oneTOGETHER UK
the power of small actions

Perioperative Warming

Quality Improvement Resource

Version 2

AfPP PROGRESSING SAFER SURGERY
The Association for Perioperative Practice

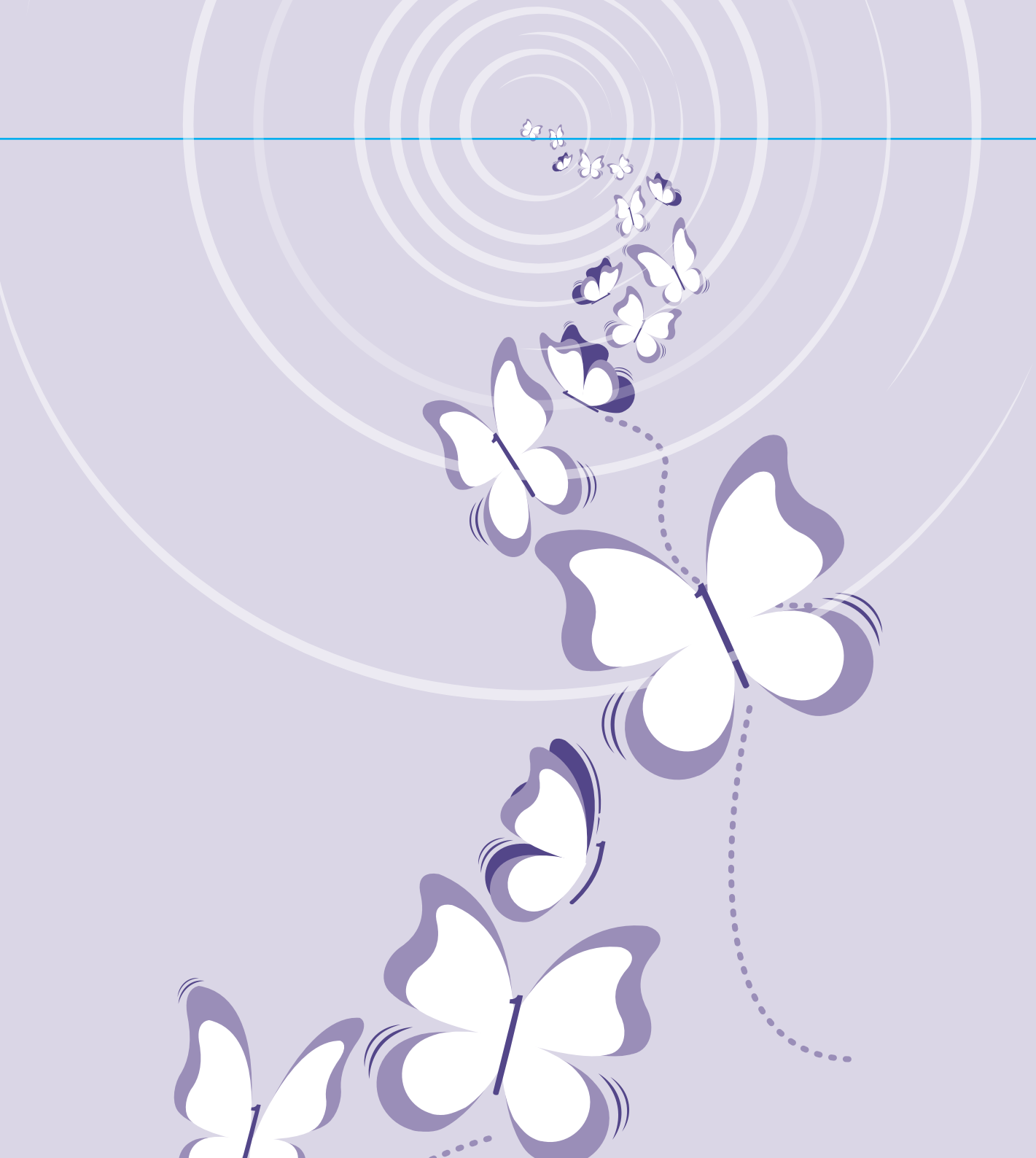
CODP
College of Operating Department Practitioners

CSC
CENTRAL STERILISING CLUB

ips Infection Prevention Society

Royal College of Nursing

3M Science. Applied to Life.™



Contents

1 Introduction to OneTogether

OneTogether is a partnership between leading professional organisations with an interest in the prevention of surgical site infection (SSI). The founding partners are:

- Association for Perioperative Practice (AfPP)
- Infection Prevention Society (IPS)
- College of Operating Department Practitioners (CODP)
- Royal College of Nursing (RCN)
- 3M Company
- 2019 partner: Central Sterilising Club (CSC)

The partnership is a quality improvement collaborative which aims to promote and support the adoption of best practice to prevent SSI throughout the patient's surgical journey. We seek to provide resources that make the evidence for practice to prevent SSI accessible to those involved in caring for surgical patients.

Resources created by the OneTogether partnership can be freely downloaded from our website: **www.onetogether.org.uk**

OneTogether Resource Development Group and Acknowledgments

OneTogether Resource Development Group

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Acknowledgements

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Ellie Wishart	Scientific Affairs Manager, Ecolab
Kate Woodhead	Director of KMW Healthcare Consultants Ltd & Technical Editor of Clinical Services Journal

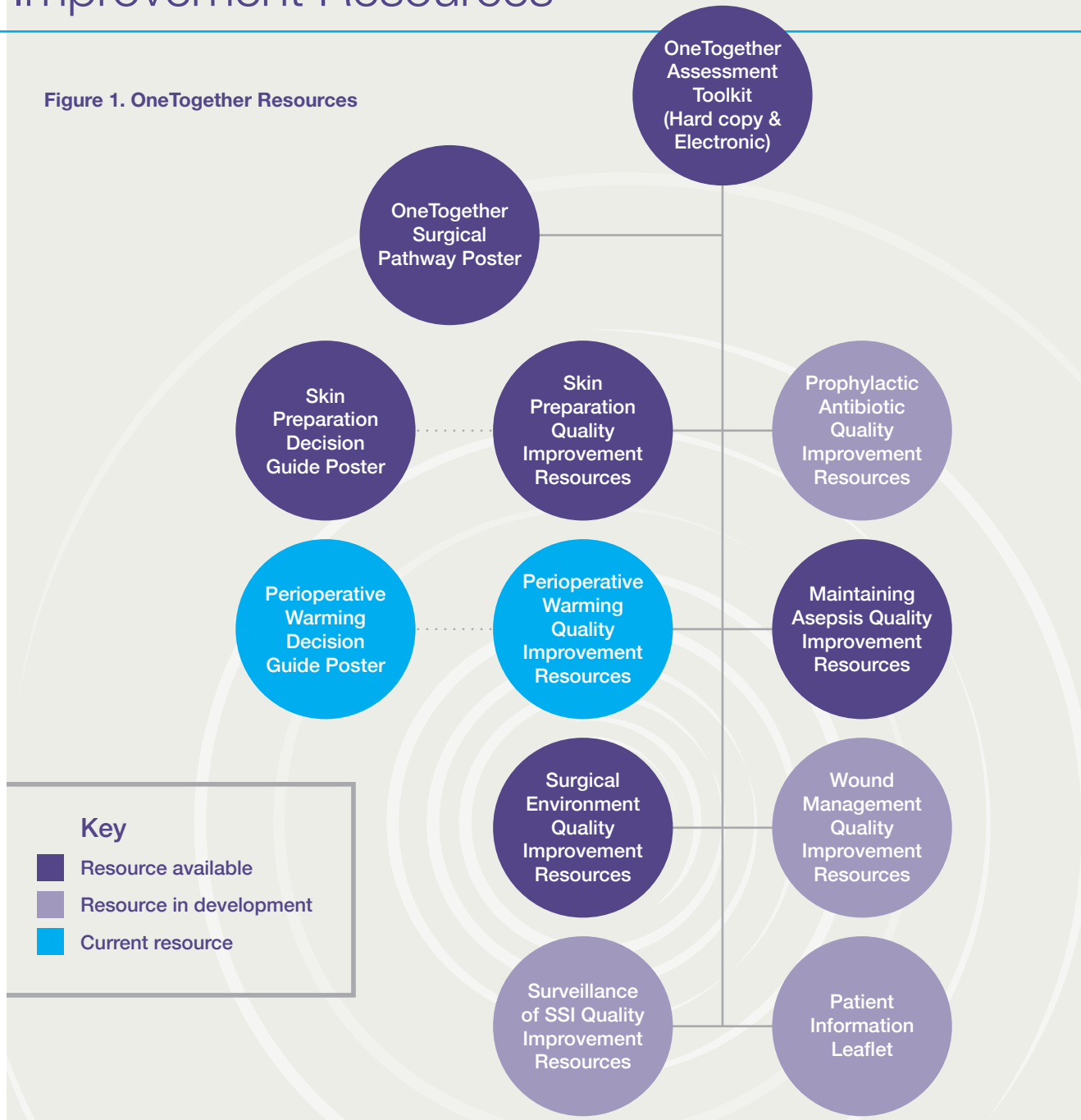
2 Overview of the Quality Improvement Resources

The OneTogether Quality Improvement Resources are intended to provide practical information for implementing best practice for each of the elements of care across the surgical pathway. These resources can be used as stand-alone documents, but we recommend they are used in conjunction with the OneTogether Assessment Toolkit.

The OneTogether Assessment Toolkit is designed to measure adherence to best practice to prevent surgical site infection (SSI). Following completion of the OneTogether Assessment, healthcare professionals will be able to identify areas of low compliance and develop a prioritised action plan for improvement.

Quality Improvement Resources summarise the evidence underpinning recommended practice and provide a competency assessment checklist. The information they contain is drawn from evidence-based guidelines or expert recommendations from professional bodies.

Figure 1. OneTogether Resources



3 Preventing Surgical Site Infection

Surgical site infection (SSI) accounts for more than 15% of all healthcare associated infections and affects at least 5% of patients who have surgery.[1,2]

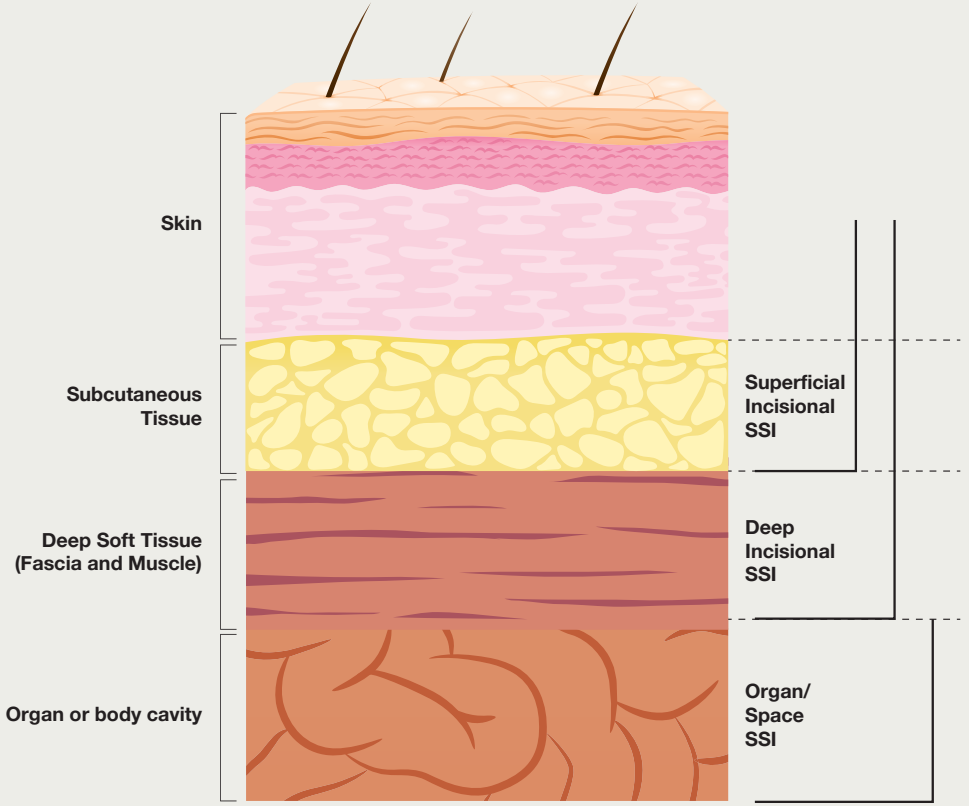
Impact of SSIs

Surgical Site Infections are associated with an increase in:[3,4]

How does SSI occur?

SSI occurs when microorganisms introduced into the incision site during the surgical procedure multiply in the wound and cause signs and symptoms such as inflammation or pus, wound breakdown or fever. Symptoms of SSI may take several days to develop and may not become apparent until after the patient has been discharged from hospital. Most SSIs affect only the superficial tissues, but some affect the deeper tissues or other parts of the body handled during the procedure.[1] (Figure 2)

Figure 2. Types of surgical site infection



3 Preventing Surgical Site Infection

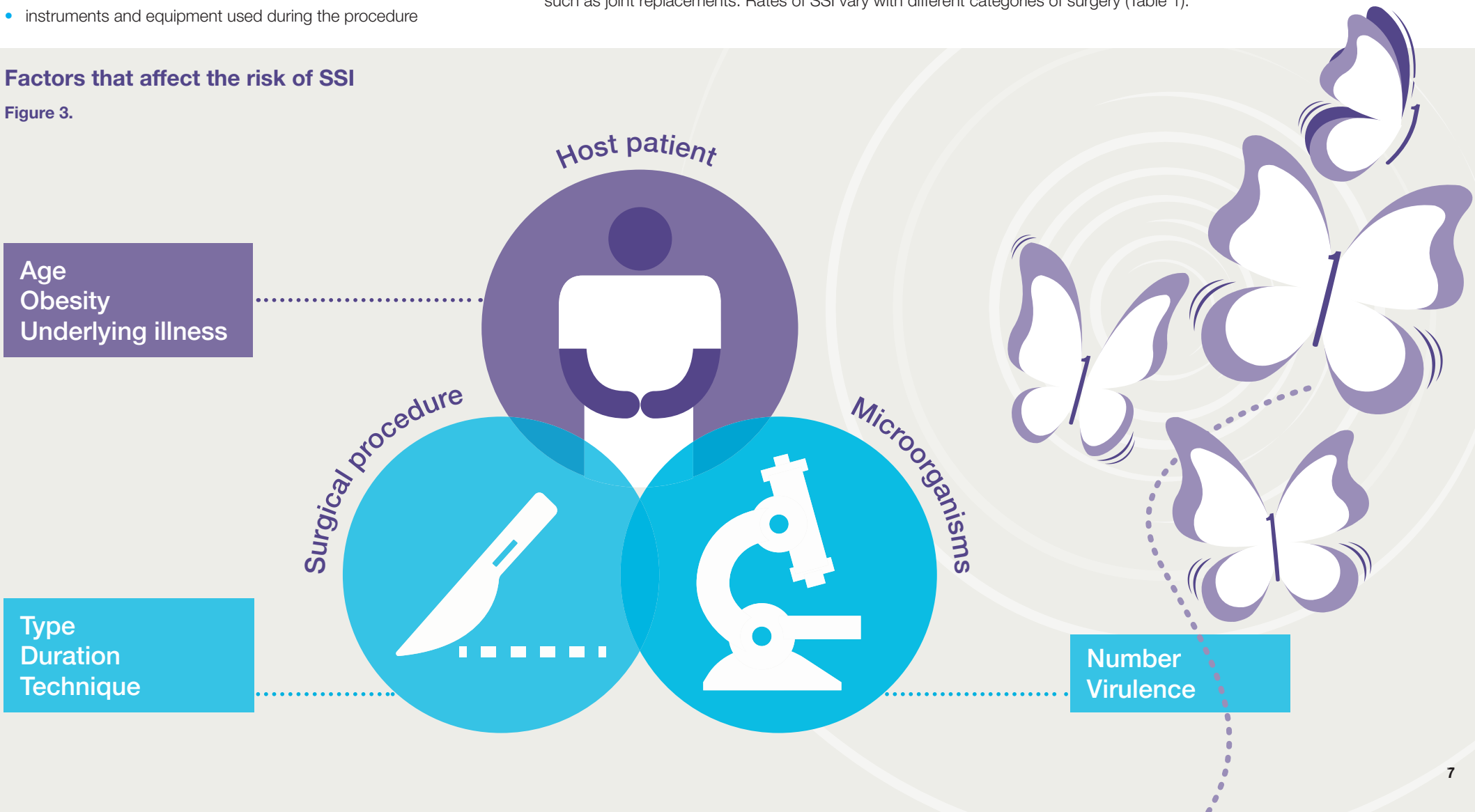
Pathogens that cause SSI may originate from:

- the patient's own microbial flora present on skin and in the body
- the skin or mucous membranes of operating personnel
- the operating room environment
- instruments and equipment used during the procedure

There are several factors which increase the risk that an SSI develops (see Figure 3). The most important is the presence of microorganisms at the site involved in the surgery. Procedures that involve parts of the body with a high concentration of normal flora, such as the bowel, are therefore associated with a higher risk of SSI than those involving sterile tissues, such as joint replacements. Rates of SSI vary with different categories of surgery (Table 1).

Factors that affect the risk of SSI

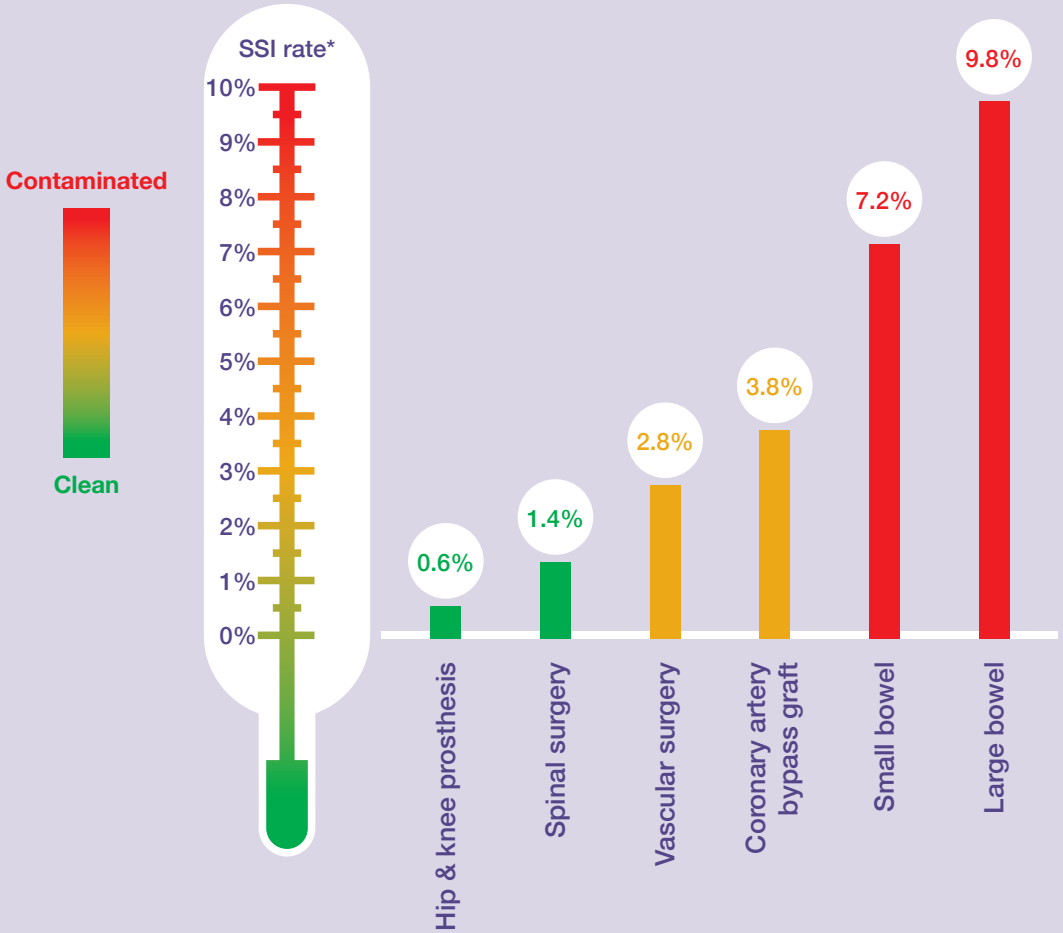
Figure 3.



3 Preventing Surgical Site Infection

Rates of SSI vary with different categories of surgery

Table 1.



*Based on SSI detected in inpatients and readmissions after surgery
Source: Surveillance of Surgical site infection in NHS hospitals in England, 2015/16

Microorganisms can be introduced into the incision site during the procedure. They may be directly introduced from the personnel involved in the operation but also indirectly on airborne particles that settle into the open tissues or on to instruments used in the procedure. The longer the procedure the greater the length of time that tissues are exposed to contamination.

The efficacy of the patients' immune response is also an important factor in determining whether microorganisms in the incision site are able to multiply to cause infection.

The risk of SSI increases with:

- The age of the patient.
- A diminished immune response due to an underlying illness (e.g. diabetes) or immunosuppressive therapy.
- Where local conditions impair healing e.g. obesity.[5]

A surgical technique that minimises damage to tissues and prevents haematoma formation reduces the risk that microorganisms left in the incision.

3 Preventing Surgical Site Infection

Practices designed to prevent SSI are an essential part of perioperative care and must be applied consistently to ensure the risk of SSI is minimised.

Procedures to prevent SSI are aimed at:

Minimising the number of microorganisms introduced into the incision site, for example removing microorganisms that normally colonise the skin of patient, maintaining asepsis and managing air quality.

Preventing the multiplication of microorganisms at the incision site, for example using prophylactic antibiotics.

Enhancing the patients' defences against infection, for example by minimising tissue damage and maintaining normal body temperature during the procedure.

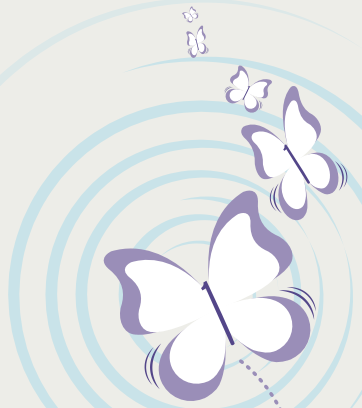
Preventing access of microorganisms into the incision site, for example postoperatively by use of a wound dressing.

Source of guidance on preventing SSI

The most authoritative guidance on the prevention of SSI can be obtained from high quality systematic reviews of research on the efficacy of interventions. In the main these studies are referenced in the following major guidelines:

- National Institute for Health and Care Excellence (NICE) guideline [NG125] Surgical site infections: prevention and treatment (2019).
- World Health Organisation (WHO) Guideline (2016)
- Centers for Disease Prevention and Control (CDC)/ Healthcare Infection Control Practices Advisory Committee (HICPAC) guidelines (2017)

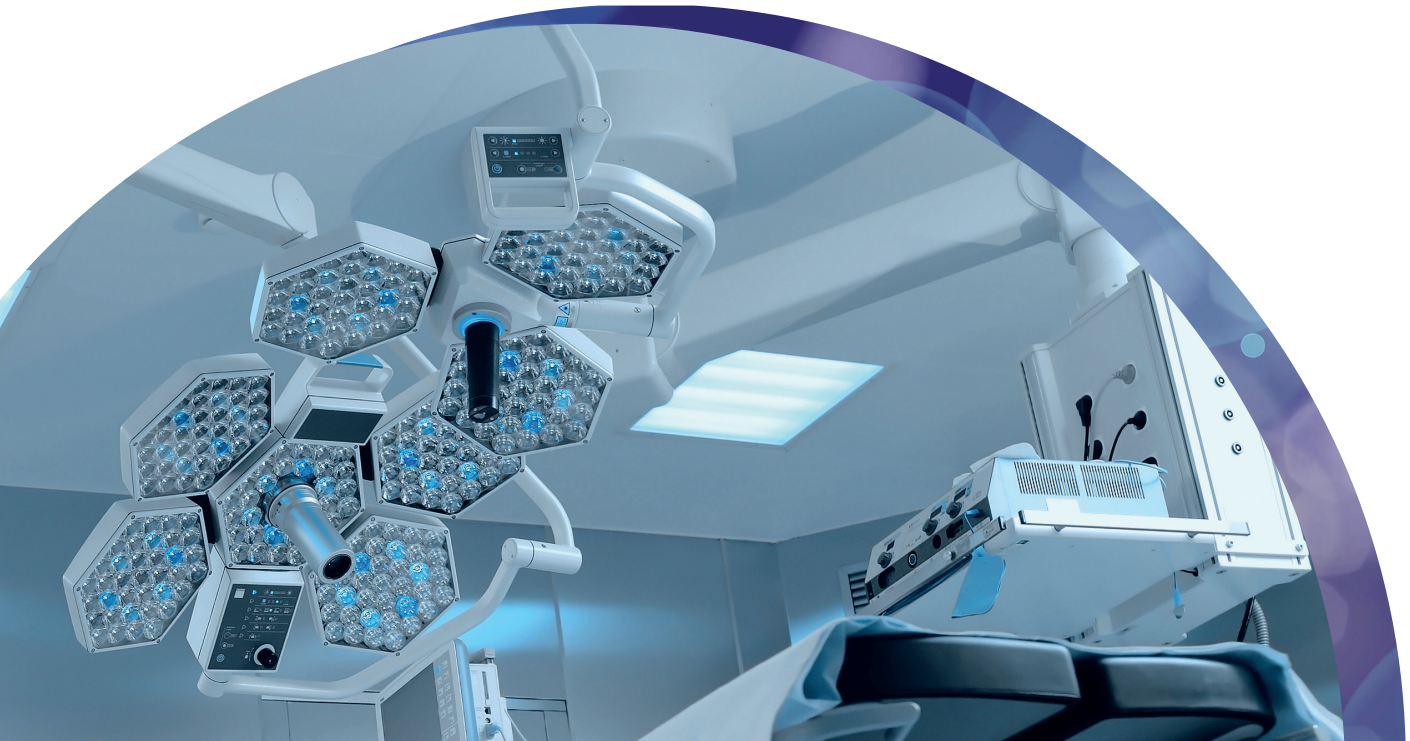
Advice contained in the OneTogether Improvement Resources has been drawn from these sources and other reviews of similar quality.



4 Preventing Inadvertent Perioperative Hypothermia

Hypothermia, defi ned as a core body temperature of less than 36.0°C, is a common but preventable complication of surgery. It is associated with a number of adverse outcomes including:[6 8 9 10]

- Increased perioperative blood loss
- Longer post-anaesthetic recovery
- Increased length of hospital stay
- Unanticipated readmission to high dependency units
- Cardiac events including arrhythmia, myocardial ischaemia
- Changes in the metabolism of drugs
- Increased risk of surgical site infection
- Postoperative shivering and thermal discomfort (patient satisfaction)
- Pressure ulcers



Although hypothermia may need to be deliberately induced during some cardiac surgical procedures, inadvertent perioperative hypothermia (IPH) will affect as many as 70% of patients undergoing routine surgery unless active steps to keep them warm are taken.[6]

NICE has also estimated costs associated with IPH, which contribute to an overall increase in the cost of care (see Table 2).

Table 2. Estimated costs associated with IPH

Cost per adverse event*	Cost
Surgical wound infection (minor surgery)	£950
Surgical wound infection (major surgery)	£3,858
Transfusion	£24
Morbid cardiac event	£1,906
Mechanical ventilation	£1,144
Pressure ulcer	£1,064

*Source: National Institute for Health and Clinical Excellence (NICE) Resource impact report: Hypothermia: prevention and management in people having surgery (CG65)[7]

4 Preventing Inadvertent Perioperative Hypothermia

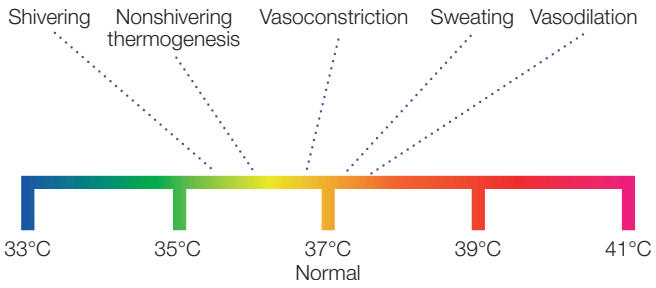
How does the body control temperature?

The core body temperature of blood and internal organs is maintained at a normothermic level (between 36.5°C and 37.5°C) by the thermoregulatory system.

The thermoregulatory system is controlled by the hypothalamus in the brain, which receives information about the body's temperature from thermoreceptors located across the body. The hypothalamus responds to this information and induces a biological response to maintain temperature within the normothermic range.

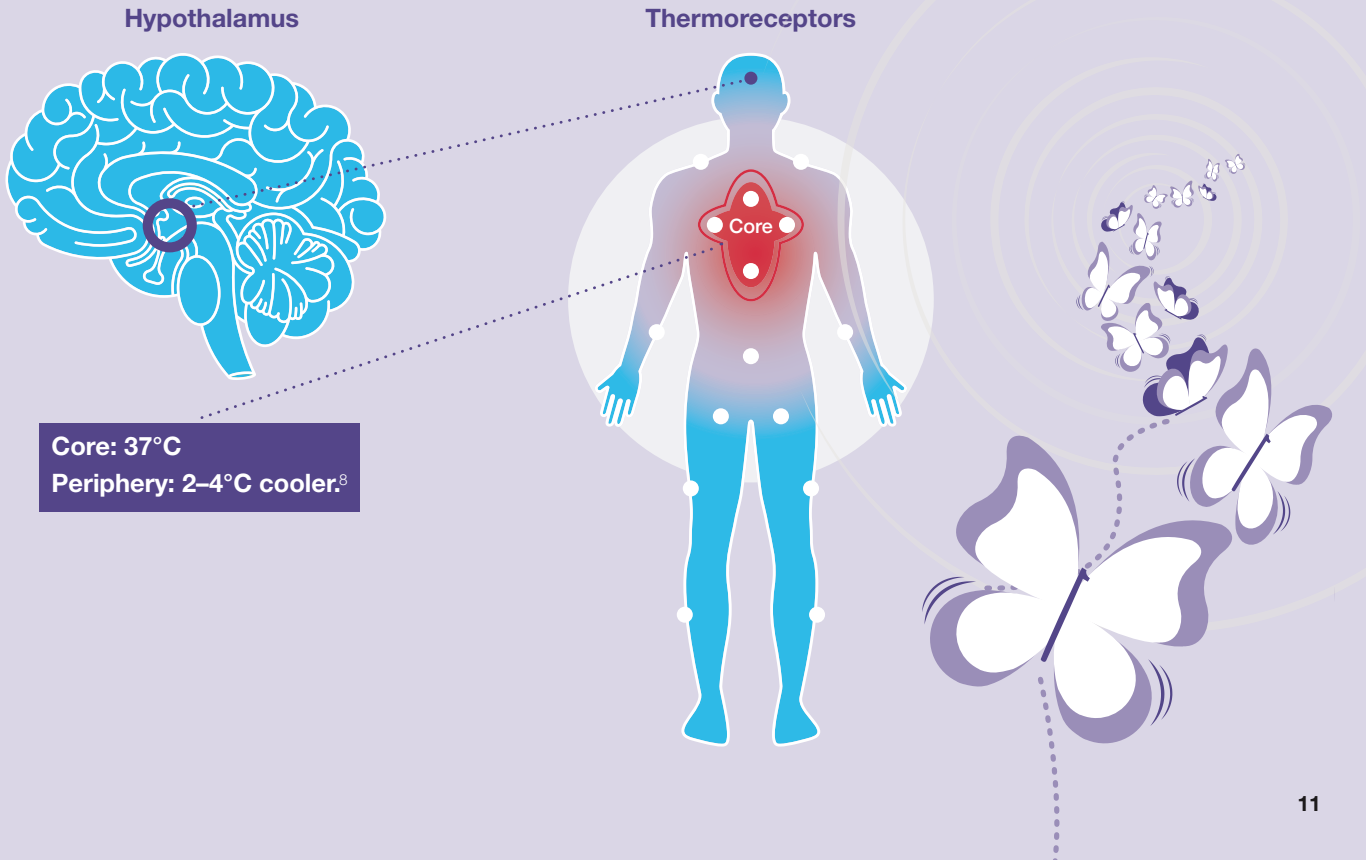
Physiological responses to cold temperature include, vasoconstriction (narrowing of blood vessels), non-shivering thermogenesis (an increase basal metabolic rate) and shivering itself. If the body becomes too warm, physiological responses to reduce temperature include vasodilation (widening of blood vessels) and sweating (see Figure 3).

Figure 3. Patterns of heat losses and gains in non anaesthetised humans



Thermoregulatory mechanisms

- The hypothalamus regulates the body's core temperature
- Thermoreceptors are used by the hypothalamus to respond to temperature
- Thermoreceptors are located in:
  - Skin
  - Spinal cord
  - Brain
  - Deep central tissues



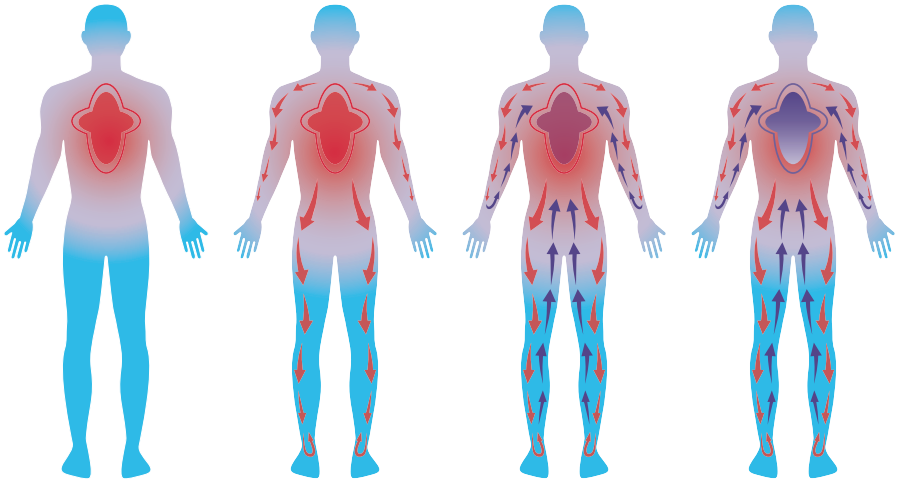
4 Preventing Inadvertent Perioperative Hypothermia

Surgery and the risk of hypothermia

It is not unusual for the patient's core temperature to drop to below 35°C within the first 30 minutes of anaesthesia if steps are not taken to maintain normothermia.[8]

General anaesthesia increases the risk of hypothermia because it inhibits the thermoregulatory response. Both general anaesthesia and regional blocks promote vasodilation of peripheral vessels. Heat is therefore redistributed to the peripheral tissues and lost from the body, subsequently reducing the core temperature[8] (see Figure 4).

Figure 4. Redistribution of heat following anaesthesia



In addition, exposure of tissue and internal organs during surgery and the ambient temperature and airflow in the operating theatre can result in the loss of body heat. Cooling may also be increased by the use of intravenous and irrigation fluids.

Hypothermia is more likely to occur if:

- the patient gets cold or is poorly perfused (i.e deprived of fluids) while waiting for surgery
- a significant surface area of their body is uncovered during surgery

Box 1: Summary of NICE Clinical Guideline CG65 (2008; updated 2016)[6]

Preoperative warming

NICE recommends that all patients should be assessed within the hour prior to surgery for their risk of perioperative hypothermia and their temperature measured using a site that produces a direct measure or direct estimate of core temperature.

All patients should be actively warmed on the ward/emergency department at least 30 minutes prior to induction of anaesthesia. If the patient's temperature is below 36°C or they are at high risk of hypothermia, they should be warmed immediately.

The patient's core temperature should be 36°C or above before they are transferred to theatre, unless there is a need to expedite surgery.

Intraoperative warming

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).

Patients having anaesthesia for longer than 30 minutes, or at a higher risk of perioperative hypothermia are warmed from induction of anaesthesia using forced-air warming.

The patient's temperature should be measured and documented before induction of anaesthesia and then every 30 minutes until the end of surgery, using a site that produces a direct measure or direct estimate of core temperature.

Intravenous fluids (500 ml or more) and blood products should be warmed to 37°C using a fluid warming device and irrigation fl uids should be warmed in a thermostatically controlled cabinet to a temperature of 38°C to 40°C.

Postoperative warming

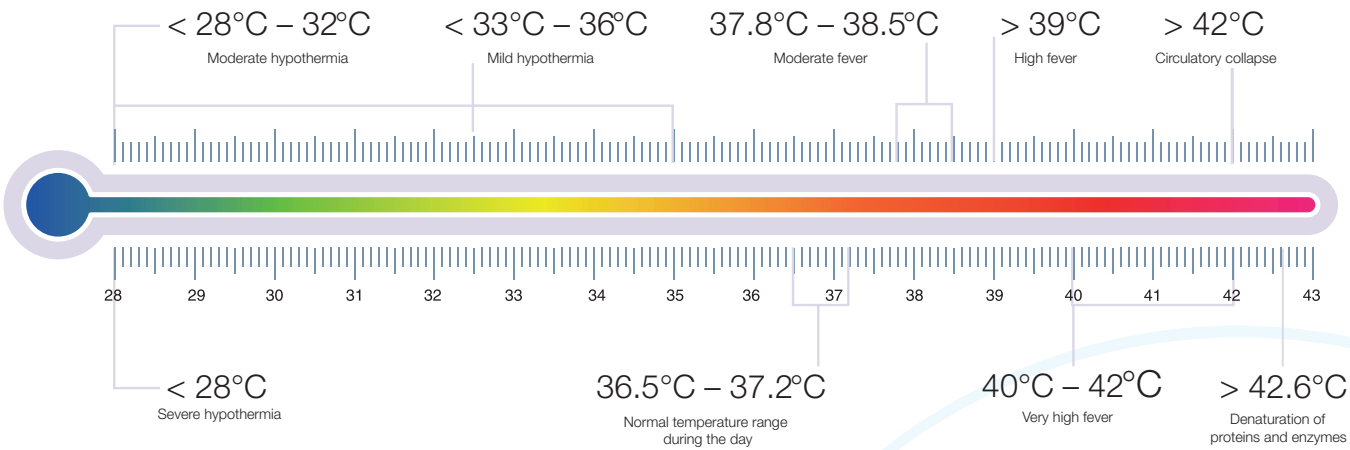
The patient's temperature should be monitored and documented every 15 minutes in recovery. The patient should not be transferred to the ward, until their temperature is 36°C or above.

4.1 Temperature Monitoring

Why should you measure a surgical patient's core temperature?

As hypothermia occurs, heat from the core body is redistributed to the periphery, which in turn increases the mean skin temperature. This can result in the patient feeling warm, even though cooling is actually taking place. Obtaining an accurate measurement of core temperature is therefore essential to identify patients affected by IPH before, during and after surgery and to ensure perioperative warming is commenced as soon as possible.

In some instances therapeutic hypothermia can be induced, whereby the patient is cooled under controlled conditions to 32-34°C. This is often used in comatose cardiac arrest survivors, head injury, and neonatal encephalopathy to protect the patient from hypoxic brain injury. Continuous core temperature monitoring is essential in these instances, to ensure that mild hypothermia in maintained, and cerebal damage is minimised.



How should you measure core temperature?

There are a range of devices that are able to measure core temperature, with varying degrees of accuracy. NICE recommends the measurement of temperature at sites which are able to:

- directly measure core temperature or
- directly estimate core temperature to within ±0.5°c.[6]

Many commonly used devices indirectly estimate core temperature (by measuring the temperature at the periphery) and adding a correction factor. This correction factor can markedly differ between different devices and at different temperatures. Their lack of accuracy could lead to IPH not being recognised and increase the risk of adverse outcomes and resource use associated with hypothermia. As a result of this inaccuracy, indirect estimates of temperature are not recommended by NICE for use in surgical patients.[6]

NICE identifies that the pulmonary artery catheter; distal oesophageal and urinary bladder are considered the most accurate methods and sites for direct core temperature measurement or direct estimation of core temperature. However, these sites may not always be appropriate for use due to their invasive nature. If an invasive method of core temperature monitoring is not appropriate, other direct methods to estimate core temperature should be used[9] (see Table 3).

4.1 Temperature Monitoring

When should a surgical patient's core temperature be measured?

Box 2: Clinical evidence to support efficacy of differing core temperature monitoring sites and devices

NICE reviewed 24 studies to identify the best site and method for accurately measuring temperature in the different phases of perioperative care.[9]

The method and sites of measuring 'true' core temperature were identifi ed as pulmonary artery catheter (PAC), oespohagus and bladder. Therefore studies involving comparisons to these three reference methods and sites were included in the review.

The committee highlighted that for most comparisons, only one study contributed towards the evidence base, and this introduces uncertainty into the evidence.

The evidence on indirect estimation of core temperature (temporal artery, infrared forehead, forehead strips, tympanic infrared) indicates that there is a lack of accuracy compared to direct methods.

In cases where invasive core temperature monitoring is not appropriate, the committee noted that other direct methods to estimate core temperature measurement, accurate to within 0.5°C of true core temperature, should be used.

4.1 Temperature Monitoring

Table 3. Sites of core temperature measurement

As well as considering accuracy in measuring core temperature, the ability to continuously monitor temperature and the invasiveness of the device should also be taken into account.[9]

Site of measurement	Type of measurement	Accuracy	Continuous measurement	Invasiveness	Recommended by NICE for surgical patients
Infrared Tympanic	Indirect estimate	Low	No	Low	✗
Infrared Temporal	Indirect estimate	Low	No	Low	✗
Infrared forehead	Indirect estimate	Low	No	Low	✗
Forehead strips	Indirect estimate	Low	No	Low	✗
Pulmonary artery catheter	Direct measurement	High	Yes	High	✓
Distal oesophagus	Direct measurement	High	Yes	High	✓
Urinary bladder	Direct measurement	High	Yes	High	✓
Sublingual*	Direct estimate	Moderate	No	Low	✓
Axilla*	Direct estimate	Moderate	No	Low	✓
Rectal	Direct estimate	High	Yes	Moderate	✓
Zero heat flux (deep forehead)	Direct estimate	High	Yes	Low	✓

Note: Nasophryngeal is regarded as a good direct estimation of core temperature; however no evidence was identifi ed comparing nasopharyngeal site of measurement to any of the three reference methods and sites (pulmonary artery catheter, oesophageal or urinary bladder) therefore no recommendation was made about this site of temperature measurement.[9]

*Be aware of possible inaccuracies in core temperature estimation when using peripheral sites, such as sublingual or axilla, in patients whose core temperature is outside the normothermic range (36.5°C to 37.5°C).

4.2 Preoperative Warming

Why should patients be warmed preoperatively?

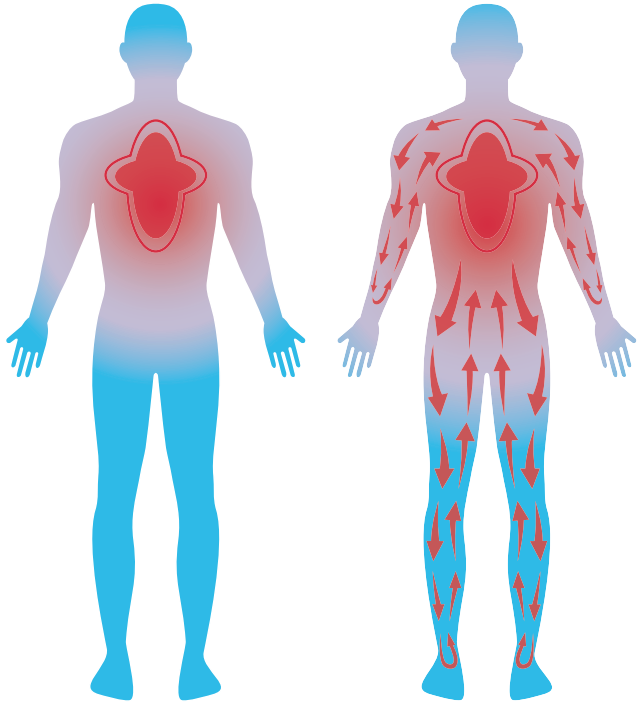
The pre-operative phase is defined as the 1 hour before induction of anaesthesia (when the patient is prepared for surgery on the ward, admission area or in the emergency department).

During the first 30 to 40 minutes of anaesthesia, a patient's temperature can drop to below 35.0°C due to cold environmental conditions and an impaired thermoregulatory response under general or regional anaesthesia.

It has been reported than an average core temperature drop of 1.6°C can occur in the fi rst hour of general anaesthesia.[8]

When the patient is awake, there is a natural temperature gradient between the core and the periphery (skin) of about 2–4°C.8 Warming the surface of the body reduces this gradient and increases the overall heat content of the body, so that the initial drop in temperature on induction of anaesthesia is reduced.

Preoperative warming was found to be highly likely to be cost effective because benefits of preventing hypothermia outweigh the additional cost of the consumables required to prewarm.[9]

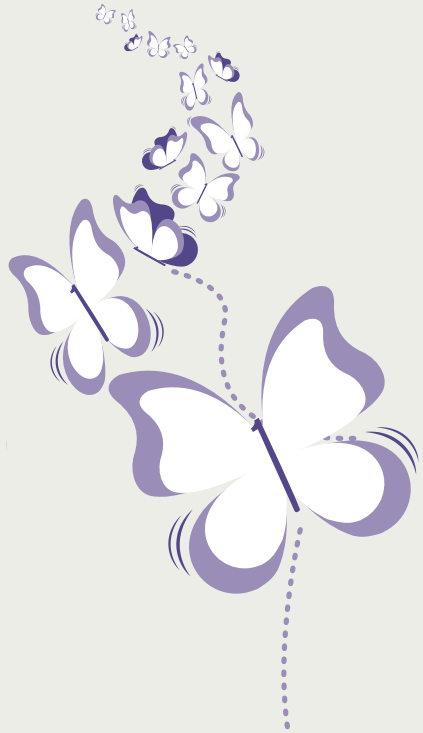


What patients are at high risk of inadvertant perioperative hypothermia?

In the hour before anaesthesia assess all patients for risk factors that can contribute towards perioperative hypothermia and take their temperature.

Patients should be managed as high risk if two or more of the following apply:[6]

- an ASA grade II to V (see table 4)
- is having combined general and regional anaesthesia
- is undergoing major/intermediate surgery
- is at risk of cardiovascular complications
- a preoperative temperature below 36°C



4.2 Preoperative Warming

Table 4. American Society of Anesthesiologists' (ASA) Physical Classification System[10]

ASA PS Classification	Definition	Examples, including, but not limited to:
ASA I	A normal healthy patient	Healthy, non-smoking, no or minimal alcohol use.
ASA II	A patient with mild systemic disease	Mild diseases only without substantive functional limitations. Examples include (but not limited to): current smoker, social alcohol drinker, pregnancy, mild obesity (BMI 30–40), well controlled diabetes or hypertension, mild lung disease.
ASA III	A patient with severe systemic disease	Substantive functional limitations; One or more moderate to severe diseases. Examples include (but not limited to): poorly controlled diabetes or hypertension, chronic obstructive pulmonary disease (COPD), morbid obesity (BMI 40+), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, end stage renal disease (ESRD) undergoing regularly scheduled dialysis, history (greater than 3 months) of myocardial infarction (MI), cerebrovascular accident (CVA), transient ischemic attack (TIA), or coronary artery disease (CAD)/stents.
ASA IV	A patient with severe systemic disease that is a constant threat to life	Examples include (but not limited to): recent (greater than 3 months) MI, CVA, TIA, or CAD/stents, ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, sepsis, disseminated intravascular coagulation (DIC), acute respiratory distress (ARD) or ESRD not undergoing regularly scheduled dialysis.
ASA V	A moribund patient who is not expected to survive without the operation	Examples include (but not limited to): ruptured abdominal/thoracic aneurysm, massive trauma, intracranial bleed with mass effect, ischemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction.

4.2 Preoperative Warming

Which patients should warmed preoperatively?

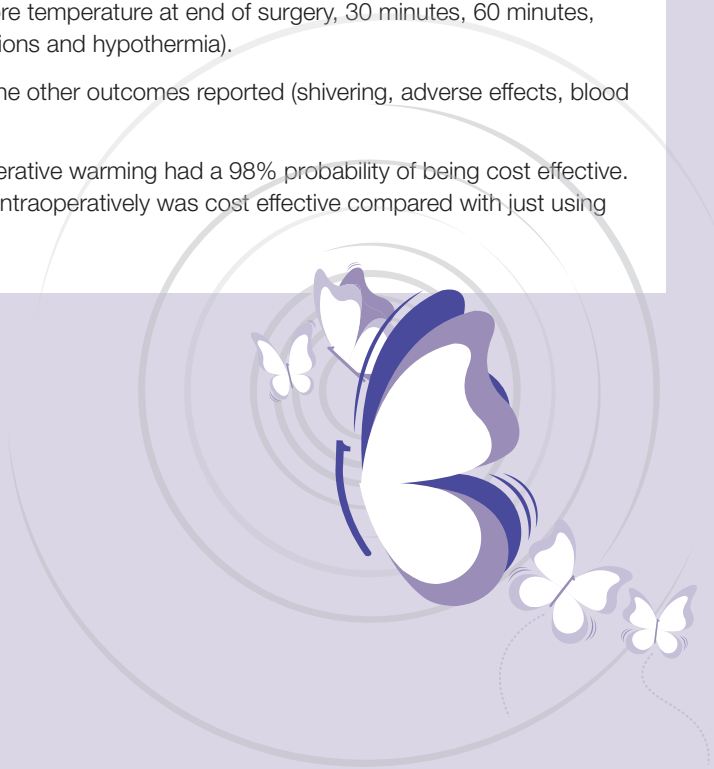
All patients should be actively warmed on the ward/emergency department at least 30 minutes prior to induction of anaesthesia. If the patient's temperature is below 36°C or they are at high risk of hypothermia, they should be warmed immediately.

The patient's core temperature should be 36°C or above before they are transferred to theatre, unless there is a need to expedite surgery.[6] (See Appendix B).

Box 3: Summary of clinical evidence to support preoperative warming

Twelve studies including 1281 participants contributed data to the analysis considered in NICE guidance CG65. The quality of and certainty in the evidence for each outcome ranged from very low to moderate.

- Preoperative active warming was found to be significantly more effective than no preoperative active warming for critical outcomes (core temperature at end of surgery, 30 minutes, 60 minutes, 120 minutes, surgical and wound infections and hypothermia).
- There was no significant difference for the other outcomes reported (shivering, adverse effects, blood transfusion and cardiac complications).
- An economic analysis found that preoperative warming had a 98% probability of being cost effective. Using forced air warming both pre and intraoperatively was cost effective compared with just using forced air warming intraoperatively.[8]



What devices can be used to actively warm patients?

Active warming devices

Convective warming

Involves heat transfer due to gentle dispersion of warmed, filtered air across the patient's skin. Examples include:

- Forced-air warming blankets
- Forced-air warming gowns

Conductive warming

Involves heat transfer due to surface-surface contact between the heating device and the patient. Examples include:

- Electric blankets
- Electric heated pads
- Radiant heating
- Resistive heating mattresses
- Resistive heating blankets

4.3 Intra and Postoperative Warming

Why should patients be warmed intra and postoperatively?

The intraoperative phase is defi ned as the total anaesthesia time, whilst the postoperative phase is defined as the 24 hours after admission into the recovery area and includes transfer to and time spent on the ward.

Due to the effects of general anaesthesia and cold environmental conditions (see figure 5), the patient is susceptible to IPH throughout the perioperative phase.

Warming a patient reduces the gradient between the periphery and core, and therefore increases the overall heat content of the body.

The aim of warming throughout the intra and postoperative phases is to maintain a normothermic temperature, and thereby reduce the risk of adverse effects associated with IPH.

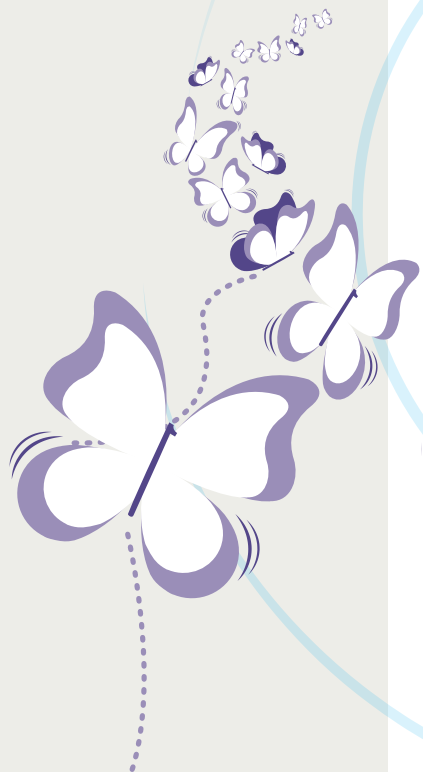
Which patients should be warmed intra and postoperatively?

Patients should be actively warmed, using a forced air warming device from the induction of anaesthesia, who meet at least one of the following criteria:

- have been assessed as at high risk of perioperative hypothermia
- have a core temperature below 36°C
- whose anaesthesia is expected to last longer than 30 minutes

Figure 5: Cold environmental conditions

- Theatre temperatures are 18–22°C
- During preparation and surgery, large areas of skin are exposed to the cold operating room
- Surgical incisions expose internal organs
- Length of surgery
- Blood and fl uid loss
- Wet skin preps



4.3 Intra and Postoperative Warming

How should patients be warmed intra and postoperatively?

All patients should be kept covered to reduce heat loss and the ambient temperature of the operating theatre should be maintained at least 21°C.

If patients require warming intra or post-operatively (in recovery and on the ward), then active warming using forced-air should be implemented.

Temperature should be monitored every 30 minutes during surgery, every 15 minutes during recovery and every 4 hours on the ward. If the patient's core temperature drops below 36°C at any time, then forced-air warming should commence.

Facilitating patient movement may be a consideration when selecting a method of active warming preoperatively. The type of preoperative warming device used will therefore depend on the individual patient, the setting, the operation and the hospital.

If forced-air devices are considered unsuitable for a specific patient or procedure then a resistive heating mattress or blanket can be used instead.

Intraoperative forced air warming has been found to be more likely to be cost effective compared with resistive heating mattresses and blankets.[6]

The use of forced-air warming and SSI

It has been suggested that forced-air warming may increase the risk of surgical site infection during implantation surgery (such as joint replacement) because the air flowing through the forced-air warming device disrupts the air flow around the surgical site. However, NICE recommends that more evidence is needed on the incidence of surgical site infection in implantation surgery comparing forced-air warming with conductive warming in laminar flow theatre.[6]

In 2017, the Food & Drug Administration (FDA) in the USA, undertook a thorough review of available data on using forced air thermal regulating systems in conjunction with laminar flow ventilation. They were unable to identify a consistently reported association between the use of forced air and surgical site infection. Therefore, the FDA continues to recommend the use of thermoregulating devices (including forced air thermal regulating systems) for surgical procedures.[12]

Box 4: Summary of clinical evidence to demonstrate efficacy of different active warming methods intraoperatively

NICE reviewed 26 studies comparing forced air warming with other active warming methods during the intraoperative phase. A focus on forced air warming and resistive heating was undertaken as both of these methods are used in clinical practice in England and Wales, whereas the other active warming methods are no longer routinely used.

The studies all differed with regards to the devices used, the temperature used, the location of core temperature measurement and the proportion of the body that the warming device covered.

The evidence for the comparisons of interest in the intraoperative period (forced-air warming versus resistive heating) ranged from very low to high quality.

Meta-analysis of 18 studies with 1029 participants found that forced air warming was more effective than resistive heating mattresses.[6]

Meta-analysis of 6 studies after a sensitivity analysis found that forcedair warming was more effective than resistive heating blanket at end of surgery but there was no difference at the different timepoints during surgery.[6]

For other outcomes such as cardiac events, blood loss and SSI, differences between methods of active warming were not significant, although many of the studies were small in size and underpowered to detect the relatively rare events.

4.4 Warming of Intravenous and Irrigation Fluids

Why should intravenous and irrigation fluids be warmed?

If a patient is in receipt of a large volume of intravenous fluids (i.e. fluids administered into veins) and/or irrigation fluids (fluids used to wash parts of the body) then their temperature can impact the patient's core temperature.

If the temperature of these fluids is below core body temperature, they can cause significant heat loss.

Warming intravenous and irrigation fluids to core body temperature or above might prevent some of this heat loss and subsequent hypothermia.[13]

How should intravenous fluids be warmed?

In a recent review of clinical evidence, it was found that warmed intravenous fluids kept the core temperature of study participants about half a degree warmer than that of participants given room temperature intravenous fluids at 30, 60, 90 and 120 minutes, and at the end of surgery.[13]

Warmed intravenous fluids also further reduced the risk of shivering compared with room temperature intravenous fluids.[13]

The degree of warming produced by warming fluids may be related to both the volume infused and the rate at which it is delivered.[13]

Intravenous fluids (500 ml or more) and blood products should be warmed to 37°C using a fluid warming device.[6]

How should irrigation fluids should be warmed?

Evidence suggests that the body cavity irrigated, along with temperature, volume and duration of irrigation, is likely to impact core temperature by transferring heat from the body to the solution.[13]

However, a review of current evidence shows that there is no statistically significant differences in core body temperature or shivering between individuals given warmed and room temperature irrigation fluids. However, this evidence is described as weak.[6 13]

Based on all evidence, NICE recommends that all irrigation fl uids used intraoperatively should be warmed to a temperature of 38–40°C in a warming cabinet.[6]

Irrigation warming devices are able to provide a consistent temperature of fluids administered, however current practice relies on warming cabinets, which need to be used with caution (see Box 5).

Box 5: Practical considerations when warming irrigation fluids

- The time taken to warm irrigation fluids may vary between cabinets. Therefore it is recommended that manufacturer's instructions for use inform local policy.
- Fluids may be heated above 37°C but must be allowed to cool before use. Cooling occurs rapidly once fluids are outside the cabinet and protocols must provide accurate advice on the timeline between removal and use.
- Best practice to assure patient safety is to test the fluid temperature immediately prior to use with a sterile thermometer. Alternatively use an active fluid warming system with integral temperature monitoring and control.

5 Competency Checklist

Prepare patients for clinical procedures	Demonstrated to preceptee	Assessment of competence by preceptor		
		6 weeks	3 months	6 months
Criteria	**Signature/date**	**Signature/date**	**Signature/date**	**Signature/date**
Be competent in identifying patients at high risk of inadvertent hypothermia at preoperative stage				
Demonstrate the correct method of recording core temperature from preoperative, through intraoperative to postoperative stage				
Demonstrate the correct application of active warming devices at preoperative stage				
Demonstrate correct application of forced air warming through intra operative and postoperative stage				
Demonstrate correct cleaning methods for all equipment utilised to support temperature monitoring and maintenance of normothermia				
Underpinning Knowledge		**Discussed Signature/date**	**Knowledge achieved Signature/date**	**Assessment method**
Be able to describe the anatomy and physiology of temperature regulation				
Be able to explain the effects of anaesthesia on a patients ability to regulate their temperature				
Be able to describe those patients that require warming throughout surgery				
Be able to describe the risk factors to identify patients that are at higher risk of inadvertent perioperative hypothermia				
Be able to discuss the accepted methods of recording core temperature for surgical patients				
List the consequences of not maintaining normothermia for surgical patients				
Describe the importance of pre-operative temperature recording				
Describe the importance of actively warming patients at the preoperative stage				
Identify the correct methods of actively warming patients at intraoperative and postoperative stages				

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Standards and Guidance
Reducing the risk of Surgical Site Infection (SSI)

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1. Skin Preparation

1.1 Washing

Recommendation

NICE recommends that patients should shower or have a bath (or be assisted to shower, bath or bed bath) using soap, either the day before, or on the day of surgery.[1]

1.2 Hair Removal

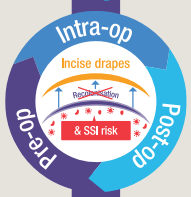
Recommendation

NICE recommends that razors should not be used for hair removal because they increase the risk of SSI. If hair must be removed, then clippers with disposable heads are recommended.[1]

1.3 Skin Antisepsis

Recommendation

Prepare the skin at the surgical site immediately before incision using an antiseptic preparation. Unless contra indicated alcohol-based solution of chlorhexidine is first choice.[1]



1.4 Reducing Skin Recolonisation

Recommendation

NICE recommends that if an incise drape is used, this should be iodophor impregnated unless the patient has an iodine allergy.[1]

1.5 Reducing Nasal Colonisation

Recommendation

NICE recommends to consider applying nasal mupirocin in combination with a chlorhexidine body wash before procedures which are locally determined.

4. Maintaining Asepsis

Recommendation

All pre sterilised instruments must be checked for evidence that they have been sterilised and that the packs are intact.

Instruments should be set up in a clean area, as close to the procedure time as possible. All prepared instruments must be closely observed at all times.

Staff who undertake procedures which require skills such as aseptic technique, must be trained and demonstrate proficiency before being allowed to undertake these procedures independently.[5,6]

3. Perioperative Warming

Recommendation

NICE recommends that all patients should be assessed within the hour prior to surgery for their risk of perioperative hypothermia and their temperature measured using a site that produces a direct measure or direct estimate of core temperature.

Active warming should commence on the ward/emergency department at least 30 minutes prior to induction of anaesthesia for all patients (and immediately if their temperature is below 36°C).

The patient's core temperature should be 36°C or above before they are transferred to theatre, unless there is a need to expedite surgery.

Patients having anaesthesia for longer than 30 minutes, or at a higher risk of perioperative hypothermia are warmed from induction of anaesthesia using forced-air warming.

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.

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

Irrigation fluids should be warmed in a thermostatically controlled cabinet to a temperature of 38°C to 40°C.

The patient's temperature should be monitored and documented every 15 minutes in recovery.

The patient should not be transferred to the ward, until their temperature is 36°C or above.[4]

2. Prophylactic Antibiotics

Recommendation

NICE recommends that there must be a local guide to antibiotic prescribing including advice on appropriate surgical prophylaxis.[1]

Surgical prophylaxis should be given intravenously on induction of anesthesia or within 60 mins before the incision is made.[2]

In most circumstances a single dose of antibiotic with a long enough half-life to achieve activity throughout the operation is sufficient.[3]

7. Surveillance

Recommendation

The risk of SSI should be monitored using a standardised surveillance methodology to provide feedback to surgeons and the surgical team about the quality of infection prevention in the operating theatre.

Monitoring of infection rates is essential to provide patients with accurate information about the risk of SSI associated with the operation.[6,7]

5. Surgical Environment

Recommendation

An effective air changing ventilation system should be in operation and regularly monitored.

The doors to the operating theatre should remain closed and traffic in and out of theatre restricted to a minimum to ensure efficiency of the ventilation.

The number of personnel present in theatre should be kept to a minimum.[5]

There is a process to ensure equipment is cleaned prior to admission into the operating theatre.

6. Incision and Wound Management

Recommendation

6.1. Only apply an antiseptic or antibiotic to the wound before closure as part of a clinical research trial.

6.2. NICE recommends that when using sutures, consider using antimicrobial triclosan-coated sutures, especially for paediatric surgery.

6.3. NICE recommends consider using sutures rather than staples to close the skin after caesarean section to reduce the risk of superficial wound dehiscence.

6.4. NICE recommends that surgical incisions should be covered with an appropriate interactive dressing at the end of the operation.[1]

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AfPP The Association for Perioperative Practice
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CSC Central Sterilising Club
IPS Infection Prevention Society
Royal College of Nursing
3M

Updated 2019

Perioperative Warming – Decision Guide

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Pre-op

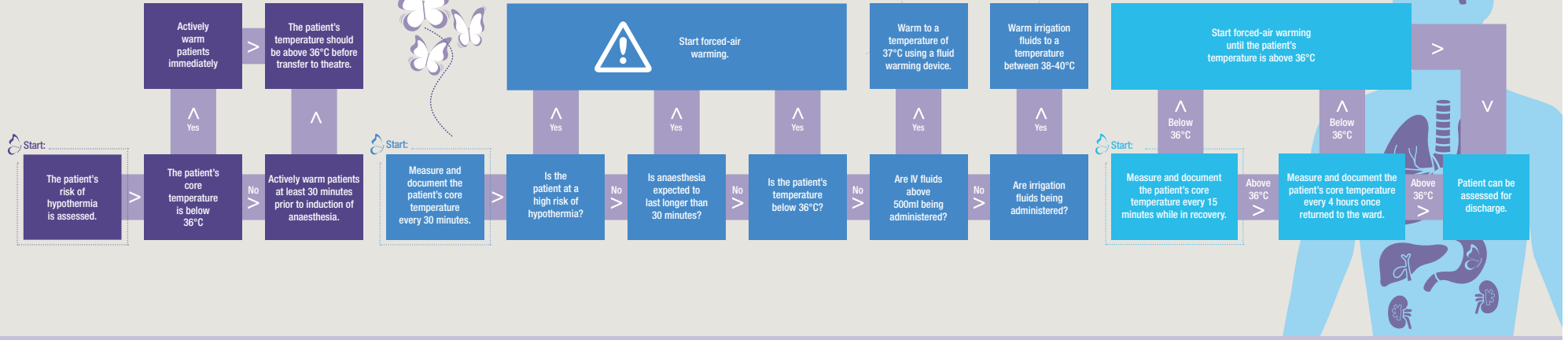
The pre-operative phase is defined as 1 hour before induction of anaesthesia.

Intra-op

The intra-operative phase is defined as the total anaesthesia time (including the time in the anaesthetic room before induction of anaesthesia).

Post-op

The post-operative phase is defined as 24 hours after the patient enters the recovery area.



The Facts About Perioperative Hypothermia:

Clinical hypothermia = core temperature less than 36°C

Patients can lose up to 1.6°C core temp within the first 1 hour of anaesthesia

70% of patients experience hypothermia unless steps to keep them warm are undertaken:

Hypothermic patients are associated with:

- Readmission to high dependency units
- Longer hospital stay
- Increased surgical site infection rates
- Cardiac events
- Higher overal costs of treatment
- Changes to metabolism of drugs
- Longer post-anaesthetic recovery
- Post-operative shivering and thermal discomfort

Who is at risk?

- Any patient undergoing a surgical procedure anticipated to require more than 30 minutes of anaesthesia time
- Any patient undergoing anaesthesia anticipated to last less than 30 minutes who:
  - has an ASA grade greater than 1
  - is having combined GA and regional anaesthesia
  - is undergoing major/intermediate surgery
  - is at risk of cardiovascular complications
  - Has a pre-operative temperature below 36°C

ASA grading

ASA Classification	Definition
ASA I	A normal healthy patient
ASA II	A patient with mild systemic disease
ASA III	A patient with severe systemic disease
ASA IV	A patient with severe systemic disease that is a constant threat to life
ASA V	A moribund patient who is not expected to survive without the operation

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The Association for Perioperative Practice is a registered charity working to enhance skills and knowledge within the perioperative arena. For more than 50 years they have promoted best practice and standards of care within this area and currently represent 7,200 theatre practitioners from across the UK and overseas.
www.afpp.org.uk

The Infection Prevention Society is a registered charity whose mission is to inform promote and sustain expert infection prevention policy and practice in the pursuit of patient or service user and staff safety wherever care is delivered. Its vision is that no person is harmed by a preventable infection.
www.ips.uk.net

The College of Operating Department Practitioners is the professional body for operating department practitioners (ODPs).
It provides guidance on professional and educational issues to members of the profession, and advises a broad selection of national and local bodies on matters relating to operating department practice.
It represents more than 5000 members throughout the UK and overseas, and hosts regular seminars and other public events.
www.codp.org.uk

The Royal College of Nursing is the UK's largest nursing professional body and trade union representing more than 430,000 nursing staff. Founded in 1916, the RCN has worked for more than 100 years to improve nursing education, develop and share good practice and promote nursing as a profession.
The RCN Perioperative Forum and the Infection Prevention and Control Network support nursing staff working in settings where surgical care is given.
www.rcn.org.uk

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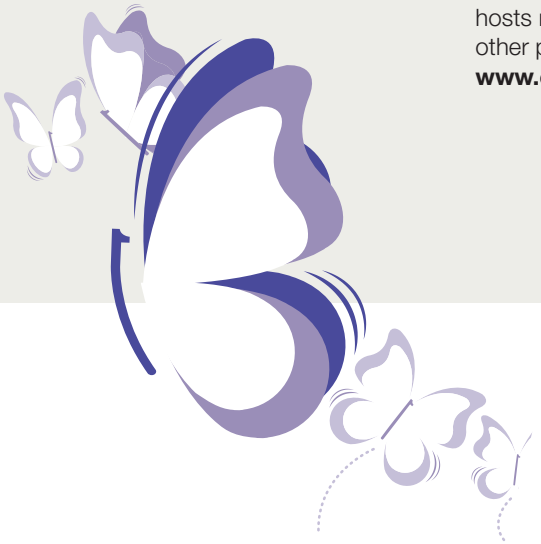
The CSC was founded in 1960 by a small group of enthusiastic individuals working in sterile service departments and those solving problems in the cleaning, disinfection and sterilization field covering surgical instruments, medical devices, patient and hospital environments. CSC is the original decontamination forum solely dedicated to all aspects of cleaning, disinfection sterilization.
Its focus includes medical device and equipment decontamination, the general healthcare environment, infection prevention and control engineering and technical aspects of decontamination equipment, services and products.
www.centralsterilisingclub.org



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