tr>
<th>Level of Evidence</th>
<th>Strength of Individual External Evidence*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level I</td>
<td>Systematic statistical review of multiple controlled studies (eg, meta-analysis)</td>
</tr>
<tr>
<td>Level II</td>
<td>Systematic interpretive, tabular integrative review of multiple studies, primarily of quantitative research</td>
</tr>
<tr>
<td>Level III</td>
<td>Experimental studies; may be called randomized controlled trials (RCTs)</td>
</tr>
<tr>
<td>Level IV</td>
<td>Quasi-experimental studies, such as non-randomized control group studies or interventional time series</td>
</tr>
<tr>
<td>Level V</td>
<td>Systematic interpretive, tabular integrative review of multiple studies primarily of qualitative research</td>
</tr>
<tr>
<td>Level VI</td>
<td>Non-experimental studies, such as correlational, descriptive research, as well as qualitative research or systematically designed case studies</td>
</tr>
<tr>
<td>Level VII</td>
<td>Systematically obtained, verifiable quality or program evaluation data from the literature</td>
</tr>
<tr>
<td>Level VIII</td>
<td>Consensus opinion of respected authorities (eg, a nationally known guideline group)</td>
</tr>
</tbody>
</table>

*All such levels/sources of evidence must be of an acceptable quality. Copyright © Cheryl Stetler, 2001.

**Notes**
Clinical Practice Guideline

Background

Content Expert: Jan Odom-Forren, PhD, RN, CPAN, FAAN

Perioperative hypothermia, defined as a core temperature below 36°C, has adverse effects that range from patient thermal discomfort to increased morbidity and mortality. Even mild intraoperative hypothermia, a core temperature of 34°C to 36°C, has adverse consequences that are well documented. In a seminal study, Frank et al determined that hypothermic patients were three times as likely to experience adverse myocardial outcomes, and this is likely a conservative estimate. Hypothermia may directly impair neutrophil function or trigger subcutaneous vasoconstriction, which results in subsequent tissue hypoxia, causing an increased incidence of surgical wound infection. Researchers have demonstrated that the incidence of surgical site infection was increased up to three fold after colon resection and significantly increased in hypothermic patients undergoing cholecystectomies. Interestingly, even when patients with infections were excluded from the results of one study, hypothermia increased the duration of hospitalization by 20%, likely due to impaired healing of the wound. In a study of patients undergoing hip arthroplasty, a reduction in temperature of 1.6°C increased blood loss by 500 mL and increased the need for allogeneic blood transfusions. Preventing inadvertent perioperative hypothermia significantly reduces blood loss and transfusion requirements. Hypothermia also causes prolonged and altered drug effects in many drug classes, including muscle relaxants and intravenous agents. Hypothermia has been linked to pressure ulcer development, increased length of hospital stay for post-surgery patients and delay of discharge from the PACU. Thermal discomfort has also been shown to decrease patient satisfaction. There is clear evidence of the consequences of hypothermia, thus providing justification for evidence-based guidelines to maintain normothermia.

The prevention of unplanned perioperative hypothermia and promotion of normothermia remains a national priority in the prevention of surgical site infection, and has been designated as a quality measure by the Surgical Care Improvement Project (SCIP). Recognition of the continued adverse impact of perioperative hypothermia on patient safety and quality care prompted ASPAN to appoint a Strategic Work Team (SWT) consisting of 11 multi-disciplinary, multi-specialty experts (Appendix) charged with the systematic review and analysis of published evidence and development of consensus recommendations regarding the revision of the ASPAN Clinical Guideline for the Prevention of Unplanned Perioperative Hypothermia, published in 2001. The SWT included nationally recognized academic and clinical practice experts from a wide variety of geographic areas. Members included peri-anesthesia nurses from all perianesthesia phases, anesthesiologist representing the American Society of Anesthesiologists (ASA), a nurse anesthetist representing the American Association of Nurse Anesthetists (AANA), a nurse representing the Association of periOperative Registered Nurses (AORN), nurses with expertise in clinical practice guideline development, and representatives from the ASPAN Research and EBP committees.

Consensus was defined by the group as 100% agreement regarding each guideline recommendation. While all guideline recommendations were fully supported by all team members, the team had agreed that if full agreement could not be reached on a topic considered clinically important, the majority and minority views would be presented in the guideline discussion.

Goals and Specific Aims

The SWT convened in October of 2008 in St. Louis, MO, with the specific objective to improve health outcomes in adult surgical patients through the development of a multi-disciplinary, multi-modal evidence-based clinical practice guideline directing the promotion of perioperative normothermia. The specific aims of this conference were to:

1. Critique and synthesize the evidence regarding the promotion of perioperative normothermia in the adult population to include:
   a. Identification and stratification of risk factors for perioperative hypothermia
b. Identification of the clinical consequences of perioperative hypothermia  
c. Identification of preventative measures for perioperative hypothermia  
d. Identification of treatment recommendations for perioperative hypothermia  

2. Develop multi-disciplinary, multi-modal, evidence-based recommendations regarding the promotion of perioperative normothermia in the adult population to include:  
a. Temperature measurement  
b. Preoperative assessment and management  
c. Intraoperative assessment and management  
d. Postoperative assessment and management  

3. Identify areas of needed research to include:  
a. Gaps in the evidence regarding the promotion of perioperative normothermia  
b. Research priorities for the translation of the source document (clinical practice guideline) to practice  

Guideline Intent and Definitions  

Although it is commonly agreed that perioperative hypothermia exists across all patient populations, the intent of this guideline is to provide clinicians with an evidence-based, practical, bedside approach to the promotion of perioperative normothermia in the adult patient. The guidelines apply to both inpatient and outpatient settings and to procedures performed in the OR, as well as in other locations where sedation or anesthesia may be administered. These guidelines are not intended to serve as standards or absolute requirements, but as an evidence-based resource for anesthesia providers and peri-anesthesia/perioperative nurses involved in the care of adult patients at risk for, or experiencing perioperative hypothermia.  

For the purposes of this guideline, the major terms are defined as follows:  

- **Active Warming Measures**: Active warming measures include the application of a forced air convection warming system, as well as circulating-water mattresses, resistive heating blankets, radiant warmers, negative-pressure warming systems, and warmed humidified inspired oxygen.  
- **Assessment**: A systematic and interactive process of information gathering and analysis for the purpose of identifying actual and potential health problems and to evaluate effectiveness of care.  
- **Clinical Practice Guidelines**: Systematically developed guidelines or statements designed to assist the practitioner and/or patient in making appropriate health care decisions in specific clinical circumstances.  
- **Core Temperature**: The temperature of the core thermal compartment, which is a well-perfused compartment consisting of the major organs of the trunk and head (not including the skin and peripheral tissues). This compartment maintains a relatively stable temperature and provides the most accurate indication of temperature during periods of rapid temperature fluctuation.  
- **Expected Outcomes**: Demonstrable changes in the patient’s status as a result of health care intervention.  
- **Hypothermia**: A core temperature less than 36°C (96.8°F).  
- **ICU**: Intensive care unit  
- **Normothermia**: A core temperature range of 36°C to 38°C (96.8°F to 100.4°F).  
- **Passive Thermal Care Measures**: Passive thermal care measures include the application of warmed cotton blankets, reflective blankets, socks, and head covering, as well as limiting skin exposure to lower ambient room temperature.  
- **Perioperative**: The time periods including preoperative, intraoperative, and postoperative phases of surgical and anesthesia interventions.  
- **Phase I PACU**: The nursing roles in this phase focus on providing postanesthesia nursing care during the immediate post-anesthesia period, transitioning to a Phase II level of care, the in-patient setting, or to an intensive care setting for continued care. Basic life-sustaining needs are of the highest priority. Constant vigilance is required during this phase.  
- **Phase II PACU**: The nursing roles in this phase focus on the preparation for care in the home, extended observation, or an extended care environment.
• **Postoperative Shivering:** Uncomfortable rhythmic muscle contractions.\(^{54}\)

• **Prewarming:** The warming of peripheral tissues or surface skin before induction of anesthesia.\(^{55}\)

• **Standard:** Authoritative statements enunciated and promulgated by a profession by which the quality of practice, service, or education can be judged.\(^{50}\)

• **Thermal Comfort:** A patient’s perception that they are neither too warm nor too cold.

### Risk Factors for Perioperative Hypothermia

**Content Experts:** Vallire D. Hooper, PhD, RN, CPAN, FAAN, Jacqueline Ross, MSN, RN, CPAN

The primary aim in risk factor identification in the preoperative period is to determine the potential risk of a patient developing hypothermia during the perianesthesia/perioperative period. The consensus group defined risk factors as an independent predictor, not an associated factor of an untoward event.\(^{56}\) Risk factors imply correlation but not causation. A patient can have risk factors and not develop perioperative hypothermia.

The content experts investigated the risk factors related to hypothermia during the perianesthesia/perioperative experience. Medline and CINAHL databases were searched to locate published studies on risk factors for perioperative hypothermia in the adult patient. The time frame searched was January 1990 to September of 2008. Search terms included hypothermia, perioperative complications, and risk factors. Twenty articles were retrieved and reviewed by the content experts. Additional searches for non-indexed randomized controlled trials using the reference lists of retrieved articles were also conducted, with no additional articles found. After review, it was determined that four of the articles did not pertain to the question and they were removed from the evaluation process, leaving 16 studies related to the topic of interest. Although the range of surgical procedures was varied, five studies involved abdominal or colon procedures.\(^{46,57-60}\)

In the investigation into risk factors, weight/body mass index (BMI)\(^{46,57,59,61-64}\) and age\(^{57,59,61-63,65}\) were the most common risk factors studied. Ambient room temperature\(^{62,63,65,66}\) and duration of surgical time\(^{61,65,67,68}\) were examined in four of the studies. Studies also showed that patients with a preoperative systolic blood pressure less than 140 mm Hg were more likely to develop hypothermia postoperatively.\(^{58,60,69}\) Gender was investigated in two predictive models.\(^{57,63}\)

### Risk Factors Supported by Strong Evidence

There were no risk factors supported by strong evidence.

### Risk Factors Supported by Weak Evidence (Class IIA or IIB, Level B)

- **Extremes of age (Class IIA, Level B)**\(^{57,59,61-63,65,70}\)
- **Systolic blood pressure less than 140 mm Hg (Class IIA, Level B)**\(^{58,60,69}\)
- **Female gender (Class IIB, Level B)**\(^{57,63}\)
- **Level of spinal block (Class IIB, Level B)**\(^{62}\)

### Risk Factors Supported by Insufficient Evidence (Class IIA or IIB, Level C)

- **BMI below normal (Class IIA, Level C)**\(^{46,57,59,61-64}\)
- **Normal BMI (Class IIB, Level C)**
- **Procedural duration (Class IIB, Level C)**\(^{61,63,67,68}\)
- **Body surface/wound area uncovered (Class IIB, Level C)**
- **Anesthesia duration (Class IIB, Level C)**
- **History of diabetes with autonomic dysfunction (Class IIB/Level C)**\(^{60}\)

### Temperature Measurement

**Content Experts:** Susan J. Fetzer, PhD, RN, Vallire D. Hooper, PhD, RN, CPAN, FAAN

Although the measurement of core temperature (eg, pulmonary artery, distal esophagus, nasopharynx, tympanic membrane [via thermistor]) is the best indicator of thermal status, core temperatures are frequently not feasible and are unrealistic during the perianesthesia period. Skin temperature, easily obtained during the perioperative period, is a function of external influences and thermoregulatory function of the body. Clinically available “nearcore” measures (eg, oral, bladder, rectal, temporal artery, tympanic membrane [via infrared sensor], axilla) must be relied on to evaluate thermal balance.
across the perioperative period. Unfortunately, each near-core measure has limitations in the ability to reflect core temperature. Rectal measurements are invasive and time-consuming, and positioning for rectal temperature measurement in the peri-anesthesia period is difficult to impossible to achieve. The difference between tympanic thermistor and tympanic infrared measurements exceeds 1.5°C.\(^{71}\)

The content experts conducted a comprehensive and critical review of the research evaluating select invasive and noninvasive temperature measurement methods used to evaluate core temperature. Medline and CINAHL databases were searched to locate published studies on temperature measurement. The timeframe searched was January 1982 to September 2008. Search terms included body temperature measurement, core temperature measurement, oral temperature measurement, oral body temperature, temperature measurement, temporal artery, temporal artery thermometer, thermometer, tympanic membrane, tympanic thermometers, and chemical dot thermometry. Articles were included if they were data-based, a clinical study, included an adult population, and compared a noninvasive core temperature measurement to an invasive core measurement. Laboratory studies and studies limited to the pediatric population were excluded. Thirty-seven articles were identified meeting the inclusion/exclusion criteria. The references of these articles were reviewed for other research studies meeting the inclusion/exclusion criteria.

The evidence revealed that it is generally accepted that temperature inaccuracy between instruments should not exceed 0.5°C.\(^{72}\) The majority of studies seeking to validate the most appropriate measurement device for clinical practice compare near-core measures with some studies including a core temperature for comparison. Infrared tympanic membrane measurements have been compared to axillary,\(^{74,75}\) oral,\(^{74,76,77}\) urinary bladder,\(^{75}\) and temporal artery measures.\(^{74,76,78,79}\) Two studies have specifically examined tympanic variability.\(^{76,80,81}\) Temporal artery measurements have been compared to oral,\(^{74,76}\) and bladder.\(^{92}\) Four studies have tested the ability of the chemical dot thermometer to estimate an electronic oral temperature.\(^{83-86}\) Oral, tympanic membrane and temporal artery thermometers have been compared using the

Overall the research on perianesthesia temperature measurement is weak due to a lack of controls, insufficient statistical analysis, and lack of replication.

**Temperature Measurement Recommendations Supported by Strong Evidence**

- Near-core measures of oral temperature best approximates core\(^{51,74}\) (Class I, Level B)
- The same route of temperature measurement should be used throughout the perianesthesia period for comparison purposes\(^{86,87,89,90}\) (Class I, Level C)
- Caution should be taken in interpreting extreme values (< 35°C, > 39°C) from any site with near-core instruments\(^{72}\) (Class I, Level C)

**Temperature Measurement Recommendations Supported by Weak Evidence**

- Temporal artery measurements approximate core temperature at normothermic temperatures but not extremes outside of normothermia\(^{76,82,87,88,91,92}\) (Class IIb, Level C)
- Infrared tympanic thermometry does not provide accurate temperature measurements during the perianesthesia period\(^{51,72,74,76,87,93}\) (Class IIb, Level B)

**Temperature Measurement Recommendations Supported by Conflicting Evidence**

- Oral chemical dot thermometers are acceptable near-core alternatives\(^{73,83-85}\) (Class I, Level B)

**Preadmission/Preoperative Patient Assessment and Management**

*Content Experts: Theresa Clifford, MSN, RN, CPAN, Denise O’Brien, MSN, RN, ACNS-BC, CPAN, CAPA, FAAN*

In an effort to reduce complications and costs associated with perioperative hypothermia, it is imperative to maintain normothermia throughout the course of the surgical continuum (Fig 1). It is difficult to treat hypothermia caused by heat redistribution intra- or postoperatively because the internal flow of heat is large and because heat
applied to the skin requires a considerable amount of time to reach the core compartment. An effective means of maintaining perioperative normothermia is prevention through prewarming. Prewarming is defined as warming of peripheral tissues or surface skin before induction of anesthesia. Prewarming reduces redistribution hypothermia by two mechanisms, first by decreasing the core-to-peripheral temperature gradient, and secondly, by provoking vasodilation. The body switches from the typical heat conservation mode to heat dissipation. Without pre-warming, a period of hypothermia is typical even if active warming is instituted after induction of anesthesia.

The content experts investigated preoperative warming measures to define if specific patient populations should be prewarmed, or if all patients should be prewarmed. Medline and CINAHL data bases were searched to locate published studies on preoperative strategies for the prevention of perioperative hypothermia. The time frame searched was January 1982 through September of 2008. The search terms included preoperative warming, perioperative hypothermia, forced air warming, and active warming. Two-hundred ninety-five articles and/or abstracts were retrieved and reviewed by the content experts. Articles were included for analysis if they were data-based, included a sample of adults 18 years and older, and specifically examined the effects of preoperative interventions on intraoperative and/or postoperative outcomes. Articles were excluded if they referenced only pediatric patients, laboring patients, or did not use preoperative interventions to prevent inadvertent hypothermia. Fourteen studies were identified meeting the inclusion/exclusion criteria. The references of these articles were reviewed for any other research studies that met the inclusion criteria.

Evidence reviewed included prewarming methods and the minimal amount of time that a patient should be prewarmed before anesthesia induction. The literature was relatively nonspecific related to these issues. Researchers did demonstrate that preoperative warming with forced air reduces, but does not eliminate post-induction redistribution hypothermia in all cases. In addition, patients that are prewarmed with forced air will rewarm after the initial post-induction drop at a faster rate intraoperatively. These prewarmed patients will also attain average higher temperatures intraoperatively than their non-prewarmed counterparts. Premediated patients also report greater satisfaction and decreased anxiety. Additional benefits associated with preoperative warming included decreased blood loss and need for transfusions, shorter PACU length of stay, reduced total anesthesia costs, decrease in ICU admissions, reduction in myocardial infarctions, reduced need for mechanical ventilation, decreased time to extubation in mechanically ventilated patients, reduced incidence of surgical site infection, and overall decreased mortality.

**Preadmission/Preoperative Recommendations**

- **Assessment**
  - Assess for risk factors for perioperative hypothermia (see this guideline) (Class I, Level C)
  - Measure patient temperature on admission (Class I, Level C)
  - Determine patient’s thermal comfort level (Class I, Level C)
  - Assess for signs and symptoms of hypothermia (eg, shivering, piloerection, and/or cold extremities) (Class I, Level C)
  - Document and communicate all risk factor assessment findings to all members of the anesthesia/surgical team (Class I, Level A)

- **Interventions**
  - Implement passive thermal care measures (Class I, Level B)
  - Maintain ambient room temperature at or above 24°C (75°F) (Class I, Level C)
  - Institute active warming for patients who are hypothermic (Class IIb, Level B)
  - Consider preoperative warming to reduce the risk of intra/postoperative hypothermia (Class IIb, Level B)
  - Evidence suggests prewarming for a minimum of 30 minutes may reduce the risk of subsequent hypothermia

**Preadmission Testing/Preoperative Admission Expected Outcomes**

- Patient will express thermal comfort
Nonemergent patients should be normothermic prior to transfer to the OR/procedure area
- Emergent patients should be warmed as soon as clinically appropriate

Intraoperative Patient Assessment and Management

Content Experts: Robin Chard, PhD, RN, CNOR, Elizabeth A. Martinez, MD, MHS

Research indicates that patients are at risk for intraoperative hypothermia largely due to an internal core-to-peripheral redistribution of body heat. Furthermore, the greatest temperature decline occurs during the first hour of surgery. To detect and aid in the prevention of intraoperative hypothermia, the content experts conducted a systematic literature review to determine what intraoperative warming methods are supported by the evidence and if there is a preferred single or combination of interventions. The evidence regarding intraoperative temperature monitoring was also explored (Fig 2).

Medline and CINAHL databases were searched to locate published studies on the specified topics. The time frame searched was January 1982 through September of 2008. Search terms included intraoperative warming, patient warming, forced-air warming, warmed intravenous fluids and circulating water in addition to any identified warming methods: circulating water mattress, circulating water garments, Gel-pad, radiant heat, and resistive warming. Randomized controlled trials that used adult participants undergoing regional or general anesthesia and used at least one method of intraoperative warming as an intervention were included. Pediatric studies were excluded. Twenty-five articles were identified meeting the inclusion/exclusion criteria. The references of these articles were reviewed for any other research studies that met the inclusion criteria.

The evidence reviewed indicated that when selecting an intraoperative intervention to be used in a specific patient population, limitations associated with the patient and the procedure of interest should be considered. For example, many of the studies may not have been performed in the specific patient population or procedure of interest, and there may be different risks associated with a specific warming technique. Furthermore, there may be limitations to implementation of a specific warming technique, for example the limited area of skin that can potentially be covered by a forced air warming device during a plastic surgery procedure in which large areas of skin (donor sites for skin or muscle flaps) are exposed for the surgical procedure.

Specific considerations in using the various warming methods are that all devices must be used according to the manufacturer’s recommendations. Furthermore, specific discussions should take place when there will be episodes of planned ischemia (i.e. lower extremity revascularization) and timing of warming. There is insufficient evidence to support active warming for patients undergoing procedures of less than 30 minutes of anesthetic time. It is the consensus of the committee that the implementation of methods to prevent hypothermia should be considered for all patients, but especially in patients who are at high risk of either developing hypothermia or at increased risk of suffering complications of hypothermia, regardless of procedure length.

Intraoperative Recommendations

- Assessment
  - Identify patient’s risk factors for unplanned perioperative hypothermia (See this guideline) (Class I, Level C)
  - Frequent intraoperative temperature monitoring should be considered in all cases (Class I, Level C)
  - Assess for signs and symptoms of hypothermia (Class IIb, Level C)
  - Determine patient’s thermal comfort level (Class IIb, Level C)
  - Document and communicate all risk factor assessment findings to all members of the anesthesia/surgical team (Class I, Level A)

- Interventions
  - All patients should receive the following:
    - Limit skin exposure to lower ambient environmental temperatures (Class I/Level C)
    - Initiate passive warming measures (Class I/Level C).
Passive warming interventions include: cotton blankets, surgical drapes, plastic sheeting and reflective composites ("space blankets").

Maintain ambient room temperature from 20°C-25°C based on AORN and architectural recommendations.

Patients undergoing a procedure with an anticipated anesthesia time greater than 30 minutes (Class I/Level C) and/or who are hypothermic preoperatively (Class I/Level A), and/or patients at risk for hypothermia (Class I/Level C) or at increased risk for suffering its complications (Class I/Level C).

Forced air warming should be implemented (Class I/Level A). *Special Notation: Although one study evaluating the use of forced-air warming devices compared its use according to the manufacturer’s recommendations versus placing the forced air warming device between two standard hospital blankets did not report any thermal injuries, this technique should never be used as it falls outside of the parameters of manufacturer recommendations (Level C/Class III).*

There is evidence to suggest that alternative active warming measures may maintain normothermia when used alone or in combination with forced air warming (Class IIb/Level B). These warming measures include:

- Warmed IV fluids (Class IIa/Level B)
- Warmed irrigation fluids (Class IIb/Level B)
- Circulating water garments (Class IIb/Level B)
- Circulating water mattresses (Class IIb/Level B)
- Radiant heat (Class IIb/Level B)
- Gel pad (Arctic Sun) surface warming (Class IIa/Level B)
- Resistive heating (Class IIa/Level B)

**Intraoperative Expected Outcomes**

- The patient will be normothermic on discharge from the OR/procedure area.

**Postoperative Patient Management: Phase I/II PACU**

Content Experts: Susan Fossum, BSN, RN, CPAN, Kim Noble, PhD, RN, CPAN

A majority of practitioners agree that temperature management is one of the essential elements that plays a role in a patient’s perception of well-being and comfort during the perianesthesia/perioperative period. Determination of the most effective methods for postoperative rewarming should include consideration of overall patient comfort, improve patient outcomes, shorten PACU length of stay, and generally decrease the cost of a hospital stay for surgical patients.

The content experts investigated postoperative hypothermia patient management to determine the most effective methods of maintaining patient temperature, or rewarming the surgical patient during the postoperative period. Medline and CINAHL databases were searched to locate published studies on postoperative temperature maintenance and rewarming strategies for the adult surgical patient. The timeframe searched was January 1993 through September of 2008. The search terms included postoperative hypothermia, postoperative rewarming, postanesthesia care, and postanesthesia warming. Forty-two articles and/or abstracts were retrieved and reviewed by the content experts. Articles were included for analysis if they were data-based, included a sample of adults eighteen years and older, and specifically examined various methods of postoperative temperature management and/or rewarming and its effect on patient outcomes. Articles were excluded if they referenced pediatric patients or rewarming outside of the hospital environment. Nineteen articles were identified as meeting the inclusion/exclusion criteria. The references of these articles were reviewed for any other research studies that met the inclusion criteria.

Evidence reviewed included studies evaluating passive thermal care measures (head covers,
reflective blankets, and cotton blankets) and active warming measures to include forced air warming, fluid-filled circulating blankets, negative pressure rewarming, and humidified oxygen. The evidence conclusively supports the effectiveness of forced air warming as compared with passive thermal care measures. 111-116 Humidified inspired oxygen was effective in one study. 152 The evidence is inconclusive on the effectiveness of fluid-filled circulating blankets112,140 and negative pressure rewarming devices (Fig 3). 114,116,150

Phase I/II PACU Postoperative Patient Management Recommendations

- **Assessment**
  - Identify the patient’s risk factors for perioperative hypothermia (see this guideline) (Class I, Level C)
  - Document and communicate all risk factor assessment findings to all members of the health care team. 106-108 (Class I, Level A)
  - Measure patient temperature on admission to the PACU (Class I, Level C)
    - If normothermic, continue to measure temperature at least hourly, at discharge, and as indicated by patient condition 151 (Class I, Level C)
    - If hypothermic, measure temperature at a minimum of every 15 minutes until normothermia is achieved 151 (Class I, Level C)
  - Determine patient’s thermal comfort level (Class I, Level C)
  - Assess for signs and symptoms of hypothermia (eg, shivering, piloerection, and/or cold extremities) (Class I, Level C)

- **Interventions**
  - If the patient is normothermic, provide thermal comfort measures:
    - Implement passive thermal care measures 109 (Class I, Level C)
    - Maintain ambient room temperature at or above 24° C (75° F) 110 (Class I, Level C)
    - Assess patient thermal comfort level on admission, discharge, and more frequently as indicated (Class I, Level C)
    - Observe for signs and symptoms of hypothermia (eg, shivering, piloerection, and/or cold extremities) (Class I, Level C)
  - Reassess temperature if patient’s thermal comfort level changes and/or signs or symptoms of hypothermia occur (Class I, Level C)
  - Implement active warming measures as indicated (see below)
  - Measure patient temperature prior to discharge 151 (Class I, Level C)
    - If the patient is hypothermic, in addition to normothermic interventions, initiate active warming measures:
      - Apply forced-air warming system 111-116 (Class I, Level A)
      - Consider adjuvant measures:
        - Warmed intravenous fluids 139,144-147 (Class IIb, Level B)
        - Humidified warm oxygen 62 (Class IIb, Level C)
      - Assess temperature and thermal comfort level every 15 minutes until normothermia is achieved 151 (Class I, Level C)
    - Discharge teaching: Instruct the patient and responsible adult of methods to maintain normothermia after discharge (eg, warm liquids, blankets, socks, increased clothing, increased room temperature) (Class I, Level C)

Phase I/II PACU Postoperative Patient Management Expected Outcomes

- Patient achieves normothermia before discharge from the Phase I and/or Phase II PACU
- Patient verbalizes thermal comfort

Research Indications

In addition to developing evidence-based, multidisciplinary, multimodal clinical practice guidelines for the promotion of perioperative normothermia, the SWT was also charged with identifying areas of needed research, as well as research priorities for the translation of the guideline to practice. Areas of needed research in the promotion of perioperative normothermia are:

Risk Factor Identification

- Further study to characterize the risk factors for perioperative hypothermia
Research to develop a risk factor stratification and prediction model for perioperative hypothermia

**Temperature Measurement**
- What is the relationship between core temperature measurement and near-core measurements?
- Replication of studies investigating perioperative normothermia using consistent measures of temperature.
- What is the relationship between temperature and thermal comfort from a patient’s perspective?

**Preadmission/Preoperative Patient Assessment and Management**
- What patients would benefit from preoperative warming?
- What is the most effective single or combination of preoperative warming measures?
- What is the minimal amount of time that a patient should be prewarmed before his or her procedure?
- Is there a minimum core temperature that should be obtained prior to transfer of the patient to the operating/procedure area?

**Intraoperative Patient Assessment and Management**
- What is the impact of intraoperative warming measures on patient outcomes across broad, heterogenous patient populations?
- What is the best method, or combination of methods, to maintain perioperative normothermia across broad, heterogenous patient populations?
- What is the best warming method for certain populations of patients such as major spine procedures performed on specialty devices and plastic surgery procedures in which large areas are prepped as donor sites so as not to be amenable to overlying forced-air warming devices?

**Postoperative Patient Assessment and Management**
- How frequently should temperature be measured postoperatively?
- What is the relationship of self-reported thermal comfort to temperature?
- What is the effect of passive thermal care measures on postoperative temperature?

**Translation of the Guideline to Practice:**
- Is this guideline usable, easy to follow, and feasible to implement in the practice setting?
- What is the impact of the guideline on recommended expected outcomes?

**Public Review and Endorsements**
This guideline was open for public review and commentary prior to endorsement by the ASPAN Representative Assembly on April 19, 2009.

**References**

9. Stetler CB, Brunell M, Giuliano KK, Mori D, Prince L, Newell-Stokes V. Evidence-based practice and the role of


16. Fanning E. Outcomes and cost effectiveness of treating type 2 diabetes with a nurse case manager following treatment algorithms versus primary care physicians [Ph.D. 163 p.]. (The University of Texas Health Sciences Center at Houston School of Public Health). 2002.


51. Hooper VD, Andrews JO. Accuracy of noninvasive core temperature measurement in acutely ill adults: The state of the science. *Biological Research for Nursing.* 2006;8:24-34.


146. Okeke LI. Effect of warm intravenous and irrigating fluids on body temperature during transurethral resection of the prostate gland. BMC Urol. 2007;7:15.
## Appendix: Strategic Work Team Members*

<table>
<thead>
<tr>
<th>NAME/AFFILIATION</th>
<th>STRATEGIC WORK TEAM ROLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robin Chard, PhD, RN, CNOR</td>
<td>AORN representative</td>
</tr>
<tr>
<td>Association of periOperative Registered Nurses</td>
<td>Content Expert: Intraoperative warming</td>
</tr>
<tr>
<td>Perioperative Nursing Specialist</td>
<td></td>
</tr>
<tr>
<td><strong><a href="mailto:rchard@aorn.org">rchard@aorn.org</a></strong></td>
<td></td>
</tr>
<tr>
<td>Theresa Clifford, MSN, RN, CPAN</td>
<td>ASPAN Immediate Past President 2010-2011</td>
</tr>
<tr>
<td>Clinical Nurse Lead</td>
<td>Content Expert: PAT/Day of surgery</td>
</tr>
<tr>
<td>Mercy Hospital</td>
<td></td>
</tr>
<tr>
<td>144 State Street,</td>
<td></td>
</tr>
<tr>
<td>Portland, Maine 04101</td>
<td></td>
</tr>
<tr>
<td><strong><a href="mailto:tclifford@aspan.org">tclifford@aspan.org</a></strong></td>
<td></td>
</tr>
<tr>
<td>Susan Fetzer, PhD, RN</td>
<td>Content Expert: Temperature measurement</td>
</tr>
<tr>
<td>Associate Professor</td>
<td></td>
</tr>
<tr>
<td>University of New Hampshire</td>
<td></td>
</tr>
<tr>
<td>Department of Nursing Educator</td>
<td></td>
</tr>
<tr>
<td>Durham, New Hampshire</td>
<td></td>
</tr>
<tr>
<td><strong><a href="mailto:sfetzer@cisunix.unh.edu">sfetzer@cisunix.unh.edu</a></strong></td>
<td></td>
</tr>
<tr>
<td>Susan Fossum, BSN, RN, CPAN</td>
<td>ASPAN Past President</td>
</tr>
<tr>
<td>CN IV Clinical Educator (retired)</td>
<td>Content Expert: Postoperative warming</td>
</tr>
<tr>
<td>OR / PACU Same Day Surgery Center</td>
<td></td>
</tr>
<tr>
<td>UC Davis Medical Center</td>
<td></td>
</tr>
<tr>
<td>Sacramento, California</td>
<td></td>
</tr>
<tr>
<td>PACU Staff Nurse - Per Diem</td>
<td></td>
</tr>
<tr>
<td>Shriners Hospital for Children, Northern California</td>
<td></td>
</tr>
<tr>
<td><strong><a href="mailto:fossumsusan@hotmail.com">fossumsusan@hotmail.com</a></strong></td>
<td></td>
</tr>
<tr>
<td>Barbara Godden, MHS, RN, CPAN, CAPA</td>
<td>ASPAN Director for Clinical Practice</td>
</tr>
<tr>
<td>Clinical Nurse Coordinator - PACU</td>
<td></td>
</tr>
<tr>
<td>Sky Ridge Medical Center</td>
<td></td>
</tr>
<tr>
<td>Lone Tree, Colorado</td>
<td></td>
</tr>
<tr>
<td><strong><a href="mailto:bgodden@aspan.org">bgodden@aspan.org</a></strong></td>
<td></td>
</tr>
<tr>
<td>Vallire D. Hooper, PhD, RN, CPAN, FAAN</td>
<td>Project Director</td>
</tr>
<tr>
<td>Assistant Professor and Assistant Director of the PhD Program,</td>
<td>Content Expert: Risk factors</td>
</tr>
<tr>
<td>School of Nursing</td>
<td>Content Expert: Temperature measurement</td>
</tr>
<tr>
<td>Medical College of Georgia</td>
<td></td>
</tr>
<tr>
<td>Augusta, Georgia</td>
<td></td>
</tr>
<tr>
<td>EBP/Research Consultant: MCGHealth</td>
<td></td>
</tr>
<tr>
<td>Co-Editor, Journal of PeriAnesthesia Nursing</td>
<td></td>
</tr>
<tr>
<td><strong><a href="mailto:vhooper@mcg.edu">vhooper@mcg.edu</a>; <a href="mailto:vhooper@knology.net">vhooper@knology.net</a></strong></td>
<td></td>
</tr>
<tr>
<td>Elizabeth A. Martinez, MD, MHS</td>
<td>ASA representative</td>
</tr>
<tr>
<td>Massachusetts General Hospital</td>
<td>Content Expert: Intraoperative warming</td>
</tr>
<tr>
<td>Department of Anesthesia, Critical Care, and Pain Medicine</td>
<td></td>
</tr>
<tr>
<td>Harvard University, 55 Fruit St., BRB 4-44</td>
<td></td>
</tr>
<tr>
<td>Boston, Massachusetts 02114</td>
<td></td>
</tr>
<tr>
<td><strong><a href="mailto:EMARTINEZ10@PARTNERS.ORG">EMARTINEZ10@PARTNERS.ORG</a></strong></td>
<td></td>
</tr>
<tr>
<td>Kim A. Noble, PhD, RN, CPAN</td>
<td>ASPAN EBP Committee Chair</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>Content Expert: Postoperative warming</td>
</tr>
<tr>
<td>Widener School of Nursing, One University Place</td>
<td></td>
</tr>
<tr>
<td>Chester, Pennsylvania 10301</td>
<td></td>
</tr>
<tr>
<td><strong><a href="mailto:kinnoble@verizon.net">kinnoble@verizon.net</a></strong></td>
<td></td>
</tr>
</tbody>
</table>

(Continued)
Appendix. (Cont’d)

<table>
<thead>
<tr>
<th>NAME/AFFILIATION</th>
<th>STRATEGIC WORK TEAM ROLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denise O’Brien, MSN, RN, ACNS-BC, CPAN, CAPA, FAAN</td>
<td>Content Expert: Preoperative warming</td>
</tr>
<tr>
<td>Clinical Nurse Specialist, Perianesthesia Care Areas</td>
<td></td>
</tr>
<tr>
<td>Department of Operating Rooms/PACU</td>
<td></td>
</tr>
<tr>
<td>University of Michigan Health System</td>
<td></td>
</tr>
<tr>
<td>Ann Arbor, Michigan</td>
<td></td>
</tr>
<tr>
<td><a href="mailto:dedeo@umich.edu">dedeo@umich.edu</a></td>
<td></td>
</tr>
<tr>
<td>Jan Odom-Forren, PhD, RN, CPAN, FAAN</td>
<td>Content Expert: Adverse events</td>
</tr>
<tr>
<td>Assistant Professor, College of Nursing</td>
<td></td>
</tr>
<tr>
<td>University of Kentucky</td>
<td></td>
</tr>
<tr>
<td>Lexington, Kentucky</td>
<td></td>
</tr>
<tr>
<td>Co-Editor, Journal of PeriAnesthesia Nursing</td>
<td></td>
</tr>
<tr>
<td><a href="mailto:jodom29373@aol.com">jodom29373@aol.com</a></td>
<td></td>
</tr>
<tr>
<td>Corey Peterson, MSN, CRNA</td>
<td>AANA representative</td>
</tr>
<tr>
<td>Instructor</td>
<td>Content Expert: Intraoperative warming</td>
</tr>
<tr>
<td>Nurse Anesthesia Program</td>
<td></td>
</tr>
<tr>
<td>Medical College of Georgia</td>
<td></td>
</tr>
<tr>
<td>Augusta, GA</td>
<td></td>
</tr>
<tr>
<td><a href="mailto:COPETERSON@mail.mcg.edu">COPETERSON@mail.mcg.edu</a></td>
<td></td>
</tr>
<tr>
<td>Jacqueline Ross, MSN, RN, CPAN</td>
<td>ASPAN Director for Research</td>
</tr>
<tr>
<td>Patient Safety Analyst</td>
<td>Content Expert: Risk factors</td>
</tr>
<tr>
<td>The Doctors Company</td>
<td></td>
</tr>
<tr>
<td>Napa, California</td>
<td></td>
</tr>
<tr>
<td><a href="mailto:jackieross@roadrunner.com">jackieross@roadrunner.com</a></td>
<td></td>
</tr>
<tr>
<td>Linda Wilson, PhD, RN, CPAN, CAPA, BC, CNE</td>
<td>ASPAN National Office: Nurse Liaison for Education, Research, and Clinical Practice</td>
</tr>
<tr>
<td>Assistant Dean for Special Projects, Simulation and CNE Accreditation</td>
<td></td>
</tr>
<tr>
<td>Drexel University College of Nursing and Health Professions</td>
<td></td>
</tr>
<tr>
<td>Philadelphia, Pennsylvania</td>
<td></td>
</tr>
<tr>
<td><a href="mailto:lwilson@aspn.org">lwilson@aspn.org</a></td>
<td></td>
</tr>
</tbody>
</table>

*The following members have disclosed the following relationships:*
Denise O’Brien, MSN, RN, ACNS-BC, CPAN, CAPA, FAAN: Research funded by Arizant Healthcare, Inc.

**Acknowledgments**

The authors would like to thank the American Society of PeriAnesthesia Nurses for their funding and support of this project; Linda-Wilson, PhD, RN, CPAN, CAPA, BC, CNE, ASPAN Nurse Liaison for Education, Research, and Clinical Practice for her support of the project; and the following CRNA students at the Medical College of Georgia School of Nursing who assisted with the literature search and article retrieval for this project: Nicole Earhardt, MSN, CRNA, Demetria Goodwin, MSN, CRNA, DaDonna Marshall, MSN, CRNA, Eugene Pikus, MSN, CRNA, and Tivoli Thomas, MSN, CRNA.
Algorithm 1: Preadmission/ Preoperative Recommendations

Assessment

- Assess for risk factors for perioperative hypothermia (Class I, Level C)
- Measure patient temperature on admission (Class I, Level C)
- Determine patient’s thermal comfort level (Class I, Level C)
- Assess for signs and symptoms of hypothermia (e.g., shivering, piloerection, and/or cold extremities) (Class I, Level C)
- Document and communicate all risk factor assessment findings to all members of the anesthesia/surgical team (Class I, Level A)

Patient is normothermic

- Implement passive thermal care measures (Class I, Level B)
- Maintain ambient room temperature at or above 24°C or 75°F (Class I, Level C)
- Consider preoperative warming to reduce the risk of intra/postoperative hypothermia (Class IIb, Level B)

Patient is hypothermic or at risk for hypothermia

- Institute active warming for patients who are hypothermic (class IIb, Level B)

Figure 1. Preadmission/preoperative recommendations.
Algorithm 2: Intraoperative Recommendations

Assessment

- Identify patient’s risk factors for unplanned perioperative hypothermia (Class I, Level C)
- Frequent intraoperative temperature monitoring should be considered in all cases (Class I, Level C)
- Assess for signs and symptoms of hypothermia (Class IIb, Level C)
- Determine patient’s thermal comfort level (Class IIb, Level C)
- Document and communicate all risk factor assessment findings to all members of the anesthesia/surgical team (Class I, Level A)

All patients

Patients undergoing a procedure with an anticipated anesthesia time > 30 minutes (Class I/Level C), and/or who are hypothermic preoperatively (Class II/Level A), and/or patients at risk for hypothermia (Class II/Level C)

- Limit skin exposure to lower ambient environmental temperatures (Class I/Level C)
- Initiate passive warming measures (Class I/Level C).
- Maintain ambient room temperature from 20° - 25°C based on AORN and architectural recommendations (Class I/Level C)

- Forced air warming should be implemented (Class I/Level A)

- There is evidence to suggest that alternative active warming measures may maintain normothermia, used alone or in combination with forced air warming (Class IIb/Level B). These warming measures include:
  - Warmed IV fluids (Class IIa/Level B)
  - Warmed irrigation fluids (Class IIb/Level B)
  - Circulating water garments (Class IIb/Level B)
  - Circulating water mattresses (Class IIb/Level B)
  - Radiant heat (Class IIb/Level B)
  - Gel pad (Arctic Sun) surface warming (Class IIa/Level B)
  - Resistive heating (Class IIa/Level B)

Figure 2. Intraoperative recommendations.
Algorithm 3: Phase I/II PACU Postoperative Patient Management Recommendations

**Assessment**
- Identify the patient’s risk factors for perioperative hypothermia (Class I, Level C)
- Document and communicate all risk factor assessment findings to all members of the healthcare team (Class I, Level A)
- Measure patient temperature on admission to the PACU (Class I, Level C)

**Normothermic**
- Implement passive thermal care measures (Class I, Level C)
- Maintain ambient room temperature at or above 24°C or 75°F (Class I, Level C)
- Assess patient thermal comfort level on admission, discharge, and more frequently as indicated (Class I, Level C)
- Observe for signs and symptoms of hypothermia (e.g., shivering, piloerecton, and/or cold extremities) (Class I, Level C)
- Reassess temperature if patient’s thermal comfort level changes and/or signs or symptoms of hypothermia occur (Class I, Level C)
- Implement active warming measures as indicated
- Measure patient temperature prior to discharge (Class I, Level C)

**Hypothermic**
- In addition to normothermic interventions, initiate active warming measures:
  - Apply forced air warming system (Class I, Level A)
  - Consider adjuvant measures:
    - Warmed intravenous fluids (Class IIb, Level B)
    - Humidified warm oxygen (Class IIb, Level C)
  - Assess temperature and thermal comfort level every 15 minutes until normothermia is achieved (Class I, Level C)

**Discharge Teaching**
- Instruct the patient and responsible adult of methods to maintain normothermia after discharge (e.g., warm liquids, blankets, socks, increased clothing, increased room temperature) (Class I, Level C)

Figure 3. Phase I/II PACU postoperative patient management recommendations.