Perioperative Hypothermia specifies that a preoperative patient management assessment should include:

- Identification of a patient’s risk factors for unplanned perioperative hypothermia
- Measurement of patient temperature on admission
- Determining patient’s thermal comfort level (ask the patients if they are cold)
- Assessment of other signs and symptoms of hypothermia (shivering, piloerection, and/or cold extremities)
Instituting preventive warming measures for patients who are normothermic. A variety of measures may be used, unless contraindicated. Passive insulation can include warmed blankets, socks, head covering, limited skin exposure, circulating water mattresses, and an increase in ambient temperature (a minimum of 20°C-24°C or 68°F-75°F).

Instituting active warming measures for patients who are hypothermic. Active warming is the application of a forced-air convection warming system. Appropriate passive insulation may also be applied, as well as increased ambient room temperature. Warmed IV fluids may also be considered.

During the intraoperative period, ASPAN recommends that a patient’s temperature should be monitored.
Recommended warming methods

Application of appropriate passive insulation, such as warm blankets, socks, head covering, limited skin exposure, and circulating water mattress

Increasing ambient room temperature. AORN (Association of periOperative Registered Nurses) Practice Guidelines for ambient room temperature should be followed

Institution of active warming: Apply forced-air warming system

Warming IV and irrigation fluids

Humidify and warm anesthetic gases
Inditherm patient warming mattress for the prevention of inadvertent hypothermia
• 2.5 million procedures per year involve anaesthetising for 30 minutes or longer.

• This anaesthesia carries a risk of inadvertent hypothermia

• 70% of patients undergoing routine surgery may be hypothermic on admission to the recovery room

• Active warming is associated with a reduction in surgical site infections of at least 25%
Inditherm mattress

The Inditherm mattress has the following features:

– flexible, carbon-based conductive polymer technology
– moulds to the patient’s shape
– low-voltage
– reusable
– control unit prevents overheating
– fabric: latex-free, nylon, non-microporous polyurethane coating
– Maintain patient core body temperature above 36°C

The Inditherm mattress can be used on its own or with other warming methods
The Inditherm patient warming mattress should be considered for use in patients undergoing operations that carry a risk of inadvertent hypothermia.
The layers of the Inditherm Patient warming mattress

- Retaining straps
- Sealed outer cover
- Flexible polymer heating surface
- Pressure relief pad
• No evidence of safety issues
• Quality of X-ray images is not affected by the Inditherm mattress
• The Inditherm mattress can be left on the operating table between patients
• Different mattress sizes available to suit different clinical situations
• Clean the Inditherm mattress the same way as a normal operating table mattress
• 2.5 million procedures per year involve anaesthetising for 30 minutes or longer.

• This anaesthesia carries a risk of inadvertent hypothermia

• 70% of patients undergoing routine surgery may be hypothermic on admission to the recovery room

• Active warming is associated with a reduction in surgical site infections of at least 25%
Inditherm mattress

The Inditherm mattress has the following features:

- flexible, carbon-based conductive polymer technology
- moulds to the patient’s shape
- low-voltage
- reusable
- control unit prevents overheating
- fabric: latex-free, nylon, non-microporous polyurethane coating
- Maintain patient core body temperature above 36°C

The Inditherm mattress can be used on its own or with other warming methods
The Inditherm patient warming mattress should be considered for use in patients undergoing operations that carry a risk of inadvertent hypothermia.
The layers of the Inditherm Patient warming mattress

- Retaining straps
- Sealed outer cover
- Flexible polymer heating surface
- Pressure relief pad
• No evidence of safety issues
• Quality of X-ray images is not affected by the Inditherm mattress
• The Inditherm mattress can be left on the operating table between patients
• Different mattress sizes available to suit different clinical situations
• Clean the Inditherm mattress the same way as a normal operating table mattress
WARMER
Warmer

- Importance of Warming Intravenous Fluids
- Conclusive evidence demonstrating the harmful effects of cold fluid infusion was provided by Boyan and Howland in 1961. In their study, infusion of 0.5 liter of cold blood reduced core temperature of anesthetized cancer patients by 0.5 to 1.0°C. When 3.0 liters or more of cold blood was administered, esophageal temperature decreased markedly and was associated with a high incidence of cardiac arrests (12 of 25 patients). When blood was warmed, the incidence of cardiac arrests in a matched group of patients with similar surgeries, blood loss, anesthesiologist, and surgeon was only 3 of 105 patients.
• The theoretical impact of infusing fluids on body temperature can be calculated as follows:

• Change in body temperature = Thermal stress of infused fluids/ (Weight \( \times \) Sp heat)

where:

• Thermal stress = temperature difference between core and infused fluids \( \times \) specific heat of infused fluid \( \times \) volume of fluid infused

• Weight = weight of patient in kilograms

• Sp heat = specific heat of the patient (0.83 kcal/L/°C)23,24
Methods of warming

- These include immersing coiled IV tubing in a warm water bath
- microwaving the bag of fluid to be infused
- adding heated saline to blood to be infused
- passing the IV tubing through a heating block or through a plastic tube warmed with forced air
- passing the IV tubing through a conductive surface interfaced with a countercurrent heated water bath
- magnetic induction
- prewarming fluids in a convection oven or in a microwave oven, and inline microwaving.
Ideal fluid warmer-
Characteristics

• The should be capable of safely delivering fluids and blood products at normothermia at both high and low flow rates.
• At high flows, the device should be able to detect air and automatically shut off to prevent accidental infusion of air.
• The ability of blood warmers to safely deliver normothermic fluids over a wide range of flows is limited by several factors,
  – including limited heat-transfer capability of materials such as plastic
  – limited surface area of the heat exchange mechanism
  – inadequate heat transfer of the exchange mechanism at high flow rates, erythrocyte damage,
  – heat loss after the IV tubing exits the warmer
Figure 4, A and B. Level 1 H-1000 warmer (Smiths Medical, London, UK). The device consists of a cylindrical aluminum heat exchanger mounted on the warming unit and heated by a countercurrent water bath as in Figure 1. After the fluid exits this first heat exchanger, it enters a 254-cm patient line in which heat loss is prevented by surrounding the central lumen with warmed water circulating in a countercurrent direction, similar to the Hotline device. There is a double pneumatic external compressor that when activated, automatically squeezes the intravenous fluid or blood bag to increase flow.
Figure 7.
Schematic of the Astotherm warmer (Stihler Electronic, Stuttgart, Germany). This device consists of intravenous tubing coiled around a circular heating element (dry heat technology).
Figure 9. Belmont FMS 2000 disposable (Belmont Instrument Corp., Bellerica, MA). The set consists of a 120-mL reservoir chamber, fluid-out detector, pump tubing, pressure chamber, recirculating line, and patient line. Total priming volume is 220 mL. There is redundant air detection, automatic air removal, and sensors to alert the operator when the system is out of fluid, or a line is obstructed. (From Smith CE, Kabbara A, Kramer RP, Gill I. A new IV fluid and blood warming system to prevent air embolism and compartment syndrome. *TraumaCare* 2001;11:78–82.)
Figure 10. Level 1 H-1200 with integrated air detector/clamp (Smiths Medical, London, UK). The device consists of a heater that warms water and circulates it through a pump and a heat-exchange segment with a central tube (1) for water flow as in Figure 1 (countercurrent heat exchange technology). On detection of air in the line, the flow of blood and crystalloid is automatically stopped (3), allowing for removal of air and restoration of flow. There are audible and visual alarms when air is detected. The use of ultrasonic air detection coupled with automatic shutoff is a significant safety improvement.
Fluid Blanket Warmer for Operating Theatres

- These warmers are used to control the temperature of patient blankets and vital irrigating fluids used in surgery. Irrigation fluids play a vital role in most operations as a cleaning agent for wounds or open surgery and must be kept at a specific temperature to ensure shock does not occur.
REFERENCE

• “Principles of Fluid and Blood Warming in Trauma” By Charles E. Smith, and Karl Wagner, Vol. 18, No. 1, 2008 International TraumaCare (ITACCS)