3M Health Care Academy

Current warming guidelines: what you need to know

February 21, 2017

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House Keeping

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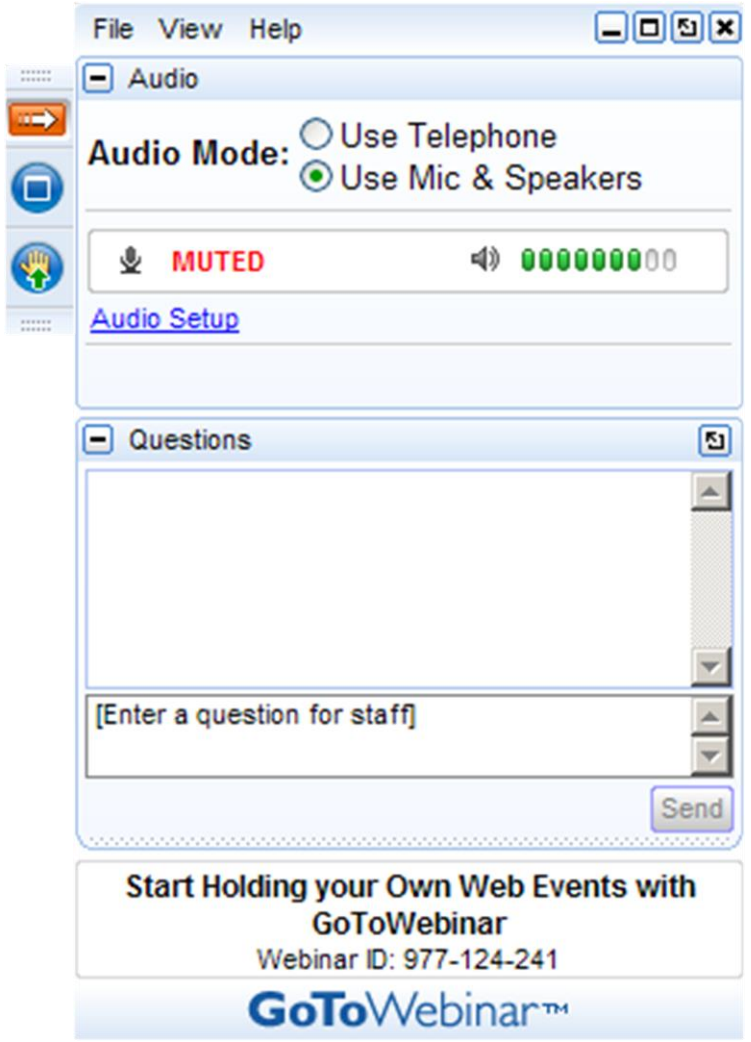
- Type a question in the question box and click send.



House Keeping

Continuing Education

Each 1 hour web meeting qualifies for 1 contact hour for nursing. 3M Health Care Provider is approved by the California Board of Registered Nurses CEP 5770.

Post webinar email

- Link to Course Evaluation
- CE Certificate Included
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Disclosure

- Janet Van and Melissa Bailey are both employees of 3M in the infection prevention division

Objectives

- Identify the different professional organizations that provide guidelines and recommendations regarding normothermia.
- Explain what the current guidelines from these professional organizations state regarding prevention of hypothermia.
- Describe the differences between the guidelines and the clinical evidence.

Thermoregulation and Inadvertent Perioperative Hypothermia (IPH)

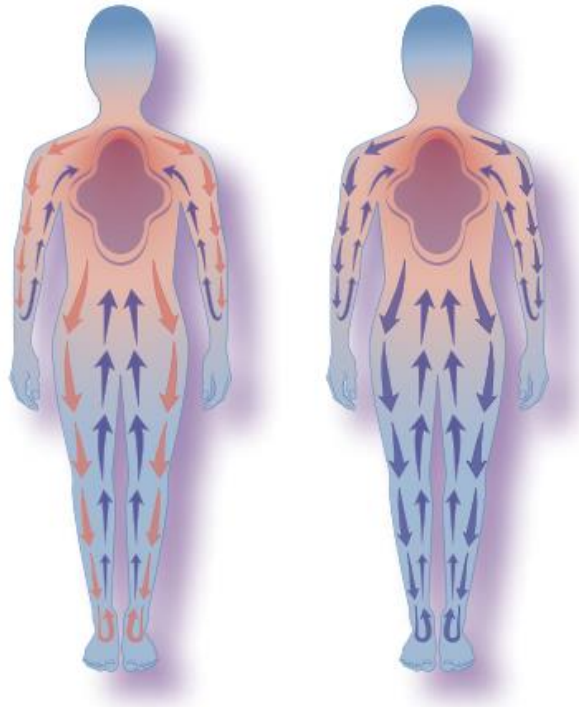
Hypothermia during the first hour of anesthesia is largely the result of core-to-peripheral redistribution of body heat[1]

Physiology of normal thermoregulation

- Core temperature is controlled within 0.4°C of its set-point (37°C), whereas the temperature of the periphery varies and is 2-4°C lower than the core[1, 2]
- If temperature deviates from the 0.4°C inter-threshold range, thermoregulatory mechanisms are triggered to restore a core temperature of 37°C[1,2]
  - ✓ Cold responses: vasoconstriction, nonshivering thermogenesis, shivering
  - ✓ Heat responses: active vasodilation and sweating

Impaired physiology with anesthesia induction

- Perioperative hypothermia occurs primarily from the redistribution of body heat from the body core to the periphery[1,2]
- Anesthetic-induced vasodilation allows heat in the warm core tissue to mix with cooler peripheral tissue, which warms the periphery at the expense of the core temperature[1,2]
  - ✓ Heat redistribution can be minimized by warming the skin and peripheral tissue before induction of anesthesia to reduce the core-peripheral temperature gradient
- Anesthetics also impair the ability to initiate thermoregulatory responses
  - ✓ By decreasing the activation threshold for responses to hypothermia by 3°C, anesthetics inhibit patients from adjusting to the core temperature changes that result from redistribution of heat

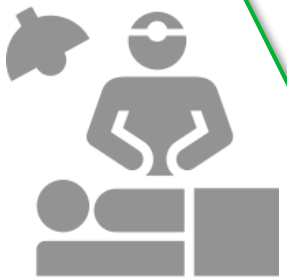


Anesthetic-induced vasodilation allows warmer blood from the core to flow freely and mix with the blood from the cooler periphery; cooler blood returns back to the heart where it causes a drop in core temperature[1,2]

1. Sessler, DI. NEJM. 1997;336(24): 1730-1737. 2. Matsukawa T, et al. Anesth. 1995;82(3):662-673.

Anesthetized patients will experience hypothermia if they are not warmed[1]

Inadvertent perioperative hypothermia is defined as a core body temperature of <36°C[1]



- Anesthesia, general or neuraxial, is the primary cause of inadvertent perioperative hypothermia[1,2]
- Anesthesia causes core-to-periphery redistribution of body heat that can cause a 1.6°C drop in temperature during the first hour after induction[2]
- Without active warming, the majority of patients will experience intraoperative hypothermia[1]
- Maintaining normothermia helps to avoid adverse outcomes and contribute to positive patient outcomes[1,2,3,4]

Redistribution temperature drop is the leading cause of inadvertent perioperative hypothermia

81% of the 1.6°C temperature decrease is due to redistribution temperature drop[2]

All other contributing factors are minor compared to anesthesia induction.[2]

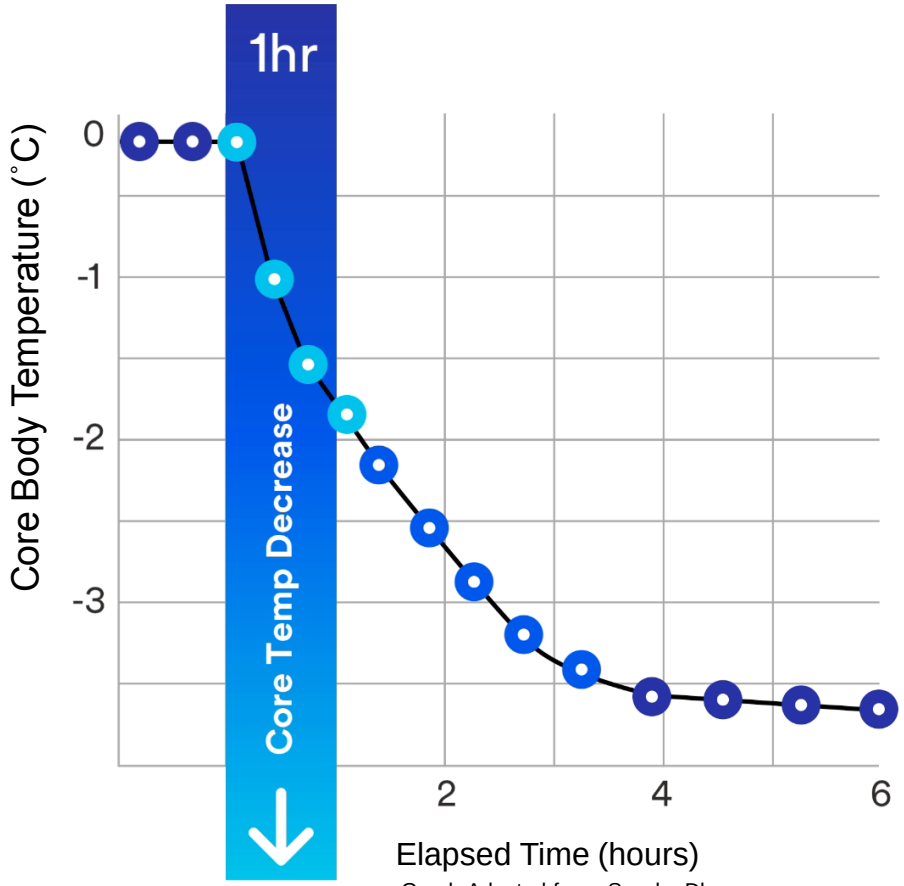
Minor Contributing Factors[2]

- Exposed body cavities
- Cold operating room (O.R.) temperatures
- Skin preparation with a cold solution
- Administration of cold I.V. fluids

1. Sessler DI. Lancet. 2016. 2. Matsukawa T, et al. Anesth. 1995. 3. Mahoney. AANA J. 1999 Apr;67(2):155-63. 4. Madrid E. The Cochrane Library. 2016.

Hypothermia in the anesthetized surgical patient follows a characteristic pattern of core temperature reduction[1,2,3]

Prewarming surgical patients reduces or prevents the redistribution of heat[3,4], which is especially important due to the significant core temperature decrease in the early phases of surgery



Graph Adapted from: Sessler DI, Anesth. 2000; 92(2): 578-96.

Characteristic Patterns of General Anesthesia-Induced Hypothermia[1,2,3]

Phase 1 - Rapid decrease in core temperature.
- Develops immediately after induction of anesthesia, a result of internal core-to-peripheral redistribution of heat
- Core temperatures can drop 0.5°C to 1.5°C

Phase 2 – Slow, linear decline in temperature.
- Occurs in the second hour, heat loss exceeds the body's ability to metabolically produce heat
- Results from significantly decreased metabolism due to anesthesia and diminished heat production by muscles

Phase 3 – Temperature plateau.
- Occurs three-to-five hours into surgery
- Reemergence of thermoregulatory vasoconstriction reestablishes the normal temperature gradient, and core temperature will plateau

1. Sessler, DI. NEJM. 1997;336(24): 1730-1737. 2. Sessler DI. Anesth. 2000. 3. Matsukawa T, et al. Anesth. 1995;82(3):662-673. 4. Hynson JM. Sessler DI. J Clin Anesth. 1992;4:194-199.

Patient Warming Benefits

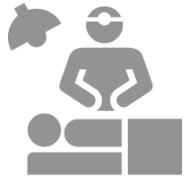
The physiological effects of hypothermia, ranging from mild to severe, can have a significant impact on patient outcomes[1,2]

Major Complications

Myocardial Events

- Cardiac events occur in **6.3% of hypothermic patients** vs. 1.4% of normothermic patients[3]
- High-risk patients with even mild hypothermia are **three times as likely** to experience adverse myocardial outcomes[3]

Surgical Site Infections (SSIs)



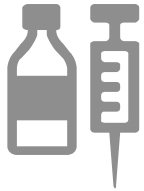
- Hypothermia can **increase the incidence of wound infection and prolong hospitalization by 20%** which increases cost[4]

Blood loss and risk of transfusion

- Even mild hypothermia significantly **increases blood loss by 16%** and the risk for **transfusion** by **~22%**[5]
- A 1.6°C reduction in core body temperature **can increase blood loss by 30%** and significantly augment allogenic transfusion requirement[6]

Minor Complications

Prolonged Recovery



- Drug metabolism is decreased which **prolongs** the duration of **post-operative recovery** by approximately **40 minutes**[7]

Thermal Discomfort

- Patients often report shivering as the **worst part of their hospitalization**, sometimes rating it worse than surgical pain[8]

Postoperative Shivering

- Occurs in **40% of unwarmed patients,**[9] increases oxygen consumption and exacerbates postoperative pain[8]

1. Madrid E. The Cochrane Library. 2016. 2. Sessler DI. Lancet. 2016. 3. Frank SM. JAMA. 1997; 277(14):1127-1134. 4. Kurz A. NEJM. 1996 May 9;334(19):1209-16. 5. Rajagopalan S. Anesth. Jan 2008;108(1):71-77. 6. Schmied H. Lancet 1996; 347:289–92. 7. Lenhardt, et al. Anesth. 1997;98(6):1318-1323. 8. Sessler DI. NEJM. 1997; 336(24):1730-1737. 9. Just B, et al. Anesth. 1992;76:60-64.

Surgical site infections (SSIs) are a significant source of morbidity and mortality among surgical populations, and lead to increased hospital stays and hospital costs[1]

Maintaining normothermia in surgical patients is especially critical due to the high level of economic burden associated with SSIs

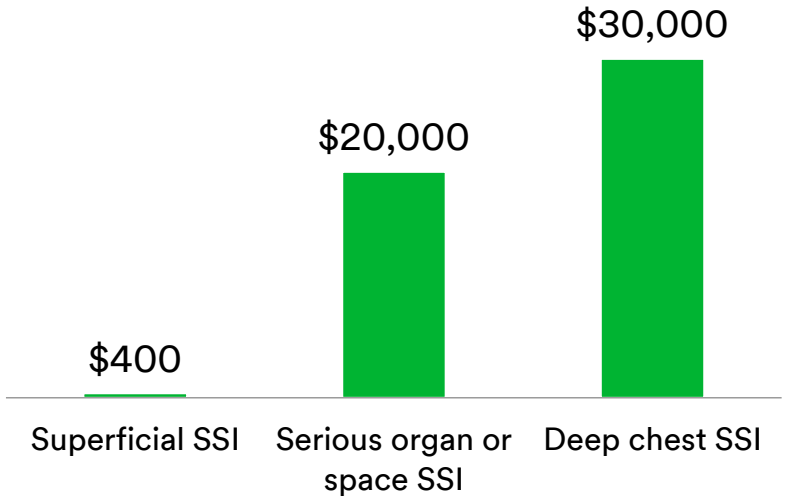
Direct Costs

- Direct costs of SSI can include longer hospital stays, readmissions, outpatient and emergency visits, further surgery, and prolonged antibiotic treatment
- Other direct costs arise from radiologic procedures, laboratory tests, home health visits and other ancillary services, drugs and professional fees[2]

Indirect Costs

- Indirect costs, which are difficult to quantify, include loss of patient and family productivity and a temporary or permanent decline in functional or mental capacity[2]

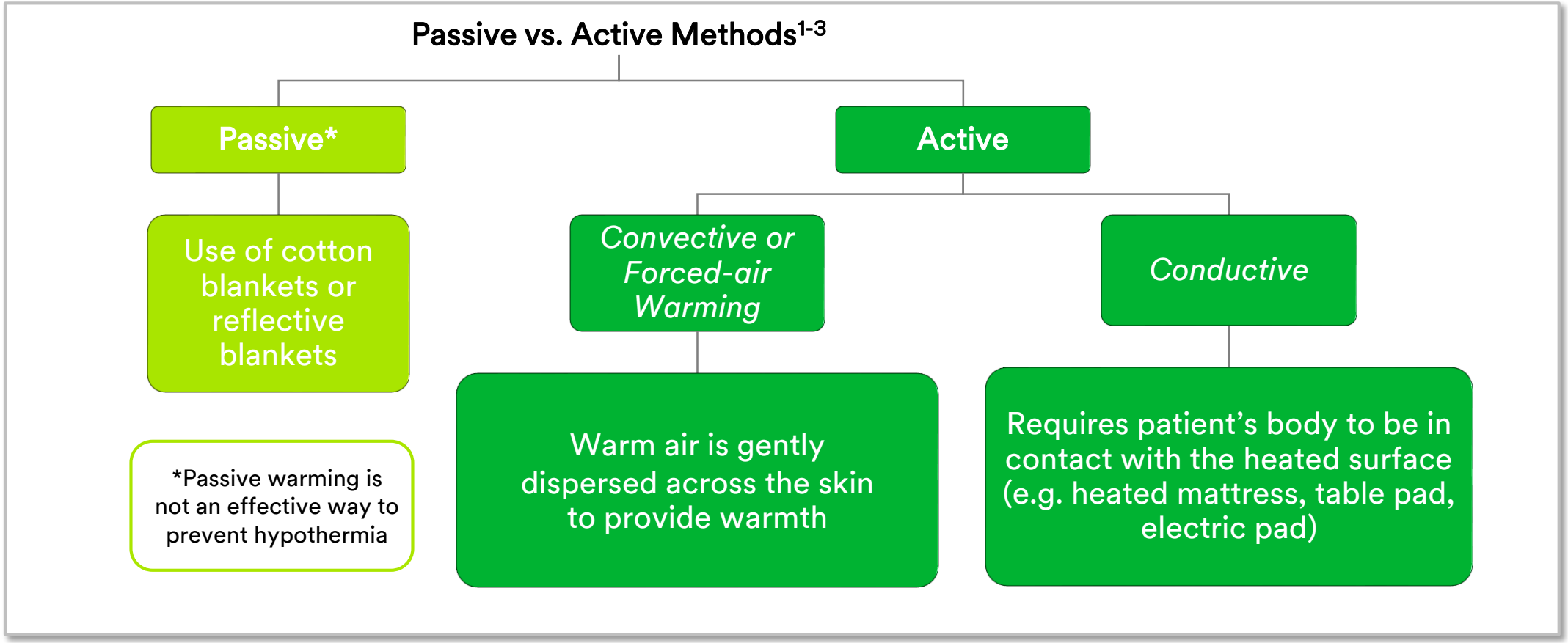
Estimated cost of managing SSI/per case[1,2]



The cost of SSIs can vary significantly based on the type and severity of the infection

[1]Hollenbeak CS. Infect Control Hosp Epidemiol. 2002 Apr;23(4):177-82. [2]Urban JA. Surg Infect (Larchmt). 2006;7 Suppl 1:S19-22.

Various measures are implemented to maintain patient normothermia and prevent hypothermia before, during and post-surgery[1-3]



1. Madrid E. The Cochrane Library. 2016. 2. Sessler DI, Lancet. 2016. 3. Sessler et al. Anesth Ananlg. 1993;77:73-77.

Guideline Development

What are Clinical Practice Guidelines?

"Systematically developed statements to assist practitioner and patient decisions about appropriate healthcare for specific clinical circumstances."[1]

- Based on review of the evidence[1,2]
- Evidence is then critiqued/appraised and scored[1,2]
- Rated based on quality of evidence related to that recommendation[1,2]
- Different, yet similar evidence appraisal models and tools exist
- Reviewed and updated at regular intervals[1,2]

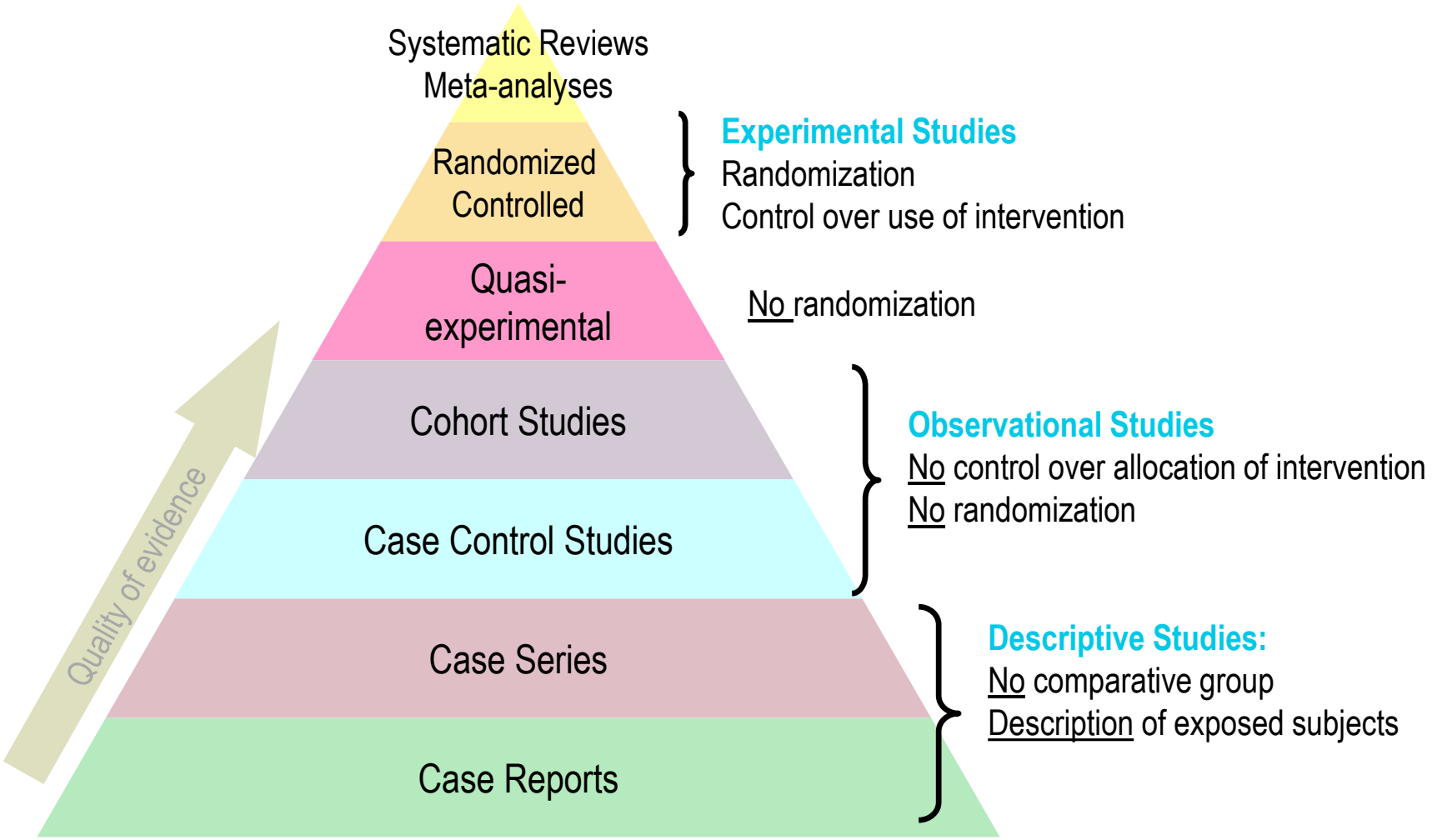
1. http://www.aornstandards.org/content/current. Accessed February 15, 2017
2. American Society of PeriAnesthesia Nurses. Clinical guideline for the prevention of unplanned perioperative hypothermia. *J Perianesth Nurs*. 2001;16:305-314.http://www.aspan.org/Portals/6/docs/ClinicalPractice/Guidelines/Normothermia_Guideline_12-10_JoPAN.pdf

How are Guidelines Developed?

- Librarian search for articles for a specific topic, identified databases, and date range.
- Evidence rating scales – evaluation of adequacy and sufficiency of research: usually indicated by levels based on type of study (i.e meta-analysis vs. descriptive study)[1,2]
- Collective evidence supporting each intervention is rated: usually indicated by levels or words like Strong Evidence, Moderate evidence, etc.[1,2]
- Clinical indication and risk vs. benefit is also assessed[1,2]

1. http://www.aornstandards.org/content/current. Accessed February 15, 2017
2. American Society of PeriAnesthesia Nurses. Clinical guideline for the prevention of unplanned perioperative hypothermia. *J Perianesth Nurs*. 2001;16:305-314.http://www.aspan.org/Portals/6/docs/ClinicalPractice/Guidelines/Normothermia_Guideline_12-10_JoPAN.pdf

Clinical Trial Designs – Hierarchy of Evidence



Example - AORN Guideline for Prevention of Unplanned Patient Hypothermia

- ❑ Recommendation I

The perioperative registered nurse (RN) should perform a pre-operative nursing assessment to determine the presence of factors that could contribute to unplanned hypothermia.

- ❑ Recommendation II

The patient's temperature should be measured and monitored in all phases of perioperative care.

- ❑ Recommendation III

In all phases of perioperative care, the perioperative RN should develop an individualized plan of care and implement the interventions chosen for prevention of unplanned hypothermia

- ❑ Recommendation IV

A quality improvement (QI)/management program should be in place to identify and respond to opportunities for improvement related to unplanned perioperative hypothermia.

- ❑ Recommendation V

Health care personnel should receive education about hypothermia as applicable to the person's job responsibilities.

http://www.aornstandards.org/content/current. Accessed February 15, 2017

Example - AORN

RECOMMENDATION (broad recommendation for optimal practice)

Recommendation II The patient's temperature should be measured and monitored in all phases of perioperative care.

Example - AORN

INTERVENTION (specific recommendations for treatment)

II.a. The method of temperature monitoring should be selected based on the requirements of the procedure (eg, accessibility of the route, invasiveness of the route, anesthesia type, anesthesia delivery method). Temperature may be measured using core temperature sites (eg, tympanic membrane [via thermistor], distal esophagus, cutaneous [via zero-heat-flux thermometry], nasopharynx, pulmonary artery) or "near-core" sites (eg, mouth, axilla, bladder, rectum, skin, tympanic membrane [via infrared sensor]).2,4,14,55–57 *[1: Strong Evidence]*

Example - AORN

ACTIVITIES (actions necessary to implement the intervention)

II.a.1. The same method of temperature measurement should be used throughout the perioperative period when clinically feasible. *[2: High Evidence]*

II.a.2. The selected temperature monitoring device should be calibrated according to the manufacturer's written instructions for use.51 *[2: High Evidence]*

Rating of collective evidence for each intervention

Guideline Review

Healthcare organizations around the world have published recommendations or guidelines emphasizing the importance of maintaining normothermia


Australian Commission on Safety and Quality in Healthcare


Guidelines for Perioperative Evaluation of the Brazilian Society of Cardiology


Canadian Patient Safety Institute


The German Society of Anaesthesiology and Intensive Care Medicine, Robert Koch Institute


Spanish Ministry of Science and Innovation


Swedish Association of Local Authorities and Regions


National Institute for Health and Clinical Excellence, Scottish Patient Safety Programme


Clinical Guideline for Nonpharmalogic Prevention of Perioperative Accidental Hypothermia


Anesthesia Guidelines to Prevent Unwanted Perioperative Hypothermia


American Association of Nurse Anesthetists, American Society of Anesthesiologists, American Society of PeriAnesthesia Nurses, Association of periOperative Registered Nurses, Association of Surgical Technologists, Centers for Disease Control and Prevention, Centers for Medicare & Medicaid Services, Institute for Healthcare Improvement, The Joint Commission

AORN

Preoperative warming

- A period of preoperative warming may be instituted as determined by the individual patient's needs
- The collective evidence conflicts in regard to the benefits of preoperative patient warming and the time frame required.
- The majority of the evidence, establishes the benefit of preoperative patient warming. However, some of the evidence indicates that there is not any benefit to preoperative warming.

Intraoperative warming

- Methods of warming (ie, active, passive, a combination of methods) should be chosen and implemented by the perioperative team after a collaborative discussion among the team members.
- The same method of temperature measurement should be used throughout the perioperative period when clinically feasible.

Postoperative Warming

- When hypothermia is identified on admission to the PACU, methods of warming (eg, forced-air warming, radiant warming devices, passive thermal measures, ambient room temperature at or above 24° C [75.2° F], warmed IV fluids, warmed oxygen) should be initiated.
- The collective evidence establishes the benefits of using warming methods in the PACU.

http://www.aornstandards.org/content/current. Accessed February 15, 2017

ASPAN

Preoperative warming

- An effective means of maintaining perioperative normothermia is prevention through prewarming.
- Consider preoperative warming to reduce the risk of intra/postoperative hypothermia
- Evidence suggests prewarming for a minimum of 30 minutes may reduce the risk of subsequent hypothermia

Intraoperative warming

- All patients should receive the following:
  -Limit skin exposure
  -Initiate passive warming
  -Maintain ambient room temperature from 20-25 C
- Patients undergoing a procedure with an anticipated anesthesia time greater than 30 minutes and/or who are hypothermic preoperatively and/or patients at risk for hypothermia or at increased risk for suffering its complications--Forced air warming should be implemented

Postoperative Warming

- If the patient is hypothermic, in addition to normothermic interventions, initiate
- active warming measures: Apply forced-air warming Consider adjuvant measures:
  - Warmed intravenous fluids
  - Humidified warm oxygen
- Assess temperature and thermal comfort level every 15 minutes until normothermia is achieved

American Society of PeriAnesthesia Nurses. Clinical guideline for the prevention of unplanned perioperative hypothermia. *J Perianesth Nurs*. 2001;16:305-314.http://www.aspan.org/Portals/6/docs/ClinicalPractice/Guidelines/Normothermia_Guideline_12-10_JoPAN.pdf

NICE

Preoperative warming

- Each patient should be assessed for their risk of inadvertent perioperative hypothermia and potential adverse consequences before transfer to the theatre suite.
- Undergoing combined general and regional anaesthesia:
  -If the patient's temperature is below 36.0°C, start active warming preoperatively on the ward or in the emergency department
- If the patient's temperature is 36.0°C or above, start active warming at least 30 minutes before induction of anaesthesia, unless this will delay emergency surgery.
- Maintain active warming throughout the intraoperative phase

Intraoperative warming

- On transfer to the theatre suite:
  active warming should be continued (or re-started as soon as possible
- Warm patients intraoperatively from induction of anaesthesia, using a forced-air warming device, if they are:
  -having anaesthesia for more than 30 minutes or
  -having anaesthesia for less than 30 minutes and are at higher risk of inadvertent perioperative hypothermia
- Consider a resistive heating mattress or resistive heating blanket if a forced-air warming device is unsuitable

National Institute for Health and Care Excellence. (2016). https://www.nice.org.uk/guidance/cg65/chapter/Recommendations#preoperative-phase. Retrieved on February 15, 2017

NICE

Postoperative Warming

- The patient's temperature should be measured and documented on admission to the recovery room and then every 15 minutes.
- Ward transfer should not be arranged unless the patient's temperature is 36.0°C or above.
- If the patient's temperature is below 36.0°C, they should be actively warmed using forced-air warming until they are discharged from the recovery room or until they are comfortably warm
- If the patient's temperature falls below 36.0°C while on the ward:
  they should be warmed using forced-air warming until they are comfortably warm
- Their temperature should be measured and documented at least every 30 minutes during warming.

National Institute for Health and Care Excellence. (2016). https://www.nice.org.uk/guidance/cg65/chapter/Recommendations#preoperative-phase. Retrieved on February 15, 2017

SHEA/IDSA Practice Recommendation

Strategies to Prevent Surgical Site Infections in Acute Care Hospitals: 2014 Update

- ❑ Maintain normothermia (temperature of 35.5C or more) during the perioperative period
- ❑ Randomized controlled trials have shown the benefits of both preoperative and intraoperative warming to reduce SSI rates and to reduce intraoperative blood loss.

Anderson DJ, Podgorny K, et al. Strategies to Prevent Surgical Site Infections in Acute Care Hospitals: 2014 Update. Infection Control and Hospital Epidemiology. 2014;35(6). http://www.jstor.org/stable/10.1086/676022. Accessed February 15, 2017

WHO Guidelines

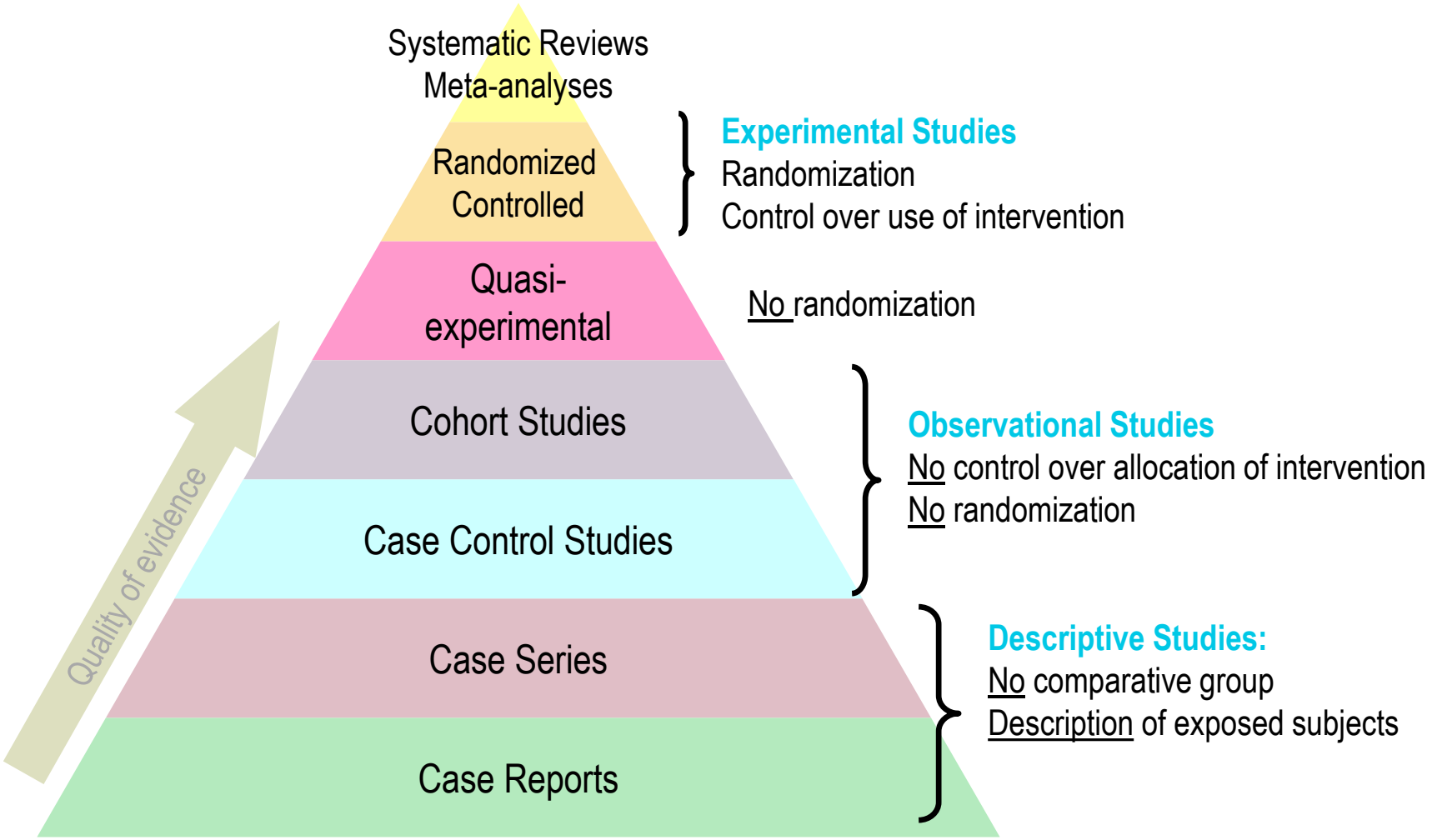
- The panel suggests the use of warming devices in the operating room and during the surgical procedure for patient body warming with the purpose of reducing SSI.

  (Conditional recommendation, moderate quality of evidence)

World Health Organization (2016).Global Guidelines for the prevention of surgical site infections. http://apps.who.int/iris/bitstream/10665/250680/1/9789241549882-eng.pdf?ua=1 retrieved February 15, 2017

Clinical Studies

Clinical Trial Designs – Hierarchy of Evidence



Prewarming Study

Effects of Prewarming Patients in the Outpatient Surgery Setting

- **Study Design**

  Randomized Control Trial (RCT). Patients (N=100) randomized to:

  - Forced-air warming (FAW – Treatment, N=50)
  - Cotton blankets (Control, N=50)

- **Objective**

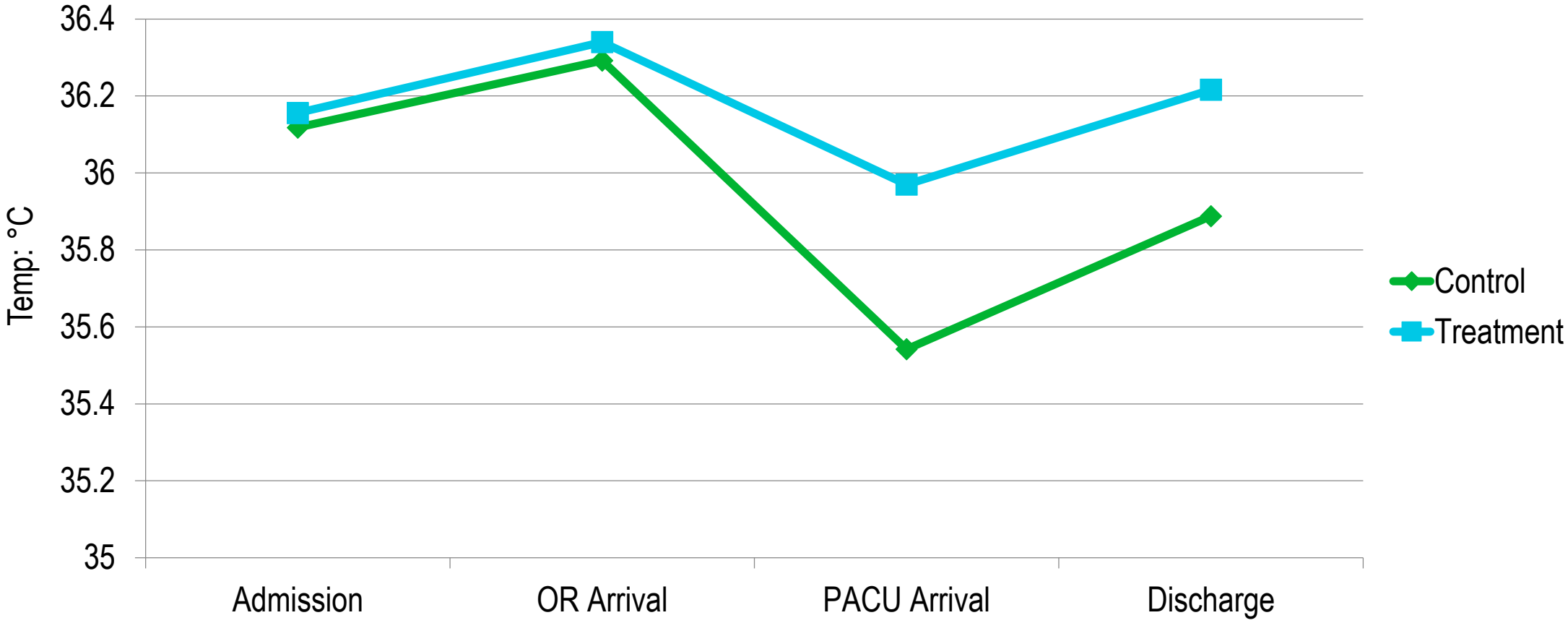
  Effect of **prewarming** on the patient temperature at arrival to PACU

Fossum S, Hays J, Henson MM. A Comparison Study on the Effects of Prewarming Patients in the Outpatient Surgery Setting. J Perianesth Nurs. 2002;16(3):187-194

Results

FAW is more effective than warmed cotton blankets in:

- achieving higher temperature post-op (p=0.000)
- more patients self reported thermal comfort (p=0.000)



Prewarming Study

Effect of Prewarming on Post-Induction Core Temperature and the Incidence of Inadvertent Perioperative Hypothermia in Patients Undergoing General Anesthesia

- **Study Design**
  - Elective spinal surgery patients (N=68) randomized to one of two groups:

    Prewarmed (n=31)

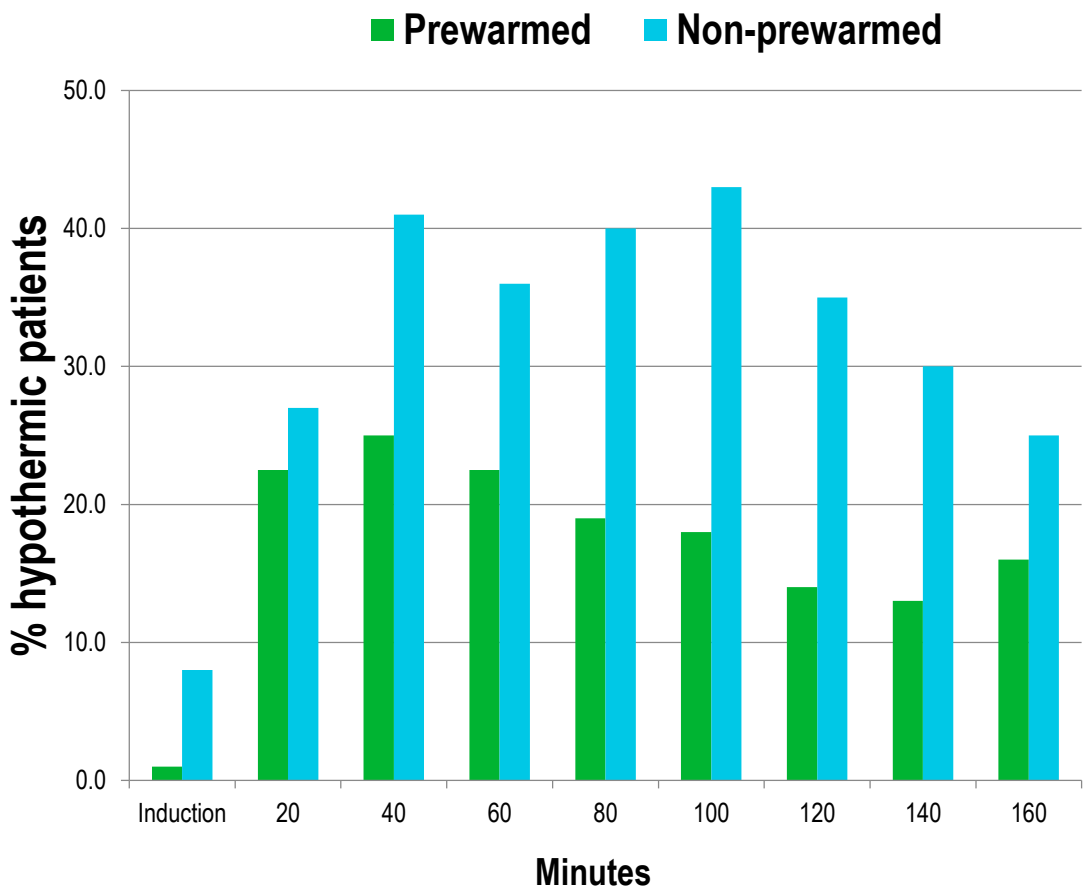
    38°C for 60 min preoperatively and warmed intraoperatively with the 3M™ Bair Hugger™ warming gown

    Intraop warming only (n=37)
- **Objective**
  - Efficacy of prewarming in preventing inadvertent perioperative hypothermia

Andrzejowski J, Hoyle J, Eapen G, Turnbull D. Effect of Prewarming on Post-Induction Core Temperature and the Incidence of Inadvertent Perioperative Hypothermia in Patients Undergoing General Anesthesia. Brit Journal of Anaesth. 2008;101(5):627-631.

Results

- **Prewarming** for 60 min with a forced-air warming gown resulted in:
  - Temperature maintained >36°C in 21 (68%) patients in the prewarmed group, compared with 16 (43%) patients in the control group (p=<0.05).
  - Significantly smaller decrease in mean core temp at 40, 60 and 80 min (p<0.05)



Prewarming Study

Perioperative warming with a thermal gown prevents maternal temperature loss during elective cesarean section. A randomized clinical trial

Study Design

- Prospective, randomized study
- 40 healthy pregnant women, greater then 37 weeks gestation scheduled for elective cesarean section
- Control group (no prewarming, warm blankets in OR) n= 20
- Gown group (30 mins forced air warming prior to spinal and during surgery) n=20

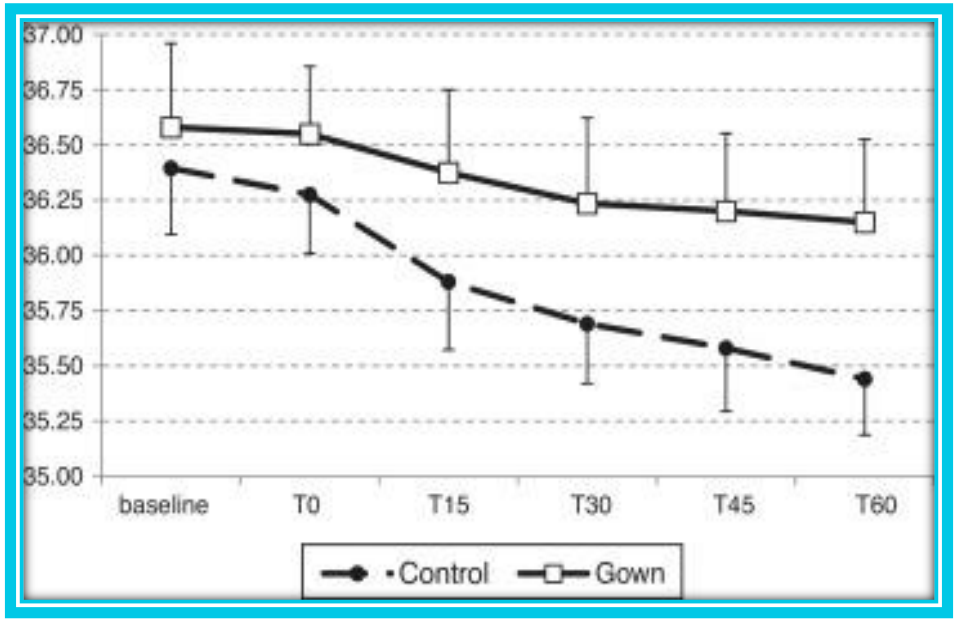
Gracco de Bernardis R. C., Siaulys M. M., Vieira J. E., Mathias L. A. S. T. Perioperative warming with a thermal gown prevents maternal temperature loss during elective cesarean section. A randomized clinical trial. Brazilian Journal of Anesthesiology. Sept-Oct 2016;66(5) p 451-455 http://dx.doi.org/10.1016/j.bjane.2014.12.007

Results

- At time zero, the no prewarmed group started off with lower temperatures than the prewarmed group (p=0.02), but was not statistically different
- Tympanic temperatures in the No prewarming group were significantly lower than the prewarmed group (P=<0.001)
- At 60 minutes the mean temp of the no prewarming group was 35.44°C and 36.15°C (P=<0.001)

Tympanic temperature

baseline to 60 min (mean ± SD). Whiskers, SD



Prewarming Study

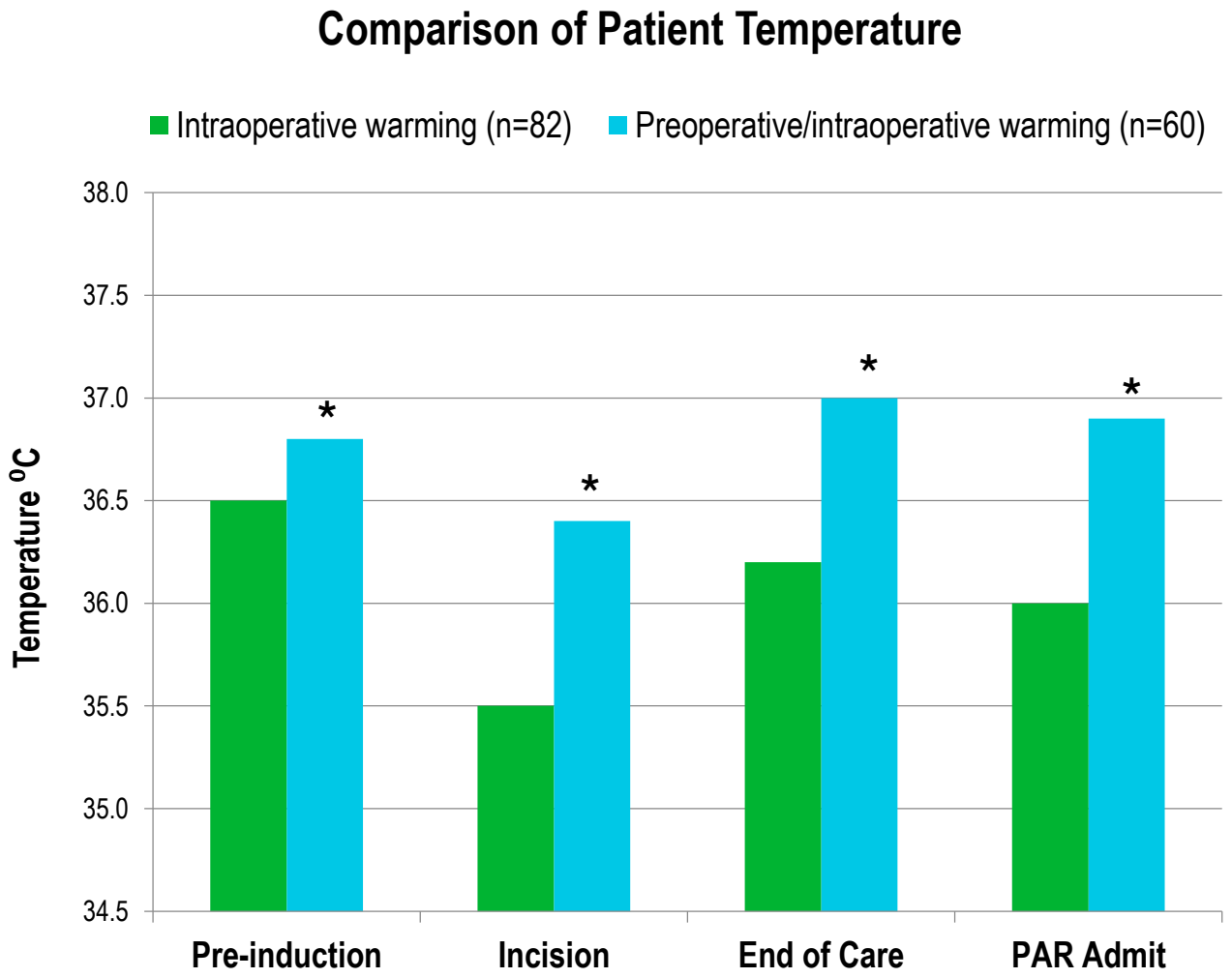
Impact of Preoperative Warming on Maintenance of Normothermia and Outcome after Colorectal Surgery

- **Study Design**
  - Phase 1: **Intraoperative warming** (FAW + Fluid warming) N=82
  - Phase 2: **Prewarming** (FAW gown + fluid warming) + Intraoperative warming N=59
  - OR room temperature maintained at 21° C
- **Outcomes Measured**
  - Primary outcome – incidence of admission to PACU with a temp < 36°C
  - Secondary outcome - complication rate during hospital stay
  - Temps taken at 4 time points: OR arrival, incision, end of surgery, and PACU arrival

Yilmaz M, Popwich D, Halverson A, Mullaghy E, McCarthy R. Impact of Preoperative Warming on Maintenance of Normothermia and Outcome after Colorectal Surgery. Anesth. 2008;109:A880.

Results

- Prewarmed group had a significantly higher percentage of normothermic patients on PACU admission **-95% vs. control 43% (p<0.01)**
- Prewarmed patients had a tendency to have fewer infections and spent less time in the hospital (LOS)



* Significantly different temperature between groups (p=0.05)

What’s the best practice?

What's the best practice?

Clinical Studies Patients who were prewarmed:	Guidelines and Recommendations
Had higher temperatures upon PACU arrival[1,4]	"If the patient's temperature is below 36°C, start active warming preoperatively on the ward or in the emergency department"[7]
Had higher temperatures throughout surgery[2,3,4]	"Consider prewarming before surgery because it may prevent hypothermia."[6]
Were less likely to experience hypothermia[1,2,3,4]	"A period of preoperative warming may be instituted as determined by the individual patient's needs"[5]

Summary

- Without active warming, the majority of patients will experience intraoperative hypothermia[1]
- The physiological effects of hypothermia, ranging from mild to severe, can have a significant impact on patient outcomes[1,2]
- Healthcare organizations around the world have published recommendations or guidelines emphasizing the importance of maintaining normothermia
- Prewarmed patients have higher temperatures throughout surgery and upon arrival to PACU[3,4,5,6]

1. Sessler DI. Lancet. 2016. 2. Matsukawa T, et al. Anesth. 1995. 3. Mahoney. AANA J. 1999 Apr;67(2):155-63. 4. Madrid E. The Cochrane Library. 2016.
2. Madrid E. The Cochrane Library. 2016.
3. Fossum S, Hays J, Henson MM. A Comparison Study on the Effects of Prewarming Patients in the Outpatient Surgery Setting. J Perianesth Nurs. 2002;16(3):187-194
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Thank you