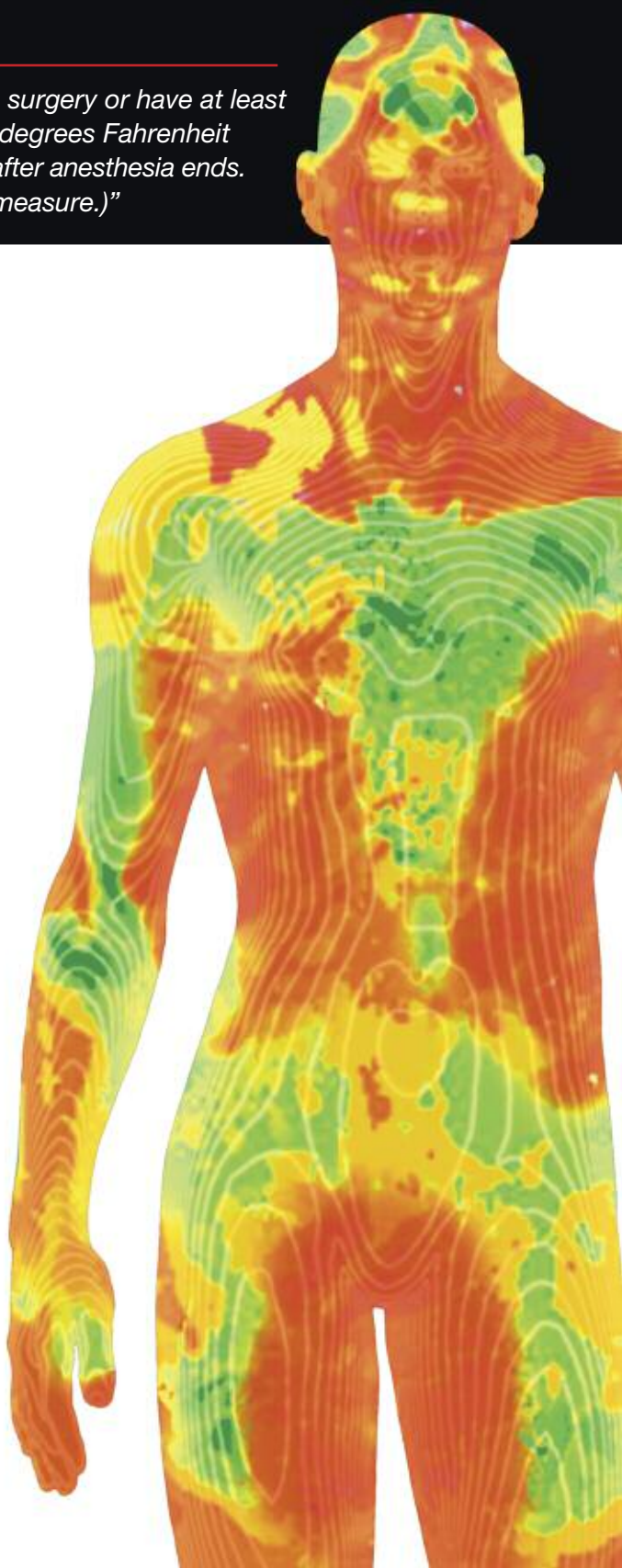
CE Article

Turn Up the Heat

Avoiding Surgical Complications with Adequate Patient Warming

SCIP-Inf-10[1]

"Measure: Surgical patients should be actively warmed during surgery or have at least one recorded body temperature equal to or greater than 96.8 degrees Fahrenheit within 30 minutes prior to the end of anesthesia to 15 minutes after anesthesia ends. (Patients with intentional hypothermia are excluded from this measure.)"



In 2003, the Joint Commission and the Centers for Medicare and Medicaid Services (CMS) teamed up to align their common measures. In the process, they decided to add a set of measures for Surgical Infection Prevention (SIP), which was quickly added as a core measure set.[2] In July, 2006, SIP was renamed the Surgical Care Improvement Project (SCIP).

Members of the SCIP Steering Committee include the Association of periOperative Nurses (AORN), the Joint Commission, the Centers for Medicare and Medicaid Services (CMS), Agency for Healthcare Research and Quality (AHRQ), American College of Surgeons (ACS), American Hospital Association (AHA), American Society of Anesthesiologists (ASA), Centers for Disease Control and Prevention (CDC), Department of Veterans Affairs, and the Institute for Healthcare Improvement (IHI).[3] This national partnership of organizations works together to improve the quality of surgical care.

To date, SCIP has introduced 10 measures, plus three others specifically addressing cardiac patients and venous thromboembolism. All measures are to be followed in order to reduce surgical-site infections and other complications of surgery. (For the complete list of all SCIP Measures, turn to the back of this article.)

SCIP-Infection (Inf.)-10, also known as SCIP Measure 10 – "Surgery Patients with Perioperative Temperature Management," went into effect October 1, 2009.[4] When the measure was first adopted, the best available temperature management evidence was on patients having colectomies while under general anesthesia. Consequently, the measure initially focused on this population.

Currently, SCIP-Inf.10 applies to patients of any age undergoing surgical or therapeutic procedures while under general or neuraxial anesthesia for one hour or more. It does not include patients undergoing cardiopulmonary bypass.[5]

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Under SCIP-Inf-10 clinicians must either actively warm patients during surgery or record a body temperature of 36 degrees C (96.8 degrees Fahrenheit) or higher within 30 minutes before or 15 minutes immediately after the end of anesthesia. Clinicians must provide clear documentation of the temperature during active warming or in relation to the end of anesthesia.

What causes perioperative hypothermia?

As warm-blooded creatures, human beings' organ systems are designed to operate within a narrow temperature range. Hypothermia occurs when a person's body loses more heat than it can produce, leading to a core body temperature drop. In nature, we know what makes us cold and we can respond. Exposure to cold air encourages us to get out of the cold or bundle up. Being damp causes us to seek drier conditions. We put on jackets or seek shelter to get out of the wind. In the OR, perioperative hypothermia is common, resulting from the effects of anesthesia on the body's thermoregulatory control system.[6]

Many factors can contribute to unplanned perioperative hypothermia, including cool air temperature in the OR, length of surgery (the longer the surgery, the greater the likelihood of hypothermia occurring), blood and fluid loss, and effects from anesthesia, which alters the patient's ability to regulate body temperature. A patient's body type can also affect heat loss. Very thin, malnourished patients as well as those who are very young or elderly are more susceptible to perioperative hypothermia.[7]

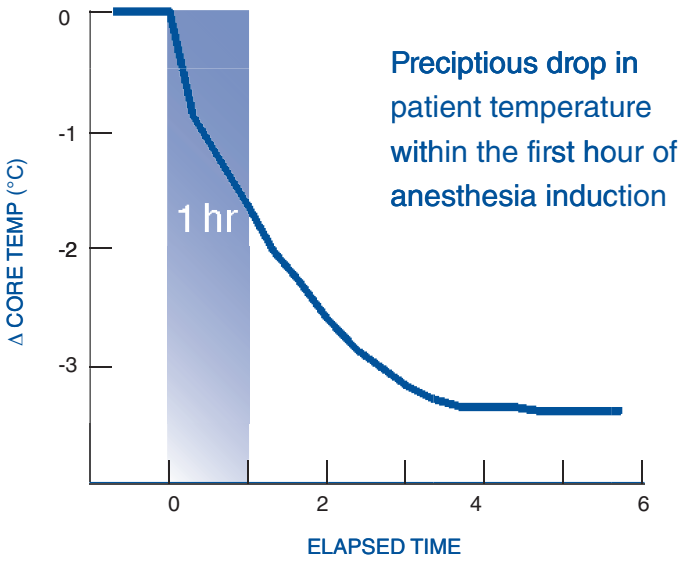
Elderly patients are more susceptible to hypothermia for a number of reasons. The body's ability to regulate temperature and to sense cold may lessen with age. Comorbidities that affect temperature regulation are more likely in older adults, including conditions such as hypothyroidism, stroke, severe arthritis, Parkinson's disease, and neuropathies including diabetic neuropathy. They are also frequently more dehydrated and malnourished than the general population. Finally, medications including some antipsychotics and sedatives (both of which are used more frequently in long-term care settings) can impair the body's ability to regulate its temperature.

Core body temperature changes occur in three stages, beginning with the onset of general anesthesia. During the first hour, redistribution is the main cause of potential perioperative hypothermia.

Intraoperative core temperatures about two degrees Celsius below normal increase the incidence of wound infection threefold and prolong hospitalization by about 20 percent.[5]

During this stage, warmer blood from the core is allowed to mix with cooler blood from the rest of the body. The blood cools as it circulates, and the cooled blood that returns to the heart can cause a decrease in body temperature[8] of up to one degree Celsius.[7]

Redistribution is followed by the second phase, which occurs during the second and third hours of anesthesia, during which heat loss exceeds the body's ability to produce heat. During this phase, warming the patient can effectively limit further heat loss. Finally, after about three to five hours of anesthesia, the patient's temperature reaches a plateau, which usually remains constant for the remainder of the surgery, regardless of how long the rest of the procedure takes.



After inducing anesthesia, a patient's core body temperature drops rapidly.[9]

Did you know?

Some patients report that shivering and being cold are worse than surgical pain. Hypothermia can cause a vigorous shivering response, which increases carbon dioxide production and increases oxygen consumption 400 to 500 percent.[10]

Complications associated with perioperative hypothermia

Hypothermia, which is defined as having a core body temperature of less than or equal to 36 degrees Celsius or 96.8 degrees Fahrenheit, is associated with several complications and an increased risk of death. Perioperative hypothermia can result in: [11]

- three times the incidence of surgical site infection
- increased bleeding and increased need for blood transfusions
- three times the risk for cardiac complications
- a higher risk for developing pressure ulcers
- prolonged recovery after surgery

Surgical site infection. Hypothermia causes the blood vessels to constrict, decreases blood flow to tissues and decreases oxygenation of surgical wounds, allowing a more favorable environment for bacterial growth. In 1996 Andrea Kurz, MD, and colleagues published a study involving 200 colorectal surgery patients; 100 were randomly assigned to undergo surgery with warming and the other 100 without warming. For those who did not receive warming, the final mean intraoperative core temperature was 34.7 degrees Celsius. The final mean temperature for those who were warmed was 36.6 degrees Celsius. Surgical wound infections were found in 19 percent of the hypothermic group and in six percent of the normothermic group. The authors concluded that intraoperative core temperatures about two degrees Celsius below normal increase the incidence of wound infection threefold and prolong hospitalization by about 20 percent.[12]

Melling et al. also conducted a study of wound infection rates following surgery. The random controlled trial included 421 patients and resulted in a four percent infection rate among patients who received local warming and 15 percent among those who were not warmed.[8]

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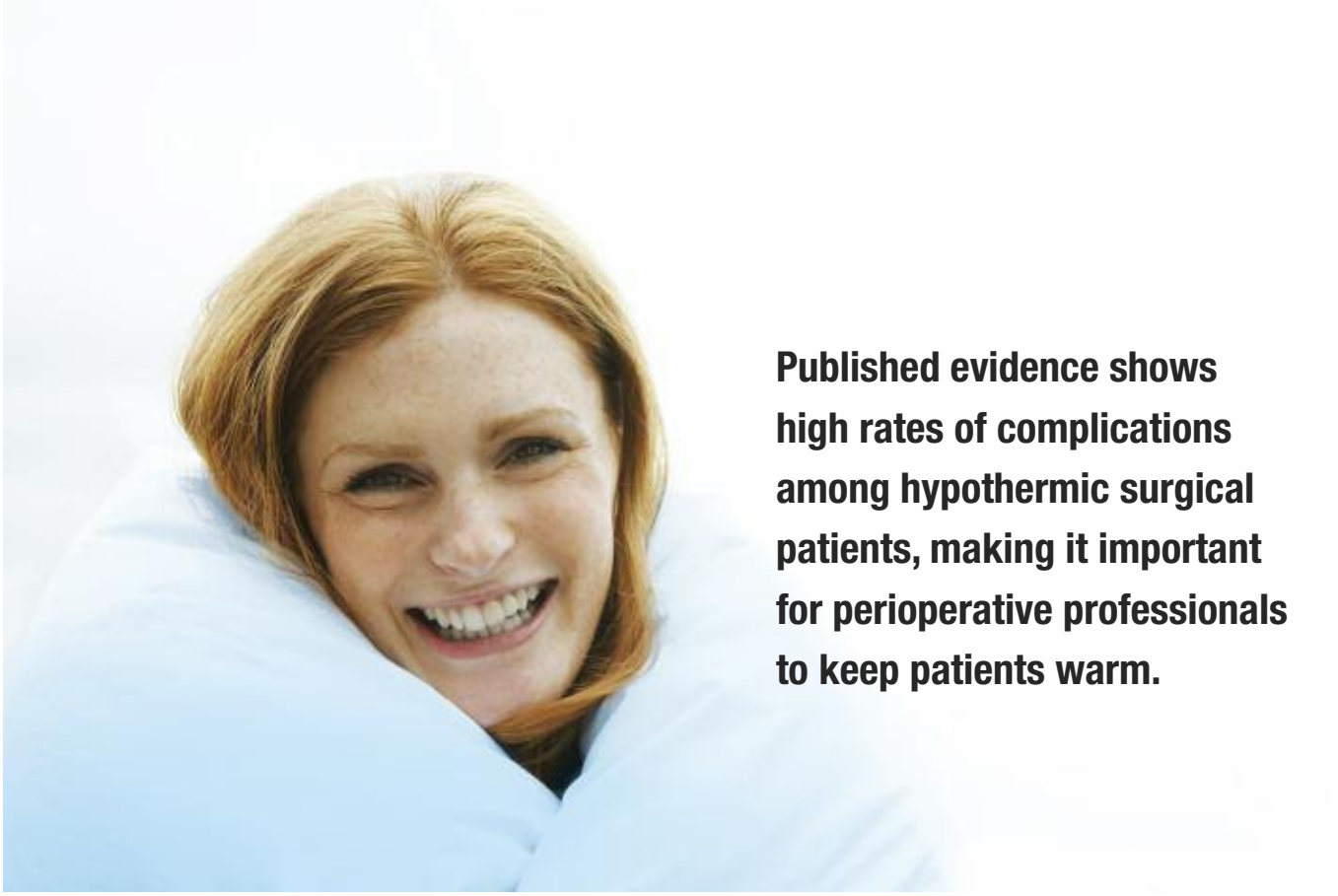


Published evidence shows high rates of complications among hypothermic surgical patients, making it important for perioperative professionals to keep patients warm.

One suspected cause of surgical site infections has been understood to be a lack of oxygen, in particular bactericidal oxide radicals. As a drop in core temperature leads to vasoconstriction to preserve heat in the body, less oxygenated blood flows to a wound site on the skin. That reduction in available oxygen at the wound site makes it more conducive to bacterial growth. One study found that dissolved oxygen (pO2) is a strong predictor of infection. Measuring levels of subcutaneous oxygen in post-surgical patients, he found that none with an oxygen tension greater than 90 mmHg developed a SSI whereas 43 percent of patients with an oxygen tension between 40 and 50 mmHg did develop a SSI.

Increased blood loss. A meta-analysis published in 2008 by Daniel Sessler, MD, professor and chair of the Department of Outcomes Research at Cleveland Clinic, and colleagues found that less than one degree of hypothermia is enough to increase blood loss by about 16 percent and increase the need for intraoperative transfusion by about 22 percent. Normothermia, however, was associated with a reduced chance of blood loss and a reduced need for transfusion.[13] Similarly, an earlier study by Schmied and colleagues in 1996 also found that mild hypothermia can increase blood loss and the need for transfusion during surgery.[14]

Cardiac complications. A 1993 study by Johns Hopkins anesthesiologist S.M. Frank, MD, and colleagues revealed that a greater number of hypothermic patients (36 percent) experienced myocardial ischemia compared with normothermic patients (13 percent). The incidence of angina postoperatively was also greater among the hypothermic group (18 percent) compared with the normothermic group (1.5 percent).[15] All 100 subjects in the study underwent a vascular reconstruction procedure.

It is important to recognize the difference between unintended hypothermia that leads to cardiac conditions, and the growing practice of therapeutic, induced hypothermia in cardiac patients. Unintentional hypothermia (perioperatively or otherwise) can lead to an unusually slow or irregular heart rate, which manifests as a weak or slow pulse or other arrythmias.[16] Therapeutic hypothermia is an evidence-based intervention that attempts to lower core temperatures to around 33 degrees Celsius for 24 hours after a cardiac event for the purpose of improving neurological outcomes.

Perioperative pressure ulcers. Because of circulatory and metabolic changes that occur during surgery, the etiology of perioperative pressure ulcers is more complex than those that

occur in medical patients.[17] In a 2001 study researchers hypothesized that patients' capacity to withstand mattress pressures during surgery would increase if hypothermia were prevented. They performed a randomized control trial to explore the relationship between tissue viability and patient core temperatures during surgery and to test the hypothesis that patient warming would reduce the incidence of pressure ulcers. Their trial involving 324 surgical patients resulted in an eight percent pressure ulcer incidence among patients who were warmed with a forced air over-blanket, versus a 65.4 percent incidence among patients who were not warmed.[18]

Prolonged recovery. Rainer Lenhardt, MD, clinical director of the Neuroscience-Anesthesia Intensive Care at the University of Louisville School of Medicine, and colleagues hypothesized that intraoperative hypothermia may prolong immediate surgical recovery by increasing the potency of the anesthetic, delaying drug metabolism or depressing cognitive function. They followed 150 patients undergoing elective major abdominal surgery and discovered that hypothermic patients required about 40 minutes longer than normothermic patients to reach fitness for discharge.[19]

Length of stay in the post-anesthesia care unit (PACU) is an important issue for health care managers. PACU nurses care for a small number of patients because of the high level of attention and care needed by a person recovering from anesthesia. Some have calculated that the personnel cost for two-hours in the PACU stay is similar to the personnel cost for a full day on a general care unit in a hospital.[20] In an era of cost control, decreasing recovery time is economically desirable for the institution.

Warming methods

As summarized above, published evidence shows high rates of complications among hypothermic surgical patients, making it important to maintain normothermia. There are several kinds of surgical warming devices available.

Types of warming devices include forced air over or under the body; circulating warm-water devices; or conductive, active warming devices, which include under-the-body warming mattresses or over-the-body warming blankets. In addition to requiring perioperative professionals to maintain normothermia in patients, SCIP-Inf.-10 also requires clear documentation regarding the use of active warming devices.[11]

How to prevent perioperative hypothermia

Although SCIP recommends keeping patients warm during surgery, it does not recommend how to keep them warm.[21] Nursing organizations, including the Association of periOperative Registered Nurses (AORN) and the American Society of Perianesthesia Nursing have developed standards for preventing hypothermia during surgery. The following are highlights from AORN's "Recommended Practices for Prevention of Unplanned Perioperative Hypothermia."[22]

Recommendation I

The perioperative registered nurse should assess the patient for risk of unplanned perioperative hypothermia.

Recommendation II

The perioperative registered nurse should develop a plan of care to minimize the risk of unplanned perioperative hypothermia in patients identified at risk.

Recommendation III

Equipment to monitor core temperature should be selected based upon reliability and access to the route.

III.a.1

There are four reliable sites for measurement of core temperature:

- **Tympanic membrane.** The tympanic membrane temperature, measured by a thermocouple, is the preferred method in many perioperative and postoperative areas. This method is noninvasive, and the monitoring site receives blood supply from the carotid artery, which supplies the thermoregulatory center of the hypothalamus.
- **Distal esophagus.** The distal esophagus is considered a desirable site to measure temperature, particularly in the operating room, and is less prone to artifact than most others. It is an alternative to the pulmonary artery and is widely used intraoperatively. Placement of the probe in the lower fourth of the esophagus prevents artifactual cooling of the probe by respiratory gases.
- **Nasopharynx.** The nasopharynx is another reliable monitoring site for intraoperative measurement because it approximates core temperature. A thermistor probe is inserted through the nares to the nasopharynx. Measurements may be influenced by the temperature of inspired gases and often are 0.5 degrees Celsius lower than pulmonary artery temperatures.
- **Pulmonary artery.** The most accurate measurement of the core body temperature is through the pulmonary artery, which is bathed in blood from the core. This invasive form of monitoring, however, is not justified solely for temperature assessment.

Recommendation IV

The core temperature of patients at risk for unplanned hypothermia should be monitored pre-operatively, intraoperatively and postoperatively.

Recommendation V

Interventions should be implemented to prevent unplanned hypothermia.

Recommendation VI

Warming devices should be used in a manner that minimizes the potential for patient injuries.

Recommendation VII

Competency

Personnel should receive initial education and competency validation and updates on the prevention of unplanned hypothermia and the use of warming equipment.

Recommendation VIII

Documentation

Patient assessments, the plan of care, interventions implemented, and evaluation of care to prevent unplanned perioperative hypothermia should be documented.

Recommendation IX

Policies and Procedures

Policies and procedures for prevention of unplanned hypothermia should be developed in collaboration with anesthesia care providers, reviewed periodically, revised as necessary, and readily available in the practice setting.

Recommendation X

Quality

A quality improvement/management program should be in place to evaluate the structure, process, and outcomes of interventions used to protect patients from unplanned perioperative hypothermia.

Methods of Patient Warming

Warm IV Fluids

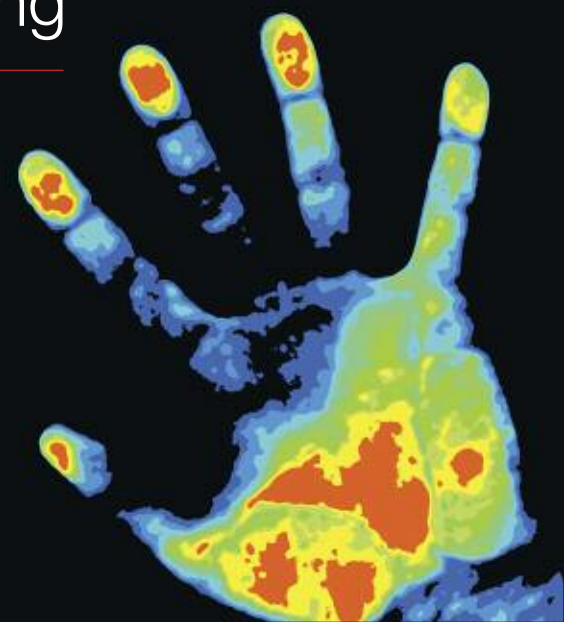
Conductive Warming Devices

Warming Blankets

Forced Air

Circulating Water Garments

Increased Operating Room Temperature



In an interview with *OR Manager*, perioperative hypothermia expert Dr. Sessler stated that it doesn't matter which warming method is used as long as the patient's temperature is approximately normal at the end of the surgery.[21] Dr. Sessler is a leading researcher in surgical warming and has co-written many studies on how hypothermia affects surgical patients and the effectiveness of warming devices.

Warm IV fluids. Warming IV fluids is another way to increase body temperature, but only under certain circumstances. AORN's "Recommended Practices for Prevention of Unplanned Perioperative Hypothermia" states:[22]

"Warming intravenous (IV) fluids should be considered only if large volumes (i.e., more than two liters/hour for adults) are being administered. Warming IV fluids to near 37 degrees Celsius (98.6 degrees Fahrenheit) prevents heat loss from the administration of cold IV fluids and should be considered as an adjunct to skin surface warming. When less than two liters of volume is given, fluid warming is of limited value because fluid-induced cooling is minimal."

Conductive warming devices. One type of patient warming pad on the market is an electrical resistive/conductive device that warms underneath the patient's body. It takes the place of an existing OR table mattress pad. The device incorporates dual fiber optic interface temperature sensors under the pad cover near the patient's skin to continuously monitor and control the heat generation of the pad. Warming can begin as soon as the patient is positioned on the OR table. The anesthesiologist can select one of five preset temperatures of 37, 38, 39, 40, or 40.5 degrees Celsius. The heating element is placed below one inch of viscoelastic memory foam to provide pressure redistribution for the patient. The entire pad is encased in a fluid proof cover and all seams are sealed to prevent penetration by spilled fluids, meaning the mattress can be cleaned and reused, eliminating unnecessary environmental waste. In addition, because the patient is warming from underneath, blankets need not be placed on top of the patient, allowing for greater surgical access. The device also operates with no noise.

Warming blankets. Warming blankets are one option that is portable, easy-to-use and effective. The downside, however, is that nurses must make multiple trips to and from the blanket warming cabinet to ensure the patient always has a warm blanket. This can reduce efficiency and increase laundry costs.[23] Also, adding too many layers of warmed cotton blankets is ineffective in raising the patient's body temperature. The first blanket can reduce heat loss by 33 percent, however, adding another blanket only adds another 18 percent reduction in heat loss. Adding three or more blankets adds no further warming.[8]

Forced air warming. Another widely used option is forced air warming. The system consists of a warming unit and a remov-

able disposable blanket. The warming unit, which resembles an industrial vacuum cleaner, draws in air from the room and warms it to a specified temperature. The warm air is then pumped through a hose into a disposable blanket that covers the patient. According to Dr. Sessler, operating rooms tend to use forced-air warming covers because they are effective, safe and inexpensive. The blowers are often provided, and the blankets are inexpensive.[21]

One difficulty with forced air warming is that it cannot always sufficiently warm a large enough surface to maintain normothermia during very large procedures when the patient is not in the supine position. For example, it can be difficult to maintain normothermia in a patient undergoing a colectomy in the lithotomy position. So much skin is exposed that there is not enough surface area to warm. In cases like this, a combination of patient warming devices and an ambient operating room may be the solution for maintaining normothermia.[21]

Some surgical staff reject the use of forced air warming because it can contribute to field contamination and the unit itself can be a source of pathogens. Another criticism of forced-air warming is that it can create too warm an environment for the surgeon.[8] The blowing can also create a considerable amount of noise in the OR.

Circulating water garments. These devices circulate water through a segmented garment that is wrapped around the anterior and posterior sides of the patient. This is in contrast to circulating water mattresses, which the patient lies on in a supine position, thereby warming the posterior side of the body.

Research conducted by Dr. Sessler has shown that circulating water garments and energy transfer pads warm patients about 50 percent better than forced air because they warm both over and under the body. These systems tend to be more costly, however, experts argue the cost is justified by better patient outcomes when compared with other warming methods.

The following is an excerpt from a study by Taguchi et al., which compares the efficacy of circulating water garments versus forced air to maintain perioperative normothermia.[6] To read the study in its entirety, go to www.ncbi.nlm.nih.gov/pmc/articles/PMC1409744/?tool=pubmed. Akiko Taguchi, MD, is an instructor in the Department of Anesthesiology at Washington University in St. Louis, MO.

"Differences in perioperative patient warming systems result largely from what tissues are in contact with what heating element and the available surface area. Heat transfer also depends on physical characteristics of the heater-skin interface. For example, the surface area of the lung is enormous, but airway heaters and humidifiers transfer trivial amounts of heat because the thermal capacity of air is small.

With any cutaneous warming system, heat transfer into the thermal core depends on skin temperature, tissue insulation, and circulatory convection of heat within the body. Device efficacy thus depends on which surface area is heated because the core is relatively isolated from distal skin surfaces. But most importantly, cutaneous heat transfer depends on skin temperature. Nearly all commercially available patient-warming systems are electrically powered; there is, therefore, no intrinsic physical limit to the calories that can be provided. Instead, the limitation is always the skin temperature that can be tolerated without undue risk of burns.

Despite the high heat capacity and thermal conductivity of water, the efficacy of conventional circulating-water mattresses is modest. Poor efficacy results because 1) the posterior surface is a relatively small fraction of the body surface area, 2) this area is poorly perfused because the weight of the body compresses cutaneous capillaries, and, 3) most heat is lost via radiation and convection from the anterior surfaces rather than conduction

Despite the high heat capacity and thermal conductivity of water, the efficacy of conventional circulating-water mattresses is modest.

For most patients, raising the room temperature to more than 73.4º F may reduce the severity of hypothermia.

into the operating-table mattress. As might thus be expected, the circulating-water garment transferred only 21 kcal/h across the posterior skin surface. This is more than reported previously with a conventional circulating-water mattress, possibly because of a better interface material. However, it is roughly the same change in cutaneous heat transfer that is provided by a single cotton blanket in a normothermic subject.

Anterior surface heat transfer was comparable with each warming system, and the change in anterior surface heat gain from 0 to 0.5 elapsed hours averaged ≈65 kcal/h with each treatment. Heat transfer per anterior unit area was thus similar with each system. A corollary of this observation is that virtually the entire difference between the two tested warming systems resulted from heat transfer into posterior surfaces, that is from the portion of the circulating-water garment that acts as mattress. Core temperature increased 0.4 degrees Celsius/h faster with circulating water than forced air, a result that is consistent with Janicki et al. Although not tested in this study, our results suggest that heat transfer and core rewarming with the circulating-water garment would be similar to that provided by combining a forced-air cover and a conventional circulating-water mattress.

The core and peripheral thermal compartments were of similar size (e.g., weight). However, active warming increased peripheral tissue heat content roughly three times as much as the core over the course of the study. The differences were even more pronounced during the initial warming phase. For example, peripheral heat content after one hour of circulating water increased 114 kcal whereas core content increased only 34 kcal. The analogous values for forced air were 71 and 9 kcal. Peripheral compartment heat content thus increased 60-80 kcal more than the core compartment with each device. These data indicate that tissue insulation restricted rapid flow of heat from the periphery to the core. In other words, applied heat was constrained by the insulating properties of peripheral tissues, thus significantly limiting the rate at which core temperature increased.

That peripheral tissues insulated the core and slowed heat transfer in our volunteers is consistent with observations of Plattner et al. who found that peripheral tissues isolate the core from heat applied to the skin surface in the post-anesthetic period. Similarly, Szmuk et al. found that core rewarming was slowed by postoperative vasoconstriction. In contrast, peripheral-to-core heat transfer is unimpeded during anesthesia, whether subjects are vasodilated or vasoconstricted. The critical distinction amongst these studies is that volunteers were fully anesthetized in the later protocols whereas they were unanesthetized in the former ones. Although our volunteers remained intubated, they were very lightly anesthetized and fully vasoconstricted. It is thus unlikely that they were given sufficient anesthesia to cause direct arteriolar vasodilation that seems to be critical for rapid peripheral-to-core heat transfer.

Although core temperatures were virtually identical at onset of warming, peripheral tissue temperature was slightly cooler on the circulating-water day. This lower initial skin temperature and greater initial core-to-peripheral tissue-temperature gradient increases the apparent efficacy of circulating water. However, the tissue temperature difference was only a few tenths of one degree Celsius and thus unlikely to have substantially altered the results.

Traditional circulating-water mattresses are associated with 'pressure-heat necrosis' (i.e., burn) that results when tissue compressed by the weight of the patient is simultaneously warmed. Gali et al. recently reported the case of a 67-year-old woman who developed burns on her back after 6.5 hours of surgery while being warmed with the same circulating-water garment we used. Thus, when using this system, clinicians should consider any risk factors such as age, length of surgery, and nutritional status, which may predispose a patient to skin injury.

In summary, the circulating-water garment transferred more heat than forced air, especially during the first hour of warming, with the difference resulting largely from posterior heating. Excessive heating of peripheral thermal compartment indicates that peripheral tissues insulated the core, thus slowing heat transfer. "

Increasing operating room temperature. When active skin warming is not feasible or skin warming by itself is inadequate for maintaining normothermia, increasing the room temperature is

an option. For most patients, raising the room temperature to more than 23 degrees Celsius (73.4 degrees Fahrenheit) may reduce the severity of hypothermia.[22]

Combining warming techniques

Some have suggested the need for a holistic approach incorporating several different warming techniques to adequately warm a patient. Overall, depending on the surgeon, the surgical team, and patient and the circumstances, the best method of active warming may vary.[23]

Conclusion

Looking to the future, as surgical team awareness and further research into normothermia continues to develop, even more effective patient-temperature management devices are sure to follow. Warming device experts predict the development of more sustainable technologies that can be cleaned and re-used, unlike forced air warming which creates environmental waste with its disposable blankets. In addition, developing effective equipment that covers less of the body surface than forced-air warming or circulating water devices can offer greater convenience and access for anesthesiologists and surgical teams.[23]

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Patient Safety Quality Measures for the Surgical Care Improvement Project

	Measure	Rationale	Strategy
SCIP-Inf-1	Prophylactic antibiotics are administered one hour prior to incision.	Studies find that the lowest incidence of post-operative infection is associated with antibiotic administration during the one hour prior to surgery. The risk of infection increases progressively with greater time intervals between administration of the antibiotic and the skin incision.	• Include administration and documentation of the antibiotic in the surgical time out. • For one-hour antibiotics, the antibiotic is hung in pre-op, a surgical team member administers and documents the antibiotic infusion.
SCIP-Inf-2	Prophylactic antibiotics are consistent with current guidelines (specific to each type of surgical procedure).	Use an agent that is safe, cost-effective, and has a spectrum of action that covers most of the probable intraoperative contaminants for the operation. First- or second-generation cephalosporins satisfy these criteria for most operations, although anaerobic coverage is needed for colon surgery.	• The use of pre-printed orders that include the recommended antibiotic will assist surgeons with choosing appropriate antibiotics. • Vancomycin is appropriate if there is a risk of MRSA.
SCIP-Inf-3	Prophylactic antibiotics are to be discontinued within 24 hours after anesthesia end time. The discontinuation time extends to 48 hours for cardiac surgery patients.	Administration of antibiotics for more than a few hours after the incision is closed offers no additional benefit to the surgical patient. Prolonged administration increases the risk of *Clostridium difficile* infection and the development of antimicrobial resistant pathogens.	• Begin antibiotics in the PACU. • Administer cephalosporins every 6 hours rather than every 8 hours. • Antibiotics are not provided for more than 24 hours after surgery without appropriate documentation.
SCIP-Inf-4	Cardiac surgery patients with controlled 6 a.m. blood glucose (≤ 200 mg/dL) for the first two postoperative days.	Hyperglycemia in the immediate postoperative phase increases the risk of infection in both diabetic and non-diabetic patients; the higher the level of hyperglycemia, the higher the potential for infection in both patient populations.	• Blood glucose levels are monitored from pre-op through 48 hours post operative. • The use of an insulin protocol for treating hyperglycemia with an insulin drip is strongly recommended.
SCIP-Inf-6	Surgery patients with appropriate surgical site hair removal. No hair removal, hair removal with clippers, or depilatory is appropriate.	There is no strong evidence to contraindicate preoperative hair removal; however, there is strong evidence against hair removal with a razor. Shaving is considered inappropriate.	• Take ALL razors out of the peri-operative area. • Instruct patients not to shave the surgical site.
SCIP-Inf-9	Surgical patients with urinary catheter removed on Postoperative Day 1 or Postoperative Day 2 with day of surgery being day zero. (This measure does not apply to certain urological, gynecological or perineal procedures.)	It is well-established that the risk of catheter-associated urinary tract infection (UTI) increases with increasing duration of indwelling urinary catheterization.	• Create a system of alerts or reminders to identify all patients with urinary catheters and assess the need for continued catheterization. • Develop guidelines and protocols for nurse-directed removal of unnecessary urinary catheters and management of postoperative urinary retention. • Consider the use of external catheters for cooperative males

Measure		Rationale	Strategy
SCIP-Inf-10	Surgical patients should be actively warmed during surgery or have at least one recorded body temperature equal to or greater than 96.8° F within 30 minutes prior to the end of anesthesia to 15 minutes after anesthesia end time. (Patients with intentional hypothermia are excluded from this measure.)	Research has correlated impaired wound healing, adverse cardiac events, altered drug metabolism, and coagulopathies with unplanned perioperative hypothermia. A study by Kurtz, et al. (1996), found that incidence of culture-positive surgical site infections among those with mild perioperative hypothermia was three times higher than the normothermic perioperative patients.	• Use aggressive warming measures during surgery. • Ensure accurate documentation of post-operative temperature.
SCIP-CARD-2	Surgery patients on beta-blockers prior to admission should continue beta-blocker therapy during the perioperative period.	The American College of Cardiology and the American Heart Association recommend continuation of beta-blocker therapy in the perioperative period as a class I indication, and accumulating evidence suggests that titration to maintain tight heart rate control should be the goal.	• Instruct patients to take their beta blockers the day of surgery. • Educate in-house clinicians about the importance of patients receiving their beta blockers the day of surgery, even while the patients are otherwise NPO. • Meet with physician office staff to ensure consistent instructions to the patients.
SCIP-VTE-1	Surgery patients with recommended venous thromboembolism (VTE) prophylaxis ordered anytime from hospital arrival to 48 hours after *Anesthesia End Time.*	Despite the evidence that VTE is one of the most common postoperative complications and prophylaxis is the most effective strategy to reduce morbidity and mortality, it is often underused. The frequency of venous thromboembolism (VTE), which includes deep vein thrombosis and pulmonary embolism, is related to the type and duration of surgery, patient risk factors, duration and extent of postoperative immobilization, and use or nonuse of prophylaxis.	• Use pre-printed orders that include nationally recommended guidelines for VTE prophylaxis. • A "hard stop" would be not to allow patients to leave the recovery area until VTE orders are completed by the surgeon. • Ensure that surgeon "preference" cards mirror national guidelines. • Pharmacists should assist surgeons with understanding the risk of bleeding with pharmacological interventions.
SCIP-VTE-2	Surgery patients who received appropriate venous thromboembolism (VTE) prophylaxis within 24 hours prior to *Anesthesia Start Time* to 24 hours after *Anesthesia End Time*.	Timing of prophylaxis is based on the type of procedure, prophylaxis selection, and clinical judgment regarding the impact of patient risk factors. The optimal start of pharmacologic prophylaxis in surgical patients varies and must be balanced with the efficacy-versus-bleeding potential. Due to the inherent variability related to the initiation of prophylaxis for surgical procedures, 24 hours prior to surgery to 24 hours post surgery was recommended by consensus of the SCIP Technical Expert Panel in order to establish a timeframe that would encompass most procedures.	• (Please note that rates for SCIP-VTE- 2 may be lower than those for SCIP-VTE-1 as a result of more stringent criteria. SCIP-VTE-2 requires documentation that prophylaxis was ordered and actually started, whereas SCIP-VTE-1 requires only documentation of an order.) • Organizations with decreased VTE 2 rates should assess their processes to determine why physician orders are not being implemented.

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Turn Up the Heat

Avoiding Surgical Complications with Adequate Patient Warming

True/False

1. **Extremely thin and malnourished patients are more susceptible to perioperative hypothermia** T F

2. **SCIP Inf.-10 went into effect April 1, 2007.** T F

3. **Forced air warming is a widely used option for patient warming.** T F

4. **Cool air temperature in the operating room can contribute to unplanned perioperative hypothermia.** T F

5. **Perioperative hypothermia can cause a drastic drop in blood pressure.** T F

6. **Some surgical professionals reject the use of forced air warming because it can contribute to field contamination.** T F

Multiple Choice

7. **A 2008 study by Sessler and colleagues found that less than one degree of hypothermia during surgery is enough to increase blood loss by about ___ percent.**
   a. 25
   b. 46
   c. 16
   d. None of the above

8. **In the Scott study, what was the incidence of pressure ulcers among patients who were not warmed during surgery?**
   a. 72.5 percent
   b. 15.3 percent
   c. 65.4 percent
   d. 22.8 percent

9. **Which of the following is NOT a known complication of perioperative hypothermia?**
   a. Surgical site infection
   b. Prolonged recovery
   c. Myocardial ischemia
   d. Pneumonia

10. **During anesthesia, core body temperature changes occur in ____ stages.**
    a. Three
    b. Five
    c. Two
    d. Seven

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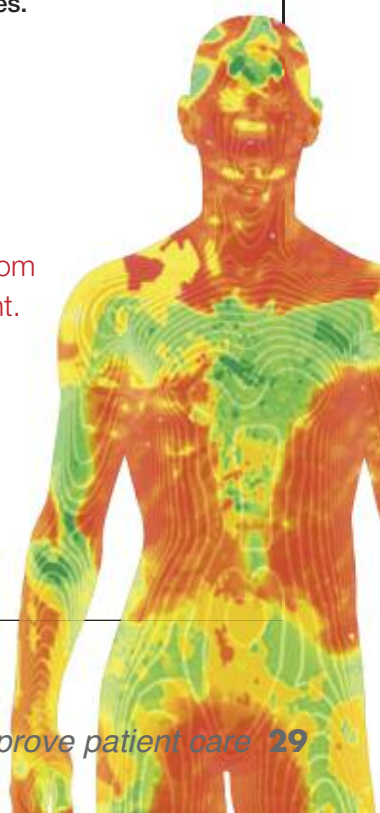

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