

Inadvertent perioperative hypothermia

The management of inadvertent perioperative
hypothermia in adults

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NICE clinical guideline 65

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Contents

Introduction	3
Patient-centred care	5
Key priorities for implementation	6
1 Guidance	9
1.1 Perioperative care	9
1.2 Preoperative phase	10
1.3 Intraoperative phase	11
1.4 Postoperative phase	12
2 Notes on the scope of the guidance	14
3 Implementation	15
4 Research recommendations	16
4.1 Preoperative insulation and warming	16
4.2 Comparison of intraoperative warming devices	16
4.3 Use of both preoperative and intraoperative warming	17
4.4 Temperature thresholds for preoperative warming	17
4.5 Effects of nutritional solutions	18
5 Other versions of this guideline	19
5.1 Full guideline	19
5.2 Information for the public	19
6 Related NICE guidance	20
7 Updating the guideline	21
Appendix A: The Guideline Development Group	22
Appendix B: The Guideline Review Panel	24
Appendix C: The algorithm	25
About this guideline	26

Introduction

Inadvertent perioperative hypothermia is a common but preventable complication of perioperative procedures, which is associated with poor outcomes for patients. Inadvertent perioperative hypothermia should be distinguished from the deliberate induction of hypothermia for medical reasons, which is not covered by this guideline.

In this guideline, hypothermia is defined as a patient core temperature of below 36.0°C. Hereafter, 'temperature' is used to denote core temperature. Adult surgical patients are at risk of developing hypothermia at any stage of the perioperative pathway. In the guideline, the perioperative pathway is divided into three phases: the preoperative phase is defined as the 1 hour before induction of anaesthesia (when the patient is prepared for surgery on the ward or in the emergency department), the intraoperative phase is defined as total anaesthesia time, and the postoperative phase is defined as the 24 hours after entry into the recovery area in the theatre suite (which will include transfer to and time spent on the ward). The phrase 'comfortably warm' is used in recommendations relating to both the preoperative and postoperative phases, and refers to the expected normal temperature range of adult patients (between 36.5°C and 37.5°C).

During the first 30 to 40 minutes of anaesthesia, a patient's temperature can drop to below 35.0°C. Reasons for this include loss of the behavioural response to cold and the impairment of thermoregulatory heat-preserving mechanisms under general or regional anaesthesia, anaesthesia-induced peripheral vasodilation (with associated heat loss), and the patient getting cold while waiting for surgery on the ward or in the emergency department.

It is important to prevent inadvertent perioperative hypothermia. Although there are several different types of patient warming devices available that can be used for prevention, the evidence for many of these was too limited for recommendations to be made, and further research in this area is required. There was sufficient evidence of clinical effectiveness and cost effectiveness for recommendations to be made on the use of forced air warming to prevent and treat perioperative hypothermia. The key priorities for implementation in this guideline provide strong direction for healthcare professionals in helping to prevent perioperative hypothermia in adults undergoing surgery.

NICE has published 'Inditherm patient warming mattress for the prevention of inadvertent hypothermia' ([NICE medical technology guidance 7](#)). The medical technology guidance does not supersede the guideline recommendations on pre- or perioperative warming. It also does not update the guideline with respect to the recommendation about forced air warming as a cost-effective use of resources. However, it does, for this product, update the recommendation for further research on the use of different warming devices. When considering new investment in warming devices, consideration should be given to whether use of the Inditherm patient warming mattress would be beneficial.

Patient-centred care

This guideline offers best practice advice on the care of the adult surgical population undergoing general, regional or combined anaesthesia.

Treatment and care should take into account patients' needs and preferences. People undergoing surgery should have the opportunity to make informed decisions about their care and treatment, in partnership with their healthcare professionals. If patients do not have the capacity to make decisions, healthcare professionals should follow the [Department of Health's advice on consent](#) and the [code of practice that accompanies the Mental Capacity Act](#). In Wales, healthcare professionals should follow [advice on consent from the Welsh Government](#).

Good communication between healthcare professionals and patients is essential. It should be supported by evidence-based written information tailored to the patient's needs. Treatment and care, and the information patients are given about it, should be culturally appropriate. It should also be accessible to people with additional needs such as physical, sensory or learning disabilities, and to people who do not speak or read English.

If the patient agrees, families and carers should have the opportunity to be involved in decisions about treatment and care.

Families and carers should also be given the information and support they need.

Key priorities for implementation

Throughout the guidance, 'temperature' is used to denote core temperature.

Perioperative care

- Patients (and their families and carers) should be informed that:
 - staying warm before surgery will lower the risk of postoperative complications
 - the hospital environment may be colder than their own home
 - they should bring additional clothing, such as a dressing gown, a vest, warm clothing and slippers, to help them keep comfortably warm
 - they should tell staff if they feel cold at any time during their hospital stay.
- When using any device to measure patient temperature, healthcare professionals should:
 - be aware of, and carry out, any adjustments that need to be made in order to obtain an estimate of core temperature from that recorded at the site of measurement
 - be aware of any such adjustments that are made automatically by the device used.

Preoperative phase

- Each patient should be assessed for their risk of inadvertent perioperative hypothermia and potential adverse consequences before transfer to the theatre suite. Patients should be managed as higher risk (see section 1.3.7) if any two of the following apply:
 - ASA grade II to V (the higher the grade, the greater the risk)^[1]
 - preoperative temperature below 36.0°C (and preoperative warming is not possible because of clinical urgency)
 - undergoing combined general and regional anaesthesia
 - undergoing major or intermediate surgery
 - at risk of cardiovascular complications.

- If the patient's temperature is below 36.0°C:
 - forced air warming should be started preoperatively on the ward or in the emergency department (unless there is a need to expedite surgery because of clinical urgency, for example bleeding or critical limb ischaemia)
 - forced air warming should be maintained throughout the intraoperative phase.

Intraoperative phase

- The patient's temperature should be measured and documented before induction of anaesthesia and then every 30 minutes until the end of surgery.
- Induction of anaesthesia should not begin unless the patient's temperature is 36.0°C or above (unless there is a need to expedite surgery because of clinical urgency, for example bleeding or critical limb ischaemia).
- Intravenous fluids (500 ml or more) and blood products should be warmed to 37°C using a fluid warming device.
- Patients who are at higher risk of inadvertent perioperative hypothermia (see section 1.2.1) and who are having anaesthesia for less than 30 minutes should be warmed intraoperatively from induction of anaesthesia using a forced air warming device.
- All patients who are having anaesthesia for longer than 30 minutes should be warmed intraoperatively from induction of anaesthesia using a forced air warming device.

Postoperative phase

- 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.

^[1] ASA = American Society of Anesthesiologists.

1 Guidance

The following guidance is based on the best available evidence. The [full guideline](#) gives details of the methods and the evidence used to develop the guidance.

Throughout the guidance 'temperature' is used to denote core temperature. The phrase 'comfortably warm' is used in recommendations relating to both the preoperative and postoperative phases, and refers to the expected normal temperature range of adult patients, which is between 36.5°C and 37.5°C.

1.1 Perioperative care

1.1.1 Patients (and their families and carers) should be informed that:

- staying warm before surgery will lower the risk of postoperative complications
- the hospital environment may be colder than their own home
- they should bring additional clothing, such as a dressing gown, a vest, warm clothing and slippers, to help them keep comfortably warm
- they should tell staff if they feel cold at any time during their hospital stay.

1.1.2 When using any temperature recording or warming device, healthcare professionals should:

- be trained in their use
- maintain them in accordance with manufacturers' and suppliers' instructions
- comply with local infection control policies.

1.1.3 When using any device to measure patient temperature, healthcare professionals should:

- be aware of, and carry out, any adjustments that need to be made in order to obtain an estimate of core temperature from that recorded at the site of measurement
- be aware of any such adjustments that are made automatically by the device used.

1.2 Preoperative phase

The preoperative phase is defined as the 1 hour before induction of anaesthesia, during which the patient is prepared for surgery on the ward or in the emergency department, including possible use of premedication.

- 1.2.1 Each patient should be assessed for their risk of inadvertent perioperative hypothermia and potential adverse consequences before transfer to the theatre suite. Patients should be managed as higher risk (see section 1.3.7) if any two of the following apply:
- ASA grade II to V (the higher the grade, the greater the risk)^[2]
 - preoperative temperature below 36.0°C (and preoperative warming is not possible because of clinical urgency)
 - undergoing combined general and regional anaesthesia
 - undergoing major or intermediate surgery
 - at risk of cardiovascular complications.
- 1.2.2 Healthcare professionals should ensure that patients are kept comfortably warm while waiting for surgery by giving them at least one cotton sheet plus two blankets, or a duvet.
- 1.2.3 Special care should be taken to keep patients comfortably warm when they are given premedication (for example, nefopam, tramadol, midazolam or opioids).
- 1.2.4 The patient's temperature should be measured and documented in the hour before they leave the ward or emergency department.
- 1.2.5 If the patient's temperature is below 36.0°C:
- forced air warming should be started preoperatively on the ward or in the emergency department (unless there is a need to expedite surgery because of clinical urgency, for example bleeding or critical limb ischaemia)

- forced air warming should be maintained throughout the intraoperative phase.

1.2.6 The patient's temperature should be 36.0°C or above before they are transferred from the ward or emergency department (unless there is a need to expedite surgery because of clinical urgency, for example bleeding or critical limb ischaemia).

1.2.7 On transfer to the theatre suite:

- the patient should be kept comfortably warm
- the patient should be encouraged to walk to theatre where appropriate.

1.3 Intraoperative phase

The intraoperative phase is defined as total anaesthesia time, from the first anaesthetic intervention through to patient transfer to the recovery area of the theatre suite.

1.3.1 The patient's temperature should be measured and documented before induction of anaesthesia and then every 30 minutes until the end of surgery.

1.3.2 Standard critical incident reporting should be considered for any patient arriving at the theatre suite with a temperature below 36.0°C.

1.3.3 Induction of anaesthesia should not begin unless the patient's temperature is 36.0°C or above (unless there is a need to expedite surgery because of clinical urgency, for example bleeding or critical limb ischaemia).

1.3.4 In the theatre suite:

- the ambient temperature should be at least 21°C while the patient is exposed
- once forced air warming is established, the ambient temperature may be reduced to allow better working conditions.
- using equipment to cool the surgical team should also be considered.

-
- 1.3.5 The patient should be adequately covered throughout the intraoperative phase to conserve heat, and exposed only during surgical preparation.
- 1.3.6 Intravenous fluids (500 ml or more) and blood products should be warmed to 37°C using a fluid warming device.
- 1.3.7 Patients who are at higher risk of inadvertent perioperative hypothermia (see section 1.2.1) and who are having anaesthesia for less than 30 minutes should be warmed intraoperatively from induction of anaesthesia using a forced air warming device.
- 1.3.8 All patients who are having anaesthesia for longer than 30 minutes should be warmed intraoperatively from induction of anaesthesia using a forced air warming device.
- 1.3.9 The temperature setting on forced air warming devices should be set at maximum and then adjusted to maintain a patient temperature of at least 36.5°C.
- 1.3.10 All irrigation fluids used intraoperatively should be warmed in a thermostatically controlled cabinet to a temperature of 38–40°C.

1.4 Postoperative phase

The postoperative phase is defined as the 24 hours after the patient has entered the recovery area of the theatre suite.

- 1.4.1 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.

1.4.2 Patients should be kept comfortably warm when back on the ward.

- Their temperature should be measured and documented on arrival at the ward.
- Their temperature should then be measured and documented as part of routine 4-hourly observations.
- They should be provided with at least one cotton sheet plus two blankets, or a duvet (see section 1.2.2).

1.4.3 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.

^[2] ASA = American Society of Anesthesiologists

2 Notes on the scope of the guidance

NICE guidelines are developed in accordance with a scope that defines what the guideline will and will not cover. The scope of this guideline is [available](#).

The guideline covers adults (age 18 years and over) undergoing elective or emergency surgery (including surgery for trauma), under general or regional (central neuraxial block) anaesthesia. Subgroups were considered, based on patient demographics, concurrent medication, duration of anaesthesia and surgery, and/or grade of surgery (see NICE clinical guideline 3 'Preoperative tests: the use of routine preoperative tests for elective surgery').

The guideline does not cover:

- children and young people under 18 years of age
- pregnant women
- patients who have been treated with therapeutic hypothermia
- patients undergoing operative procedures under local anaesthesia
- patients with severe head injuries resulting in impaired temperature control.

How this guideline was developed

NICE commissioned the National Collaborating Centre for Nursing and Supportive Care to develop this guideline. The Centre established a Guideline Development Group (see appendix A), which reviewed the evidence and developed the recommendations. An independent Guideline Review Panel oversaw the development of the guideline (see appendix B).

There is more information about [how NICE clinical guidelines are developed](#) on the NICE website. A booklet, 'How NICE clinical guidelines are developed: an overview for stakeholders, the public and the NHS' is [available](#).

3 Implementation

The Healthcare Commission assesses the performance of NHS organisations in meeting core and developmental standards set by the Department of Health in [Standards for better health](#).

Implementation of clinical guidelines forms part of the developmental standard D2. Core standard C5 says that national agreed guidance should be taken into account when NHS organisations are planning and delivering care.

NICE has developed [tools](#) to help organisations implement this guidance (listed below).

- Slides highlighting key messages for local discussion.
- Costing tools:
 - costing report to estimate the national savings and costs associated with implementation
 - costing template to estimate the local costs and savings involved.
- Implementation advice on how to put the guidance into practice and national initiatives that support this locally.
- Audit support for monitoring local practice.

4 Research recommendations

The Guideline Development Group has made the following recommendations for research, based on its review of evidence, to improve NICE guidance and patient care in the future.

4.1 Preoperative insulation and warming

Is thermal insulation or active warming applied preoperatively better than usual care in preventing perioperative hypothermia in patients undergoing short operations?

Why this is important

There is weak evidence demonstrating that the use of reflective hats and jackets and active warming devices preoperatively may reduce the incidence of hypothermia and its consequences. Large randomised controlled trials (RCTs) (with at least 100 patients in each arm) should be conducted to compare reflective hats and jackets and different active warming devices with usual care preoperatively in patients not at high risk of perioperative hypothermia having anaesthesia for less than 1 hour. All intravenous fluids given should be warmed to 37°C, but there should be no other warming during the intraoperative phase. Primary outcomes should be the incidence of hypothermia, and patient temperature intraoperatively (at 15, 30, 45 and 60 minutes) and in recovery. Adverse effects and numbers of patients with complications of hypothermia (for example, wound infections, morbid cardiac events) should be recorded.

4.2 Comparison of intraoperative warming devices

Are different active warming devices (for example, forced air warming devices, electric heating mattresses, electric heating pads) used intraoperatively equally effective in preventing inadvertent perioperative hypothermia?

Why this is important

Forced air warming has been shown to be cost effective compared with usual care. There is emerging evidence to suggest that electric heating mattresses, electric heating pads and heated water garments may be as effective as forced air warming; however, such evidence is currently insufficient for use of these devices to be recommended. Further large RCTs (with at least 100 patients in each arm, stratified by risk of hypothermia) are required to compare forced air

warming with alternative active warming devices in adults having surgery. All intravenous fluids given should be warmed to 37°C. Primary outcomes should be the incidence of hypothermia, and patient temperature intraoperatively (at 15, 30, 60 and 120 minutes) and in recovery. Intervention costs, adverse effects and numbers of patients with complications of hypothermia (for example, morbid cardiac events, wound infections) should be recorded.

4.3 Use of both preoperative and intraoperative warming

Does preoperative warming further reduce the incidence of perioperative hypothermia and its consequences in patients who are warmed intraoperatively?

Why this is important

There is insufficient evidence to show whether preoperative warming can further reduce the incidence of intraoperative hypothermia in patients who are actively warmed intraoperatively. Large RCTs (with at least 100 patients in each arm) should be carried out to compare warming begun preoperatively and continued intraoperatively with warming in the intraoperative phase only in adults undergoing surgery. This comparison should be repeated for several different active warming interventions (for example, forced air warming, electric heating mattresses). All intravenous fluids given should be warmed to 37°C. Primary outcomes should be incidence of hypothermia, and patient temperature intraoperatively (at 15, 30, 60 and 120 minutes) and in recovery. Patients should be stratified by anaesthesia duration. Adverse effects and numbers of patients with complications of hypothermia (for example, morbid cardiac events, wound infections) should be recorded.

4.4 Temperature thresholds for preoperative warming

What is the optimum temperature target when warming patients preoperatively?

Why this is important

Preoperative warming is intended to minimise the impact of redistribution hypothermia by reducing the temperature difference between the patient's core temperature and peripheral temperature. There is a lack of evidence for the optimum preoperative temperature for preventing intraoperative hypothermia. Large RCTs (with at least 100 patients in each arm) should be conducted in adults undergoing surgery to compare warming patients to 36.5°C and

37.0°C in the preoperative phase. Warming should be continued intraoperatively in all patients. All intravenous fluids given should be warmed to 37°C. Primary outcomes should be the incidence of hypothermia, and patient temperature intraoperatively (at 15, 30, 60 and 120 minutes) and in recovery. The duration of warming required to achieve the target preoperative temperature should be recorded. Adverse effects (including patient discomfort) and numbers of patients with complications of hypothermia (for example, morbid cardiac events, wound infection) should be recorded.

4.5 Effects of nutritional solutions

Does the infusion of nutritional solutions such as amino acids and fructose further reduce the incidence of inadvertent perioperative hypothermia in patients receiving intraoperative warming?

Why this is important

Limited evidence suggests that infusion of amino acids or fructose in the preoperative and intraoperative phases may prevent hypothermia. Such infusions may also have additional benefits in fasted patients. A large RCT (with at least 100 patients in each arm) comparing infusions of amino acids, fructose and saline should be conducted in adults undergoing surgery. These infusions should be started before the induction of anaesthesia and continued throughout the intraoperative phase. All patients should receive forced air warming intraoperatively and all intravenous fluids given should be warmed to 37°C. Primary outcomes should be the incidence of hypothermia, and patient temperature intraoperatively (at 15, 30, 60 and 120 minutes) and in recovery. Adverse effects and numbers of patients with complications of hypothermia (for example, morbid cardiac events, wound infections) should be recorded.

5 Other versions of this guideline

5.1 Full guideline

The full guideline, 'The management of inadvertent perioperative hypothermia in adults', contains details of the methods and evidence used to develop the guideline. It is published by the National Collaborating Centre for Nursing and Supportive Care, and is available from our [website](#).

5.2 Information for the public

NICE has produced [information for the public](#) explaining this guideline.

We encourage NHS and voluntary sector organisations to use text from this booklet information in their own information materials.

6 Related NICE guidance

Preoperative tests: the use of routine preoperative tests for elective surgery. [NICE clinical guideline 3](#) (2003).

7 Updating the guideline

NICE clinical guidelines are updated as needed so that recommendations take into account important new information. We check for new evidence 2 and 4 years after publication, to decide whether all or part of the guideline should be updated. If important new evidence is published at other times, we may decide to do a more rapid update of some recommendations.

Appendix A: The Guideline Development Group

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Appendix B: The Guideline Review Panel

The Guideline Review Panel is an independent panel that oversees the development of the guideline and takes responsibility for monitoring adherence to NICE guideline development processes. In particular, the panel ensures that stakeholder comments have been adequately considered and responded to. The panel includes members from the following perspectives: primary care, secondary care, lay, public health and industry.

Mr Peter J. Robb – Chair

Consultant Ear, Nose and Throat (ENT) Surgeon, Epsom General Hospital

Mrs Jill Freer

Director of Patient Services, NHS Warwickshire

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Appendix C: The algorithm

There is a care pathway for the management of perioperative hypothermia in adults on page 27 [full guidance](#).

About this guideline

NICE clinical guidelines are recommendations about the treatment and care of people with specific diseases and conditions in the NHS in England and Wales.

The guideline was developed by the National Collaborating Centre for Nursing and Supportive Care. [Responsibility for undertaking a review of this guidance at the designated review date has passed to the National Clinical Guidelines Centre for Acute and Chronic Conditions]. The Collaborating Centre worked with a group of healthcare professionals (including consultants, GPs and nurses), patients and carers, and technical staff, who reviewed the evidence and drafted the recommendations. The recommendations were finalised after public consultation.

The methods and processes for developing NICE clinical guidelines are described in [The guidelines manual](#).

We have produced [information for the public](#) explaining this guideline. Tools to help you put the guideline into practice and information about the evidence it is based on are also [available](#).

Changes after publication

January 2012: minor maintenance

October 2013: minor maintenance

Your responsibility

This guidance represents the view of NICE, which was arrived at after careful consideration of the evidence available. Healthcare professionals are expected to take it fully into account when exercising their clinical judgement. However, the guidance does not override the individual responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient, in consultation with the patient and/or guardian or carer, and informed by the summary of product characteristics of any drugs they are considering.

Implementation of this guidance is the responsibility of local commissioners and/or providers. Commissioners and providers are reminded that it is their responsibility to implement the guidance, in their local context, in light of their duties to avoid unlawful discrimination and to have

regard to promoting equality of opportunity. Nothing in this guidance should be interpreted in a way that would be inconsistent with compliance with those duties.

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