

Inadvertent perioperative hypothermia: the management of inadvertent perioperative hypothermia in adults

NICE guideline

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If you wish to comment on this version of the guideline, please be aware that all the supporting information and evidence is contained in the full version.

Contents

Introduction	3
Patient-centred care.....	4
Key priorities for implementation.....	5
1 Guidance	7
1.1 Preoperative phase	7
1.2 Intraoperative phase.....	9
1.3 Postoperative phase.....	10
2 Notes on the scope of the guidance	11
3 Implementation	12
4 Research recommendations.....	12
4.1 Thermal insulation and forced air warming.....	13
4.2 Forced air warming, electric heating mattress and electric heating pad	13
4.3 Phenylephrine, metaraminol and other alpha adrenergic agonists ..	14
4.4 Nutrition solutions	15
5 Other versions of this guideline.....	15
5.1 Full guideline	15
5.2 Quick reference guide.....	16
5.3 'Understanding NICE guidance'	16
6 Related NICE guidance	16
7 Updating the guideline	16
Appendix A: The Guideline Development Group	17
Appendix B: The Guideline Review Panel	19
Appendix C: The inadvertent perioperative hypothermia patient algorithm....	20

Introduction

Inadvertent perioperative hypothermia is a preventable complication of perioperative procedures. The guideline definition of hypothermia is a patient core temperature less than 36.0°C. Inadvertent perioperative hypothermia is a common occurrence, with adult surgical patients at risk of developing hypothermia at any stage of the perioperative pathway. 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). In preventing this adverse event, the guideline defines the preoperative period as 1 hour prior to induction of anaesthesia (when the patient is prepared for surgery on the ward/in the emergency department), the intraoperative period as total anaesthetic time, and the postoperative period as the 24 hours after entry into the theatre recovery area (which will include transfer to and time spent on the ward).

During the first 30 to 40 minutes of anaesthesia, a patient's core temperature can drop to less than 35°C. Reasons for this include the loss of the behavioural response to cold and the impairment of thermoregulatory heat-preserving mechanisms under general or regional anaesthesia, anaesthetic-induced peripheral vasodilation (with associated heat loss), and the patient getting cold while waiting for surgery on the ward or in the emergency department.

Why is it important to prevent inadvertent perioperative hypothermia?

Evidence synthesis demonstrates that it is both clinically and cost effective to warm patients who have a high risk of inadvertent perioperative hypothermia and an increased risk of a morbid cardiac event for all procedures, and to warm all other patients who have anaesthesia lasting longer than 30 minutes. Key priorities for implementation provide strong direction for healthcare professionals in optimising the adult surgical patient's perioperative journey.

The guideline will assume that prescribers will use a drug's summary of product characteristics to inform their decisions for individual patients.

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 guidelines – 'Reference guide to consent for examination or treatment' (2001) (available from www.dh.gov.uk). Healthcare professionals should also follow a code of practice accompanying the Mental Capacity Act (summary available from www.dca.gov.uk/menincap/bill-summary.htm).

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

The phrase 'comfortably warm' refers to the expected normal temperature range of adult patients, which is between 36.5°C and 37.5°C.

Preoperative phase

- Each patient prior to transfer to the theatre suite should be assessed for their risk of inadvertent perioperative hypothermia and potential adverse consequences. Patients with any two of the following should be managed as higher risk (see section 1.2.5):
 - ASA grade greater than I (the higher the grade, the greater the risk)
 - preoperative core temperature below 36.0°C
 - undergoing combined general and regional anaesthesia
 - undergoing major or intermediate surgery
 - at risk of cardiovascular complications (for example, age over 50 years).

[1.1.1]

- Patients and their 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
 - staff should be told if the patient feels cold at any time during their hospital stay. [1.1.2]
- If the patient's temperature is below 36.0°C:
 - forced air warming should be applied (unless there is a need to expedite surgery due to clinical urgency, for example bleeding or critical limb ischaemia)
 - forced air warming should be maintained throughout the intraoperative period. [1.1.6]

Intraoperative phase

- Healthcare professionals:
 - should measure and document the patient's temperature prior to induction of anaesthesia and every 30 minutes until the end of surgery
 - should not commence induction of anaesthesia unless the patient's temperature is above 36.0°C. **[1.2.2]**
- Healthcare professionals should ensure that intravenous fluids (500 ml or more) and blood products are warmed to 37°C using a fluid warming device. **[1.2.3]**
- Patients who are having anaesthesia for less than 30 minutes and who are at higher risk of inadvertent perioperative hypothermia (see section 1.1.1) should be warmed intraoperatively using a forced air warming device (minimum setting 38°C) from induction of anaesthesia. **[1.2.5]**
- All patients having anaesthesia for longer than 30 minutes should be warmed intraoperatively using a forced air warming device (minimum setting 38°C) from induction of anaesthesia. **[1.2.6]**

Postoperative phase

- The patient's temperature should be measured and documented on admission to the recovery room and then at 15-minute intervals.
 - Ward transfer can be arranged once the patient's temperature is above 36.0°C.
 - If their temperature is below 36.0°C, the patient should be actively warmed to near 36.5°C using forced air warming. **[1.3.1]**

1 Guidance

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

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 *Preoperative phase*

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

1.1.1 Each patient prior to transfer to the theatre suite should be assessed for their risk of inadvertent perioperative hypothermia and potential adverse consequences. Patients with any two of the following should be managed as higher risk (see section 1.2.5):

- ASA grade greater than I (the higher the grade, the greater the risk)
- preoperative core temperature below 36.0°C
- undergoing combined general and regional anaesthesia
- undergoing major or intermediate surgery
- at risk of cardiovascular complications (for example, age over 50 years).

1.1.2 Patients and their 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

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- staff should be told if the patient feels cold at any time during their hospital stay.
- 1.1.3 Healthcare professionals should ensure that patients are kept comfortably warm while waiting for surgery by providing all patients with at least one cotton sheet plus two blankets, or alternatively a duvet.
- 1.1.4 Healthcare professionals should take special care to keep patients comfortably warm when they are given premedication (for example, benzodiazepines such as midazolam and opioids).
- 1.1.5 The patient's preoperative temperature should be measured and documented in the hour prior to them leaving the ward or emergency department.
- 1.1.6 If the patient's temperature is below 36.0°C:
- forced air warming should be applied (unless there is a need to expedite surgery due to clinical urgency, for example bleeding or critical limb ischaemia)
 - forced air warming should be maintained throughout the intraoperative period.
- 1.1.7 The patient's temperature should be above 36.0°C prior to transfer from the ward or emergency department.
- 1.1.8 On transfer to the theatre suite:
- the patient should be kept comfortably warm
 - the patient should be encouraged to walk where appropriate.

1.2 *Intraoperative phase*

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

1.2.1 The theatre suite temperature should be at least 21°C. In order to maintain comfortable working conditions for the scrubbed surgical team, consideration should be given to using equipment to cool the team, rather than reducing the operating theatre temperature.

1.2.2 Healthcare professionals:

- should measure and document the patient's temperature prior to induction of anaesthesia and every 30 minutes until the end of surgery
- should not commence induction of anaesthesia unless the patient's temperature is above 36.0°C.

1.2.3 Healthcare professionals should ensure that intravenous fluids (500 ml or more) and blood products are warmed to 37°C using a fluid warming device.

1.2.4 In order to conserve heat, patients should be adequately covered throughout the intraoperative phase, being exposed only during surgical preparation.

1.2.5 Patients who are having anaesthesia for less than 30 minutes and who are at higher risk of inadvertent perioperative hypothermia (see section 1.1.1) should be warmed intraoperatively using a forced air warming device (minimum setting 38°C) from induction of anaesthesia.

1.2.6 All patients having anaesthesia for longer than 30 minutes should be warmed intraoperatively using a forced air warming device (minimum setting 38°C) from induction of anaesthesia.

- 1.2.7 The temperature setting on forced air warming devices should be set at maximum and then adjusted with the aim of maintaining a patient core temperature of at least 36.5°C.
- 1.2.8 All irrigation fluids used intraoperatively should be warmed in a thermostatically controlled cabinet (38–40°C).
- 1.2.9 When using forced air warming and fluid warming devices:
- they should be used and maintained in accordance with manufacturers' and suppliers' instructions
 - local infection control policies should be complied with.

1.3 *Postoperative phase*

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

- 1.3.1 The patient's temperature should be measured and documented on admission to the recovery room and then at 15-minute intervals.
- Ward transfer can be arranged once the patient's temperature is above 36.0°C.
 - If their temperature is below 36.0°C, the patient should be actively warmed to near 36.5°C using forced air warming.
- 1.3.2 Patients should be kept comfortably warm when back on the ward:
- their temperature should be measured and documented on arrival at the ward
 - temperature should be re-measured as part of routine 4-hourly observations
 - they should be provided with at least one cotton sheet plus two blankets, or alternatively a duvet (see section 1.1.3).

1.3.3 If the patient's temperature falls below 36.0°C:

- they should be warmed using forced air warming until they are comfortably warm
- their temperature should be monitored at least every 30 minutes during warming.

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 from www.nice.org.uk/page.aspx?o=374428

The guideline covers adults (age 18 years and over) undergoing elective and emergency surgery (including surgery for trauma), under general or regional (central neuraxial block) anaesthesia. Subgroups will be 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. 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 in the booklet: 'The guideline development process: an overview for stakeholders, the public and the NHS' (third edition, published April 2007), which is available from www.nice.org.uk/guidelinesprocess or by telephoning 0870 1555 455 (quote reference N1233).

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', issued in July 2004. 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). These are available on our website (www.nice.org.uk/CGXXX).

[NICE to amend list as needed at time of publication]

- 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 criteria to monitor 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 *Thermal insulation and forced air warming*

Do thermal insulation methods (especially reflective blankets and reflective hats and jackets) and forced air warming prevent hypothermia in short operations with total anaesthesia time up to 1 hour (actual duration recorded)?

Why this is important

There is insufficient evidence for short operations (total anaesthesia time less than 30 minutes). Review evidence (30 minutes) has been extrapolated from longer operative measurements. There is some evidence from poor quality/small studies demonstrating that reflective hats and jackets preoperatively and reflective blankets preoperatively and intraoperatively improve patient temperatures at 30 minutes. This needs investigation for comparative effects in different phases. A large five-armed randomised trial is proposed to compare the following: reflective blankets preoperatively and intraoperatively; reflective hats and jackets preoperatively only; reflective hats and jackets preoperatively and reflective blanket intraoperatively; reflective hats and jackets preoperatively plus forced air warming intraoperatively; forced air warming intraoperatively only. All intravenous fluids given should be warmed to 37°C. Participants should be adults undergoing surgery under general anaesthesia. Primary outcomes should be the incidence of hypothermia and patient temperatures at 15, 30, 45 and 60 minutes of anaesthesia and in recovery.

4.2 *Forced air warming, electric heating mattress and electric heating pad*

Are forced air warming devices, electric heating mattress and electric heating pad equally effective in preventing inadvertent perioperative hypothermia?

Why this is important

One small trial (conference abstract 2007) suggests electric heating mattress and forced air warming are equally effective in preventing hypothermia. A larger trial (2007) reports similar efficacy comparing forced air warming and electric pad. Electric heating pad or mattress maybe more cost effective, determined by a large randomised trial comparing electric heating mattress,

electric heating pad and forced air warming used intraoperatively. All intravenous fluids given should be warmed to 37°C. Participants should be adults undergoing surgery under general anaesthesia. Stratification should be total anaesthesia duration: short (less than 30 minutes), medium (30 minutes to 1 hour), moderate (1 to 2 hours) or long (more than 2 hours). Analysis should be intention to treat. Primary outcome should be incidence of hypothermia and patient temperatures recorded at 15, 30, 45, 60 and 120 minutes of anaesthesia and in recovery. Adverse effects and complications (for example, morbid cardiac events) of hypothermia should be recorded.

4.3 *Phenylephrine, metaraminol and other alpha adrenergic agonists*

Are phenylephrine, metaraminol and other alpha adrenergic agonists, in combination with forced air warming and warmed fluids, effective in the prevention of inadvertent perioperative hypothermia?

Why this is important

Evidence is limited, but one small study suggested that phenylephrine (given as an infusion at the start of anaesthesia) had a large significant effect on core temperature intraoperatively. Clinicians on the GDG believe that vasoconstrictors like phenylephrine and metaraminol may prevent hypothermia, with these drugs given to augment other warming mechanisms (started at induction of anaesthesia). All intravenous fluids given should be warmed to 37°C. A large randomised trial is proposed, comparing phenylephrine, metaraminol and placebo. Participants should be adults undergoing surgery under general anaesthesia. Analysis should be intention to treat. Primary outcomes should be the incidence of hypothermia and patient temperatures at 15, 30, 45, 60 and 120 minutes of anaesthesia and in recovery. Adverse effects and numbers of patients with complications (for example morbid cardiac events) of hypothermia should be recorded.

4.4 *Nutrition solutions*

Are nutritional solutions such as amino acids and fructose, in combination with forced air warming and warmed fluids, effective in the prevention of inadvertent perioperative hypothermia?

Why this is important

Limited evidence suggests that amino acids or fructose in the preoperative and intraoperative phases may prevent hypothermia. The adjunctive effect of these solutions to other warming mechanisms should be investigated, together with other potential benefits such as healing from protein synthesis and general well being in fasted patients. These infusions should be commenced prior to induction of anaesthesia and continued throughout the intraoperative period. A large randomised trial is proposed, comparing infusions of amino acids, fructose and saline, given to augment forced air warming. All intravenous fluids given should be warmed to 37°C. Participants should be adults undergoing surgery under general anaesthesia. Analysis should be intention to treat. Primary outcomes should be the incidence of hypothermia and patient temperatures at 15, 30, 45, 60 and 120 minutes of anaesthesia and in recovery. Adverse effects and numbers of patients with complications (for example morbid cardiac events) of hypothermia 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 [NCC website details to be added], our website (www.nice.org.uk/CGXXXfullguideline) and the National Library for Health (www.nlh.nhs.uk). **[Note: these details will apply to the published full guideline.]**

5.2 Quick reference guide

A quick reference guide for healthcare professionals is available from www.nice.org.uk/CGXXXquickrefguide

For printed copies, phone the NHS Response Line on 0870 1555 455 (quote reference number N1XXX). **[Note: these details will apply when the guideline is published.]**

5.3 'Understanding NICE guidance'

Information for patients and carers ('Understanding NICE guidance') is available from www.nice.org.uk/CGXXXpublicinfo

For printed copies, phone the NHS Response Line on 0870 1555 455 (quote reference number N1XXX). **[Note: these details will apply when the guideline is published.]**

6 Related NICE guidance

Published

Preoperative tests: the use of routine preoperative tests for elective surgery. NICE clinical guideline 3 (2003). Available from www.nice.org.uk/CG003

Four commonly used methods to increase physical activity: brief interventions in primary care, exercise referral schemes, pedometers and community-based exercise programmes for walking and cycling. NICE public health intervention guidance 2 (2006). Available from www.nice.org.uk/PHI002

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.

[NICE to add]

[Name; style = Unnumbered bold heading]

[job title and location; style = NICE normal]

Appendix C: The inadvertent perioperative hypothermia (IPH) patient algorithm

