

Surgical site infections: prevention and treatment

Clinical guideline

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[nice.org.uk/guidance/cg74](https://www.nice.org.uk/guidance/cg74)

Your responsibility

The recommendations in this guideline represent the view of NICE, arrived at after careful consideration of the evidence available. When exercising their judgement, professionals and practitioners are expected to take this guideline fully into account, alongside the individual needs, preferences and values of their patients or the people using their service. It is not mandatory to apply the recommendations, and the guideline does not override the responsibility to make decisions appropriate to the circumstances of the individual, in consultation with them and their families and carers or guardian.

Local commissioners and providers of healthcare have a responsibility to enable the guideline to be applied when individual professionals and people using services wish to use it. They should do so in the context of local and national priorities for funding and developing services, and in light of their duties to have due regard to the need to eliminate unlawful discrimination, to advance equality of opportunity and to reduce health inequalities. Nothing in this guideline should be interpreted in a way that would be inconsistent with complying with those duties.

Commissioners and providers have a responsibility to promote an environmentally sustainable health and care system and should assess and reduce the environmental impact of implementing NICE recommendations wherever possible.

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This guideline replaces TA24.

This guideline is the basis of QS49.

Introduction

This guideline updates and replaces NICE technology appraisal guidance 24 (published April 2001).

Surgical site infection is a type of healthcare-associated infection in which a wound infection occurs after an invasive (surgical) procedure. Other types of healthcare-associated infections that mainly affect surgical patients are postoperative respiratory and urinary tract infections, bacteraemias (including methicillin-resistant *Staphylococcus aureus* infections and intravascular cannula infections) and antibiotic-related diarrhoeas (particularly *Clostridium difficile* enteritis). Surgical site infections have been shown to compose up to 20% of all of healthcare-associated infections. At least 5% of patients undergoing a surgical procedure develop a surgical site infection.

A surgical site infection may range from a spontaneously limited wound discharge within 7–10 days of an operation to a life-threatening postoperative complication, such as a sternal infection after open heart surgery. Most surgical site infections are caused by contamination of an incision with microorganisms from the patient's own body during surgery. Infection caused by microorganisms from an outside source following surgery is less common. The majority of surgical site infections are preventable. Measures can be taken in the pre-, intra- and postoperative phases of care to reduce risk of infection.

Surgical site infections can have a significant effect on quality of life for the patient. They are associated with considerable morbidity and extended hospital stay. In addition, surgical site infections result in a considerable financial burden to healthcare providers. Advances in surgery and anaesthesia have resulted in patients who are at greater risk of surgical site infections being considered for surgery. In addition, increased numbers of infections are now being seen in primary care because patients are allowed home earlier following day case and fast-track surgery.

The guideline makes recommendations for prevention and management of surgical site infections based on rigorous evaluation of the best available published evidence.

The guideline will assume that prescribers will use a drug's summary of product characteristics to

inform their decisions for individual patients. In addition, published identified characteristics of appropriate interactive dressings and antimicrobial products should be considered before use, and local formularies and guidelines based on local microbial resistance patterns should be used to inform choice of antibiotics.

Patient-centred care

This guideline offers best practice advice on the care of adults and children to prevent and treat surgical site infection.

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

If the patient is under 16, healthcare professionals should follow the guidelines in the Department of Health's ['Seeking consent: working with children'](#).

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 those with a physical, sensory or learning disability, 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 their care.

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

Care of young people in transition between paediatric and adult services should be planned and managed according to the best practice guidance described in ['Transition: getting it right for young people'](#).

Key priorities for implementation

Information for patients and carers

- Offer patients and carers clear, consistent information and advice throughout all stages of their care. This should include the risks of surgical site infections, what is being done to reduce them and how they are managed.

Preoperative phase

- Do not use hair removal routinely to reduce the risk of surgical site infection.
- If hair has to be removed, use electric clippers with a single-use head on the day of surgery. Do not use razors for hair removal, because they increase the risk of surgical site infection.
- Give antibiotic prophylaxis to patients before:
 - clean surgery involving the placement of a prosthesis or implant
 - clean-contaminated surgery
 - contaminated surgery.
- Do not use antibiotic prophylaxis routinely for clean non-prosthetic uncomplicated surgery.
- Use the local antibiotic formulary and always consider potential adverse effects when choosing specific antibiotics for prophylaxis.
- Consider giving a single dose of antibiotic prophylaxis intravenously on starting anaesthesia. However, give prophylaxis earlier for operations in which a tourniquet is used.

Intraoperative phase

- Prepare the skin at the surgical site immediately before incision using an antiseptic (aqueous or alcohol-based) preparation: povidone-iodine or chlorhexidine are most suitable.
- Cover surgical incisions with an appropriate interactive dressing at the end of the operation.

Postoperative phase

- Refer to a tissue viability nurse (or another healthcare professional with tissue viability expertise) for advice on appropriate dressings for the management of surgical wounds that are

- healing by secondary intention.

1 Guidance

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

1.1 *Information for patients and carers*

- 1.1.1 Offer patients and carers clear, consistent information and advice throughout all stages of their care. This should include the risks of surgical site infections, what is being done to reduce them and how they are managed.
- 1.1.2 Offer patients and carers information and advice on how to care for their wound after discharge.
- 1.1.3 Offer patients and carers information and advice about how to recognise a surgical site infection and who to contact if they are concerned. Use an integrated care pathway for healthcare-associated infections to help communicate this information to both patients and all those involved in their care after discharge.
- 1.1.4 Always inform patients after their operation if they have been given antibiotics.

1.2 *Preoperative phase*

Preoperative showering

- 1.2.1 Advise patients to shower or have a bath (or help patients to shower, bath or bed bath) using soap, either the day before, or on the day of, surgery.

Hair removal

- 1.2.2 Do not use hair removal routinely to reduce the risk of surgical site infection.
- 1.2.3 If hair has to be removed, use electric clippers with a single-use head on the day of surgery. Do not use razors for hair removal, because they increase the risk of surgical site infection.

Patient theatre wear

- 1.2.4 Give patients specific theatre wear that is appropriate for the procedure and clinical setting, and that provides easy access to the operative site and areas for placing devices, such as intravenous cannulas. Consider also the patient's comfort and dignity.

Staff theatre wear

- 1.2.5 All staff should wear specific non-sterile theatre wear in all areas where operations are undertaken.

Staff leaving the operating area

- 1.2.6 Staff wearing non-sterile theatre wear should keep their movements in and out of the operating area to a minimum.

Nasal decontamination

- 1.2.7 Do not use nasal decontamination with topical antimicrobial agents aimed at eliminating *Staphylococcus aureus* routinely to reduce the risk of surgical site infection.

Mechanical bowel preparation

- 1.2.8 Do not use mechanical bowel preparation routinely to reduce the risk of surgical site infection.

Hand jewellery, artificial nails and nail polish

- 1.2.9 The operating team should remove hand jewellery before operations.
- 1.2.10 The operating team should remove artificial nails and nail polish before operations.

Antibiotic prophylaxis

- 1.2.11 Give antibiotic prophylaxis^[1] to patients before:

- clean surgery involving the placement of a prosthesis or implant

- clean-contaminated surgery
- contaminated surgery.

- 1.2.12 Do not use antibiotic prophylaxis routinely for clean non-prosthetic uncomplicated surgery.
- 1.2.13 Use the local antibiotic formulary and always consider potential adverse effects when choosing specific antibiotics for prophylaxis.
- 1.2.14 Consider giving a single dose of antibiotic prophylaxis intravenously on starting anaesthesia. However, give prophylaxis earlier for operations in which a tourniquet is used.
- 1.2.15 Before giving antibiotic prophylaxis, consider the timing and pharmacokinetics (for example, the serum half-life) and necessary infusion time of the antibiotic. Give a repeat dose of antibiotic prophylaxis when the operation is longer than the half-life of the antibiotic given.
- 1.2.16 Give antibiotic treatment (in addition to prophylaxis) to patients having surgery on a dirty or infected wound.
- 1.2.17 Inform patients before the operation, whenever possible, if they will need antibiotic prophylaxis, and afterwards if they have been given antibiotics during their operation.

1.3 *Intraoperative phase*

Hand decontamination

- 1.3.1 The operating team should wash their hands prior to the first operation on the list using an aqueous antiseptic surgical solution, with a single-use brush or pick for the nails, and ensure that hands and nails are visibly clean.
- 1.3.2 Before subsequent operations, hands should be washed using either an alcoholic hand rub or an antiseptic surgical solution. If hands are soiled then they should be washed again with an antiseptic surgical solution.

Incise drapes

1.3.3 Do not use non-iodophor-impregnated incise drapes routinely for surgery as they may increase the risk of surgical site infection.

1.3.4 If an incise drape is required, use an iodophor-impregnated drape unless the patient has an iodine allergy.

Sterile gowns

1.3.5 The operating team should wear sterile gowns in the operating theatre during the operation.

Gloves

1.3.6 Consider wearing two pairs of sterile gloves when there is a high risk of glove perforation and the consequences of contamination may be serious.

Antiseptic skin preparation

1.3.7 Prepare the skin at the surgical site immediately before incision using an antiseptic (aqueous or alcohol-based) preparation: povidone-iodine or chlorhexidine are most suitable.

1.3.8 If diathermy is to be used, ensure that antiseptic skin preparations are dried by evaporation and pooling of alcohol-based preparations is avoided.

Diathermy

1.3.9 Do not use diathermy for surgical incision to reduce the risk of surgical site infection.

Maintaining patient homeostasis

1.3.10 Maintain patient temperature in line with 'Inadvertent perioperative hypothermia' (see the NICE guideline on [hypothermia](#)).

1.3.11 Maintain optimal oxygenation during surgery. In particular, give patients sufficient oxygen during major surgery and in the recovery period to ensure that a haemoglobin saturation of more than 95% is maintained.

1.3.12 Maintain adequate perfusion during surgery.

1.3.13 Do not give insulin routinely to patients who do not have diabetes to optimise blood glucose postoperatively as a means of reducing the risk of surgical site infection.

Wound irrigation and intracavity lavage

1.3.14 Do not use wound irrigation to reduce the risk of surgical site infection.

1.3.15 Do not use intracavity lavage to reduce the risk of surgical site infection.

Antiseptic and antimicrobial agents before wound closure

1.3.16 Do not use intraoperative skin re-disinfection or topical cefotaxime in abdominal surgery to reduce the risk of surgical site infection.

Wound dressings

1.3.17 Cover surgical incisions with an appropriate interactive dressing at the end of the operation.

1.4 *Postoperative phase*

Changing dressings

1.4.1 Use an aseptic non-touch technique for changing or removing surgical wound dressings.

Postoperative cleansing

1.4.2 Use sterile saline for wound cleansing up to 48 hours after surgery.

1.4.3 Advise patients that they may shower safely 48 hours after surgery.

1.4.4 Use tap water for wound cleansing after 48 hours if the surgical wound has separated or has been surgically opened to drain pus.

Topical antimicrobial agents for wound healing by primary intention

- 1.4.5 Do not use topical antimicrobial agents for surgical wounds that are healing by primary intention to reduce the risk of surgical site infection.

Dressings for wound healing by secondary intention

- 1.4.6 Do not use Eusol and gauze, or moist cotton gauze or mercuric antiseptic solutions to manage surgical wounds that are healing by secondary intention.
- 1.4.7 Use an appropriate interactive dressing to manage surgical wounds that are healing by secondary intention.
- 1.4.8 Refer to a tissue viability nurse (or another healthcare professional with tissue viability expertise) for advice on appropriate dressings for the management of surgical wounds that are healing by secondary intention.

Antibiotic treatment of surgical site infection and treatment failure

- 1.4.9 When surgical site infection is suspected (i.e. cellulitis), either de novo or because of treatment failure, give the patient an antibiotic that covers the likely causative organisms. Consider local resistance patterns and the results of microbiological tests in choosing an antibiotic.

Debridement

- 1.4.10 Do not use Eusol and gauze, or dextranomer or enzymatic treatments for debridement in the management of surgical site infection.

Specialist wound care services

The following recommendation has been taken unchanged from 'Guidance on the use of debriding agents and specialist wound care clinics for difficult to heal surgical wounds' (NICE technology appraisal 24).

- 1.4.11 Although there is no direct evidence to support the provision of specialist wound care services for managing difficult to heal surgical wounds, a structured approach to care (including preoperative assessments to identify individuals

with potential wound healing problems) is required in order to improve overall management of surgical wounds. To support this, enhanced education of healthcare workers, patients and carers, and sharing of clinical expertise will be required.

Terms used in this guideline

Debridement The excision or wide removal of all dead (necrotic) and damaged tissue that may develop in a surgical wound. There are currently a number of other accepted methods available for wound debridement, including surgery, biosurgery, sharp debridement, hydrocolloid dressings and hydrogels.

Healing by primary intention Occurs when a wound has been sutured after an operation and heals to leave a minimal, cosmetically acceptable scar.

Healing by secondary intention Occurs when a wound is deliberately left open at the end of an operation because of excessive bacterial contamination, particularly by anaerobes or when there is a risk of devitalised tissue, which leads to infection and delayed healing. It may be sutured within a few days (delayed primary closure), or much later when the wound is clean and granulating (secondary closure), or left to complete healing naturally without the intervention of suturing.

Homeostasis The maintenance of normal physiological function.

Interactive dressing Modern (post-1980) dressing materials. Designed to promote the wound healing process through the creation and maintenance of a local, warm, moist environment underneath the chosen dressing, when left in place for a period indicated through a continuous assessment process.

Perfusion Blood flow through tissues or organs. If not optimal, it can increase the risk of infectious complications (particularly surgical site infections).

Surgical site (wound) infection This occurs when pathogenic organisms multiply in a wound giving rise to local signs and symptoms, for example, heat, redness, pain and swelling, and (in more serious cases) with systemic signs of fever or a raised white blood cell count. Infection in the surgical wound may prevent healing taking place so that the wound edges separate or it may cause an abscess to form in the deeper tissues.

The definitions of surgical site infection may vary between research studies but are commonly

based on those described by the Centers for Disease Control and Prevention although other valid measures have been used. For example, the ASEPSIS scoring method for postoperative wound infections and some studies which have focused only on the more serious deep and organ/space infections for which less subjective measures are available. Differences in case definitions should be taken into account when comparing reported rates of surgical site infection.

Surgical wound classification Clean: an incision in which no inflammation is encountered in a surgical procedure, without a break in sterile technique, and during which the respiratory, alimentary or genitourinary tracts are not entered.

Clean-contaminated: an incision through which the respiratory, alimentary, or genitourinary tract is entered under controlled conditions but with no contamination encountered.

Contaminated: an incision undertaken during an operation in which there is a major break in sterile technique or gross spillage from the gastrointestinal tract, or an incision in which acute, non-purulent inflammation is encountered. Open traumatic wounds that are more than 12–24 hours old also fall into this category.

Dirty or infected: an incision undertaken during an operation in which the viscera are perforated or when acute inflammation with pus is encountered (for example, emergency surgery for faecal peritonitis), and for traumatic wounds where treatment is delayed, there is faecal contamination, or devitalised tissue is present.

More information

You can also see this guideline in the NICE pathway on [prevention and control of healthcare-associated infections](#).

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

See also the guideline committee's discussion and the evidence reviews (in the [full guideline](#)), and information about [how the guideline was developed](#), including details of the committee.

^[1] Also see recommendations 1.4.6.19, 1.4.6.20 and 1.4.6.21 in NICE's guideline on [caesarean section](#).

2 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. The Guideline Development Group's full set of research recommendations is detailed in the full guideline (see section 5).

2.1 *Nasal decontamination*

Is it cost effective to use mupirocin for nasal decontamination? In which patients is it most effective?

Why this is important

This is important as it is not clear how many surgical site infections would be prevented by treating all patients with nasal mupirocin, or whether only patients who are nasally colonised with methicillin-resistant *Staphylococcus aureus* should be treated. The use of mupirocin and its application is cost- and time-sensitive, apart from the concern that excessive use of mupirocin may lead to resistance. There should be further research involving large numbers of study participants undergoing different operations.

2.2 *Maintaining patient homeostasis*

2.2.1 **Oxygenation**

What is the value of supplemented oxygenation in the recovery room in the prevention of surgical site infection? What are the likely mechanisms of action?

Why this is important

There have been several randomised control trials (RCTs) that show a contradictory effect of supplemental oxygenation in the recovery room period, some showing benefit, some not. Two separate trials indicate that surgical site infection rates can be halved simply by increasing the amount of inspired oxygen. However, a fraction of inspired oxygen (FiO₂) of 0.8 cannot be achieved using a face mask, and all patients already receive an increased FiO₂ to give a haemoglobin saturation of at least 95% by their anaesthetist during the operation and in the immediate postoperative period. The mechanism for improved blood oxygen carriage due to increased FiO₂ is physiologically not clear. However, this simple, cheap intervention deserves further investigation.

2.2.2 Perioperative blood glucose control

What are the possible benefits of improved postoperative blood glucose control on the incidence of surgical site infection?

Why this is important

There have been several large cohort studies in cardiac surgery which indicate that tight postoperative blood glucose control can reduce the risk of surgical site infections, and the serious complication of sternal incision infection in particular. A blood glucose level above the normal range is typical after major trauma and has been considered part of the 'normal' metabolic response. Further studies should be adequately powered RCTs covering a wide range of surgical procedures to show unequivocally that tight blood glucose control is acceptable (even if it lowers the risk of surgical site infections in general) as the lowering of glucose in the immediate postoperative period may have unwanted complications and will require added careful surveillance. Again, the physiological mechanisms that reduce the risk of surgical site infection are not entirely clear.

2.3 Closure methods

What types of closure methods will reduce the risk of surgical site infection?

Why this is important

Although there are many studies in the field of wound closure, there are still several areas in which questions remain unanswered. Natural suture materials such as catgut and silk have been replaced by tailor-made absorbable and non-absorbable polymers. However, more research is needed to convince surgeons to stop using mass closure of the abdominal wall or subcuticular sutures for skin closure, as these methods have become standard practice. The use of monofilaments or braids also depends on personal preference and further trials are unlikely to show differences in surgical site infection. There are data to show some techniques can allow more rapid closure, such as the use of staples or adhesive acrylate glues. Again, these have other disadvantages that could only be proven in what would be large, single-intervention RCTs. Further research is required on use of different suture materials and skin adhesives and their effect on the rate of surgical site infection. Research should be multi-centred, adequately powered, single-intervention RCTs. Studies should also include the cost effectiveness of different closure methods.

2.4 *Wound dressings*

What is the benefit and cost effectiveness of different types of post-surgical interactive dressings for reducing the risk of surgical site infection?

Why this is important

There are a huge number of dressings available for chronic wound care that could also be used for incisional sites. The use of island dressings compared with simple adhesive polyurethane transparent dressings is an example of a study that could be undertaken with outcomes of reductions in surgical site infections and also reductions in skin complications and improvements in final cosmetic outcomes. However, current studies are not adequate to show convincing differences. Research is also required on the effects of antiseptic-bearing dressings, placed at the end of an operation or at dressing changes. These antiseptics could include povidone-iodine, biguanides (such as chlorhexidine) or silver.

2.5 *Dressings for wound healing by secondary intention*

What are the most appropriate methods of chronic wound care (including alginates, foams and hydrocolloids and dressings containing antiseptics such as antimicrobial honey, cadexomer iodine or silver) in terms of management of surgical site infection as well as patient outcomes?

Why this is important

There are many small cohort studies which have examined the use of the wide range of dressings in surgical site infection management after an infected wound has been opened or after there has been separation of the wound edges after a surgical site infection. Differences are hard to see because the trials often include other wounds that are healing by secondary intention, such as chronic venous or diabetic ulcers and pressure sores. Specific studies using antiseptics (povidone-iodine, biguanides such as chlorhexidine, or silver) and other agents such as antimicrobial honey need to address this in powered randomised trials, specifically in the management of surgical site infection of an open wound. Similar questions need to be asked for the use of topical negative pressure, which has become widely used with or without antiseptic irrigation.

Update information

February 2017: A footnote was added to recommendation 1.2.11 linking to the NICE guideline on [caesarean section](#).

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Accreditation

