Hypothermia: prevention and management in adults having surgery

NICE guideline: short version

Draft for consultation, September 2016

This guideline covers preventing and managing inadvertent hypothermia in adults having surgery. Inadvertent hypothermia is a common complication of surgery and is associated with poor outcomes for patients. This guideline offers advice on assessing patients' risk of hypothermia, measuring and monitoring temperature, and devices for keeping patients warm before, during and after surgery. The guideline does not cover deliberate induction of hypothermia for medical reasons.

Who is it for?

- Healthcare professionals
- Adults having surgery, their families and carers

This guideline will update NICE guideline CG65 (published April 2008).

We have added new recommendations on measuring temperature, warming patients before induction of anaesthesia and warming patients after induction of anaesthesia.

You are invited to comment on the new recommendations in this guideline. These are marked as **[new 2016].**

You are also invited to comment on recommendations that NICE proposes to delete from the 2008 guideline. These are shown in recommendations that have been deleted or changed.

We have not updated recommendations shaded in grey, and cannot accept comments on them. In some cases, we have made minor wording changes for

clarification.

See Update information for a full explanation of what is being updated.

This version of the guideline contains the draft recommendations, context and recommendations for research. The supporting information and evidence for the 2016 recommendations is contained in the addendum. Evidence for the 2008 recommendations is in the full version of the 2008 guideline.

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Recommendations

People have the right to be involved in discussions and make informed decisions about their care, as described in your care.

Making decisions using NICE guidelines explains how we use words to show the strength (or certainty) of our recommendations, and has information about prescribing medicines (including off-label use), professional guidelines, standards and laws (including on consent and mental capacity), and safeguarding.

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. **[2008]**

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. **[2008]**

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. **[2008]**

1.1.4 Measure the patient's core temperature directly, using 1 of the following sites and basing the choice of site on its suitability for the patient, the type of surgery and the anaesthetic:

- bladder
- oesophagus
- pulmonary artery catheter. **[new 2016]**

1.1.5 If direct core temperature measurement is not suitable, assess core temperature indirectly, using a site or device that produces a measurement accurate to within 0.5ºC of the true core temperature. At the time of consultation these are:

- deep forehead
- infrared temporal
- infrared tympanic
- rectal
- sublingual
- thermocouple forehead with a +2ºC correction factor. **[new 2016]**

1.1.6 Do not use any site or device to indirectly assess core temperature in adults having surgery that has not been shown in research studies to produce a measurement accurate to within 0.5ºC of true core temperature. **[new 2016]**

1.2 Preoperative phase

The preoperative phase is defined as the 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 recommendation 1.3.7) if any two of the following apply:

- American Society of Anesthesiologists (ASA) grade II to V (the higher the grade, the greater the risk)
- 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. **[2008]**

1.2.2 Offer active warming for at least 30 minutes before induction of anaesthesia to all patients having general anaesthesia or central neural blockade for surgery, unless this will delay emergency surgery. **[new 2016]**

1.2.3 Pay particular attention to the comfort of patients with communication difficulties during the preoperative phase. **[new 2016]**

1.2.4 Special care should be taken to keep patients comfortably warm when they are given premedication (for example, nefopam, tramadol, midazolam or opioids). **[2008]**

1.2.5 The patient's temperature should be measured and documented in the hour before they leave the ward or emergency department. **[2008]**

1.2.6 If the patient's temperature is below 36.0°C:

- active 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)
- active warming should be maintained throughout the intraoperative phase. **[2008, amended 2016]**

1.2.7 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). **[2008]**

1.2.8 On transfer to the theatre suite:

- the patient should be kept comfortably warm
- the patient should be encouraged to walk to theatre where appropriate. **[2008]**

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. **[2008]**

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. **[2008]**

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). **[2008]**

1.3.4 In the theatre suite:

- the ambient temperature should be at least 21°C while the patient is exposed
- once active 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. **[2008, amended 2016]**

1.3.5 The patient should be adequately covered throughout the intraoperative phase to conserve heat, and exposed only during surgical preparation. **[2008]**

1.3.6 Intravenous fluids (500 ml or more) and blood products should be warmed to 37°C using a fluid warming device. **[2008]**

1.3.7 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 (see recommendation 1.2.1).

Consider a resistive heating mattress or resistive heating blanket if a forced air warming device is unsuitable. **[new 2016]**

1.3.8 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. **[2008]**

1.3.9 All irrigation fluids used intraoperatively should be warmed in a thermostatically controlled cabinet to a temperature of 38–40°C. **[2008]**

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. **[2008]**

- 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**. [2008]**

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. **[2008]**

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. **[2008]**

Putting this guideline into practice

NICE has produced tools and resources to help you put this guideline into practice.

[Optional paragraph if issues raised] Some issues were highlighted that might need specific thought when implementing the recommendations. These were raised during the development of this guideline. They are:

- [add any issues specific to guideline here]
- [Use 'Bullet left 1 last' style for the final item in this list.]

Putting recommendations into practice can take time. How long may vary from guideline to guideline, and depends on how much change in practice or services is needed. Implementing change is most effective when aligned with local priorities.

Changes recommended for clinical practice that can be done quickly – like changes in prescribing practice – should be shared quickly. This is because healthcare professionals should use guidelines to guide their work – as is required by professional regulating bodies such as the General Medical and Nursing and Midwifery Councils.

Changes should be implemented as soon as possible, unless there is a good reason for not doing so (for example, if it would be better value for money if a package of recommendations were all implemented at once).

Different organisations may need different approaches to implementation, depending on their size and function. Sometimes individual practitioners may be able to respond to recommendations to improve their practice more quickly than large organisations

Here are some pointers to help put NICE guidelines into practice:

1. **Raise awareness** through routine communication channels, such as email or newsletters, regular meetings, internal staff briefings and other communications with all relevant partner organisations. Identify things staff can include in their own practice straight away.

2. **Identify a lead** with an interest in the topic to champion the guideline and motivate others to support its use and make service changes, and to find out any significant issues locally.

3. **Carry out a baseline assessment** against the recommendations to find whether there are gaps in current service provision.

4. **Think about what data you need to measure improvement** and plan how you will collect it. You may want to work with other health and social care organisations and specialist groups to compare current practice with the recommendations. This may also help identify local issues that will slow or prevent implementation.

5. **Develop an action plan**, with the steps needed to put the guideline into practice, and make sure it is ready as soon as possible. Big, complex changes may take longer to implement, but some may be quick and easy to do. An action plan will help in both cases.

6. **For very big changes** include milestones and a business case, which will set out additional costs, savings and possible areas for disinvestment. A small project group could develop the action plan. The group might include the guideline champion, a senior organisational sponsor, staff involved in the associated services, finance and information professionals.

7. **Implement the action plan** with oversight from the lead and the project group. Big projects may also need project management support.

8. **Review and monitor** how well the guideline is being implemented through the project group. Share progress with those involved in making improvements, as well as relevant boards and local partners.

NICE provides a comprehensive programme of support and resources to maximise uptake and use of evidence and guidance. See our into practice pages for more information.

Also see Leng G, Moore V, Abraham S, editors (2014) Achieving high quality care – practical experience from NICE. Chichester: Wiley.

Context

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 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.

In 2016 we updated the guideline to take account of new evidence on active warming devices. We also added new recommendations on the site and method of measuring temperature, which had been identified as an area where guidance would be clinically useful.

More information

To find out what NICE has said on topics related to this guideline, see our web page on surgical care.

Recommendations for research

The guideline committee has made the following recommendations for research.

As part of the 2016 update, the standing committee made an additional research recommendation on combined methods of intraoperative active warming compared with a single method, and removed 3 research recommendations, on preoperative insulation and warming, comparison of intraoperative warming devices, and use of both preoperative and intraoperative warming. Details can be found in the addendum.

1 Combined methods of intraoperative active warming compared with a single method

What is the clinical and cost effectiveness of combined methods of intraoperative active warming compared with a single method in preventing inadvertent perioperative hypothermia?

Why this is important

A combination of active warming devices, such as forced air warming together with a resistive heating mattress, is usually used to warm patients during surgery. However, there is not enough evidence to show whether this is more clinically effective than a single active warming device, such forced air warming on its own. Large randomised controlled trials with at least 100 patients in each arm should be carried out to compare combined methods of intraoperative active warming (such as forced air warming together with a resistive heating mattress, or a resistive heating mattress together with a resistive heating blanket) with a single method of active warming (such as forced air warming). All intravenous fluids should be warmed to 37°C. Primary outcomes should be core temperature at the end of surgery and incidence of hypothermia. Patients should be stratified by anaesthesia duration and type of surgery. Adverse effects and numbers of patients with complications of hypothermia (for example, morbid cardiac events or wound infections) should be recorded**. [new 2016]**

2 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. **[2008]**

3 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. **[2008]**

Update information

September 2016

New recommendations have been added on measuring temperature, warming patients before induction of anaesthesia and warming patients after induction of anaesthesia. These are marked as **[new 2016].**

NICE proposes to delete some recommendations from the 2008 guideline, because either the evidence has been reviewed and the recommendations have been updated, or NICE has updated other relevant guidance and has replaced the original recommendations. Recommendations that have been deleted sets out these recommendations and includes details of replacement recommendations. Where there is no replacement recommendation, an explanation for the proposed deletion is given.

Where recommendations are shaded in grey and end **[2008]**, the evidence has not been reviewed since the original guideline.

Where recommendations are shaded in grey and end **[2008, amended 2016]**, the evidence has not been reviewed but changes have been made to the recommendation wording that change the meaning (for example, because of equalities duties or a change in the availability of medicines, or incorporated guidance has been updated). These changes are marked with yellow shading, and explanations of the reasons for the changes are given in 'Recommendations that have been deleted or changed' for information.

See also the original NICE guideline and supporting documents.

Recommendations that have been deleted or changed

Recommendations that have been deleted

Recommendation in 2008 guideline	Comment
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. [1.2.2]	Replaced by: Offer active warming for at least 30 minutes before induction of anaesthesia to all patients having general anaesthesia or central neural blockade for surgery. **[new 2016]** [1.2.2]
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. [1.3.7]	Replaced by: Warm patients intraoperatively from induction of anaesthesia, using a forced air warming device or a resistive heating blanket, 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 (see recommendation 1.2.1). Consider a resistive heating mattress or resistive heating blanket if a forced air warming device is unsuitable. **[new 2016]** [1.3.7]
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. [1.3.8].	Replaced by: Warm patients intraoperatively from induction of anaesthesia, using a forced air warming device or a resistive heating blanket, 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 (see recommendation 1.2.1). Consider a resistive heating mattress or resistive heating blanket if a forced air warming device is unsuitable. **[new 2016]** [1.3.7]

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Amended recommendation wording (change to meaning)

Recommendation in 2008 guideline	Recommendation in current guideline	Reason for change
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. [1.2.5]	If the patient's temperature is below 36.0°C: • active 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) • active warming should be maintained throughout the intraoperative phase. **[2008]** [1.2.6]	'Forced air warming' has been amended to 'active warming' to include other types of active warming.
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. [1.3.4]	1.3.4 In the theatre suite: • the ambient temperature should be at least 21°C while the patient is exposed • once active 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. **[2008]** [1.3.4]	'Forced air warming' has been amended to 'active warming' to include other types of active warming.

Appendix: The algorithm

There is a care pathway for the management of perioperative hypothermia in adults on page 27 of the full guideline.

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