NICE National Institute for Health and Care Excellence

NICE guideline

Surgical site infections: prevention and treatment

NICE guideline
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All problems (adverse events) related to a medicine or medical device used for treatment or in a procedure should be reported to the Medicines and Healthcare products Regulatory Agency using the Yellow Card Scheme.

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.

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Contents

Overview 4
Who is it for? 4
Recommendations 5
1.1 Information for patients and carers 5
1.2 Preoperative phase 6
1.3 Intraoperative phase 9
1.4 Postoperative phase 14
Terms used in this guideline 16
Recommendations for research 18
Key recommendations for research 18
Other recommendations for research 20
Rationale and impact 21
Nasal decolonisation 21
Antiseptic skin preparation 23
Antiseptics and antibiotics before wound closure 24
Closure methods 26
Context 28
Finding more information and committee details 30
Update information 31

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This guideline replaces CG74.

This guideline is the basis of QS49.

Overview

This guideline covers preventing and treating surgical site infections in adults, young people and children who are having a surgical procedure involving a cut through the skin. It focuses on methods used before, during and after surgery to minimise the risk of infection.

Who is it for?

- Healthcare professionals
- Commissioners and providers
- People having surgery, their families and carers

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Recommendations

People have the right to be involved in discussions and make informed decisions about their care, as described in NICE's information on making decisions about 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.

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. For more guidance on providing information to adults and discussing their preferences with them, see the NICE guideline on patient experience in adult NHS services. **[2008]**

1.1.2 Offer patients and carers information and advice on how to care for their wound after discharge. **[2008]**

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. **[2008]**

1.1.4 Always inform patients after their operation if they have been given antibiotics. **[2008]**

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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. **[2008]**

Nasal decolonisation

1.2.2 Consider nasal mupirocin in combination with a chlorhexidine body wash before procedures in which *Staphylococcus aureus* is a likely cause of a surgical site infection. This should be locally determined and take into account:

- the type of procedure
- individual patient risk factors
- the increased risk of side effects in preterm infants (see the recommendation on risks in babies in the section on antiseptic skin preparation)
- the potential impact of infection. **[2019]**

1.2.3 Maintain surveillance on antimicrobial resistance associated with the use of mupirocin. For information on antimicrobial stewardship programmes, see the NICE guideline on antimicrobial stewardship: systems and processes for effective antimicrobial medicine use. **[2019]**

For a short explanation of why the committee made the 2019 recommendations and how they might affect practice, see the rationale and impact section on nasal decolonisation.

Full details of the evidence and the committee's discussion are in evidence review A: nasal decontamination in the prevention of surgical site infection.

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Hair removal

1.2.4 Do not use hair removal routinely to reduce the risk of surgical site infection. **[2008]**

1.2.5 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. **[2008]**

Patient theatre wear

1.2.6 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. Take into account the patient's comfort and dignity. **[2008]**

Staff theatre wear

1.2.7 All staff should wear specific non-sterile theatre wear in all areas where operations are undertaken. **[2008]**

Staff leaving the operating area

1.2.8 Staff wearing non-sterile theatre wear should keep their movements in and out of the operating area to a minimum. **[2008]**

Mechanical bowel preparation

1.2.9 Do not use mechanical bowel preparation routinely to reduce the risk of surgical site infection. **[2008]**

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Hand jewellery, artificial nails and nail polish

1.2.10 The operating team should remove hand jewellery before operations. **[2008]**

1.2.11 The operating team should remove artificial nails and nail polish before operations. **[2008]**

Antibiotic prophylaxis

1.2.12 Give antibiotic prophylaxis to patients before:

- clean surgery involving the placement of a prosthesis or implant
- clean-contaminated surgery
- contaminated surgery. **[2008]**

  For advice on antibiotic prophylaxis before caesarean birth, see the section on timing of antibiotic administration in NICE's guideline on caesarean birth. For information on antimicrobial stewardship programmes see the NICE guideline on antimicrobial stewardship: systems and processes for effective antimicrobial medicine use.

1.2.13 Do not use antibiotic prophylaxis routinely for clean non-prosthetic uncomplicated surgery. **[2008]**

1.2.14 Use the local antibiotic formulary and always take into account the potential adverse effects when choosing specific antibiotics for prophylaxis. **[2008]**

1.2.15 Consider giving a single dose of antibiotic prophylaxis intravenously on starting anaesthesia. However, give prophylaxis earlier for operations in which a tourniquet is used. **[2008]**

1.2.16 Before giving antibiotic prophylaxis, take into account 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. **[2008]**

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1.2.17 Give antibiotic treatment (in addition to prophylaxis) to patients having surgery on a dirty or infected wound. **[2008]**

1.2.18 Inform patients before the operation, whenever possible, if they will need antibiotic prophylaxis, and afterwards if they have been given antibiotics during their operation. **[2008]**

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. **[2008]**

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. **[2008]**

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. **[2008]**

1.3.4 If an incise drape is required, use an iodophor-impregnated drape unless the patient has an iodine allergy. **[2008]**

Sterile gowns

1.3.5 The operating team should wear sterile gowns in the operating theatre during the operation. **[2008]**

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Gloves

1.3.6 Consider wearing 2 pairs of sterile gloves when there is a high risk of glove perforation and the consequences of contamination may be serious. **[2008]**

Antiseptic skin preparation

1.3.7 Prepare the skin at the surgical site immediately before incision using an antiseptic preparation. **[2019]**

1.3.8 Be aware of the risks of using skin antiseptics in babies, in particular the risk of severe chemical injuries with the use of chlorhexidine (both alcohol-based and aqueous solutions) in preterm babies. **[2019]**

1.3.9 When deciding which antiseptic skin preparation to use, options may include those in table 1. **[2019]**

Table 1 Options for antiseptic skin preparation

When	Choice of antiseptic skin preparation
First choice unless contraindicated or the surgical site is next to a mucous membrane	**Alcohol-based solution of chlorhexidine** In December 2023, 0.5% chlorhexidine in 70% alcohol solution (Prevase) was licensed for 'preoperative skin disinfection prior to surgical procedures', and 2.0% chlorhexidine in 70% alcohol applicators (ChloraPrep) was licensed for 'disinfection of the skin prior to invasive medical procedures'. In March 2024, 0.5% chlorhexidine in 70% alcohol solution (Prevase Stain) was licensed for 'preoperative skin disinfection prior to surgical procedures'. Other formulations of chlorhexidine in alcohol were off label for this use. See NICE's information on prescribing medicines.

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When	Choice of antiseptic skin preparation
Alternative if the surgical site is next to a mucous membrane	**Aqueous solution of chlorhexidine** In April 2019, 4.0% aqueous chlorhexidine (Hibiscrub) was licensed for 'preoperative and postoperative skin antisepsis for patients undergoing elective surgery'; however, relevant instructions were limited to use as a body wash to be used before the person enters the operating theatre. Other formulations of aqueous chlorhexidine were off label for this use. See NICE's information on prescribing medicines.
Alternative if chlorhexidine is contraindicated	**Alcohol-based solution of povidone-iodine** In April 2019, 10% povidone-iodine alcoholic solution (Videne alcoholic tincture) was licensed for 'topical application'. The 10% povidone-iodine (Betadine Alcoholic solution) was licensed for 'antiseptic skin cleanser for major and minor surgical procedures'. Other formulations of povidone-iodine alcoholic solution were off label for this use. See NICE's information on prescribing medicines.
If both an alcohol-based solution and chlorhexidine are unsuitable	**Aqueous solution of povidone-iodine** In April 2019, 7.5% povidone-iodine surgical scrub solution (Videne) was licensed for disinfecting the site of incision prior to elective surgery' and 7.5% povidone-iodine (Betadine surgical scrub) was licensed for 'preoperative preparation of patients' skin'. The 10% iodine antiseptic solution (Videne) was licensed for 'disinfection of intact external skin or as a mucosal antiseptic' and 10% povidone-iodine solution (Standardised Betadine antiseptic solution) was licensed for 'preoperative and postoperative antiseptic skin cleanser for major and minor surgical procedures'. Other formulations of povidone-iodine aqueous solution were off label for this use. See NICE's information on prescribing medicines.

1.3.10 If diathermy is to be carried out:

- use evaporation to dry antiseptic skin preparations **and**
- avoid pooling of alcohol-based preparations. **[2019]**

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For a short explanation of why the committee made the 2019 recommendations and how they might affect practice, see the rationale and impact section on antiseptic skin preparation.

Full details of the evidence and the committee's discussion are in evidence review B: skin antiseptics in the prevention of surgical site infection.

Diathermy

1.3.11 Do not use diathermy for surgical incision to reduce the risk of surgical site infection. **[2008]**

Maintaining patient homeostasis

1.3.12 Maintain patient temperature in line with NICE's guideline on hypothermia: prevention and management in adults having surgery. **[2008]**

1.3.13 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. **[2008]**

1.3.14 Maintain adequate perfusion during surgery. See additional recommendations on intravenous fluids and cardiac monitoring for adults in NICE's guideline on perioperative care in adults. **[2008, amended 2020]**

1.3.15 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. See the additional recommendation on blood glucose control for adults in NICE's guideline on perioperative care in adults. **[2008, amended 2020]**

Wound irrigation and intracavity lavage

1.3.16 Do not use wound irrigation to reduce the risk of surgical site infection. **[2008]**

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1.3.17 Do not use intracavity lavage to reduce the risk of surgical site infection. **[2008]**

Antiseptics and antibiotics before wound closure

1.3.18 Only apply an antiseptic or antibiotic to the wound before closure as part of a clinical research trial. **[2019]**

1.3.19 Consider using gentamicin-collagen implants in cardiac surgery. **[2019]**

For a short explanation of why the committee made the 2019 recommendations and how they might affect practice, see the rationale and impact section on antiseptics and antibiotics before wound closure.

Full details of the evidence and the committee's discussion are in evidence review C: intraoperative antiseptics and antibiotics before wound closure.

Closure methods

1.3.20 When using sutures, consider using antimicrobial triclosan-coated sutures, especially for paediatric surgery, to reduce the risk of surgical site infection. **[2019]**

1.3.21 Consider using sutures rather than staples to close the skin after caesarean birth to reduce the risk of superficial wound dehiscence. **[2019]**

For a short explanation of why the committee made the 2019 recommendations and how they might affect practice, see the rationale and impact section on closure methods.

Full details of the evidence and the committee's discussion are in evidence review D: closure materials and techniques in the prevention of surgical site infection.

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Wound dressings

1.3.22 Cover surgical incisions with an appropriate interactive dressing at the end of the operation. **[2008]**

1.4 Postoperative phase

Changing dressings

1.4.1 Use an aseptic non-touch technique for changing or removing surgical wound dressings. **[2008]**

Postoperative cleansing

1.4.2 Use sterile saline for wound cleansing up to 48 hours after surgery. **[2008]**

1.4.3 Advise patients that they may shower safely 48 hours after surgery. **[2008]**

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. **[2008]**

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. **[2008]**

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. **[2008]**

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1.4.7 Use an appropriate interactive dressing to manage surgical wounds that are healing by secondary intention. **[2008]**

1.4.8 Ask 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. **[2008]**

Antibiotic treatment of surgical site infection and treatment failure

1.4.9 When surgical site infection is suspected by the presence of cellulitis, either by a new infection or an infection caused by 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. For information on antimicrobial stewardship programmes see the NICE guideline on antimicrobial stewardship: systems and processes for effective antimicrobial medicine use. **[2008]**

Debridement

1.4.10 Do not use Eusol and gauze, or dextranomer or enzymatic treatments for debridement in the management of surgical site infection. **[2008]**

Specialist wound care services

1.4.11 Use a structured approach to care to improve overall management of surgical wounds. This should include preoperative assessments to identify people with potential wound healing problems. Enhanced education of healthcare workers, patients and carers, and sharing of clinical expertise is needed to support this. **[2008]**

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Terms used in this guideline

Decolonisation

The process of eradicating or reducing asymptomatic carriage of methicillin-resistant *S. aureus* (MRSA). This used to be referred to as decontamination.

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 suturing.

Interactive dressing

Dressings 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.

Surgical site (wound) infection

A surgical wound with local signs and symptoms of infection, 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, causing the wound edges to separate, or it may cause an abscess to form in the deeper tissues.

Definitions of the severity of surgical site infections vary and this should be taken into account when comparing reported rates of surgical site infection.

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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 to 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 if treatment is delayed, there is faecal contamination, or devitalised tissue is present

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Recommendations for research

The 2008 guideline committee made the following recommendations for research marked **[2008]**. The guideline committee's full set of recommendations for research is detailed in the 2008 full guideline.

As part of the 2019 update, the guideline committee updated recommendations for research on nasal decolonisation and wound closure methods, and made new recommendations for research on antiseptic skin preparation and antiseptics and antibiotics before wound closure. These are marked **[2019]**.

Key recommendations for research

1 Nasal decolonisation: effectiveness

What is the clinical effectiveness of preoperative nasal decolonisation using mupirocin in combination with a chlorhexidine body wash in the whole population? **[2019]**

For a short explanation of why the committee made the recommendation for research, see the rationale section on nasal decolonisation.

Full details of the evidence and the committee's discussion are in evidence review A: nasal decontamination in the prevention of surgical site infection.

2 Nasal decolonisation: antimicrobial resistance

Is the use of chlorhexidine body wash associated with increased antimicrobial resistance? **[2019]**

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For a short explanation of why the committee made the recommendation for research, see the rationale section on nasal decolonisation.

Full details of the evidence and the committee's discussion are in evidence review A: nasal decontamination in the prevention of surgical site infection.

3 Antiseptic skin preparation

What is the clinical and cost effectiveness of chlorhexidine in alcohol at different concentrations in the prevention of surgical site infection when applied to the skin before incision? **[2019]**

For a short explanation of why the committee made the recommendation for research, see the rationale section on antiseptic skin preparation.

Full details of the evidence and the committee's discussion are in evidence review B: skin antiseptics in the prevention of surgical site infection.

4 Antiseptics and antibiotics before wound closure

Is the application of antiseptics and antibiotics in the operative field before wound closure, clinically and cost effective in reducing surgical site infection rates? **[2019]**

For a short explanation of why the committee made the recommendation for research, see the rationale section on antiseptics and antibiotics before wound closure.

Full details of the evidence and the committee's discussion are in evidence review C: intraoperative antiseptics and antibiotics before wound closure.

5 Closure methods

Which patient groups, contamination groups and which layers gain the most benefit from the use of triclosan-coated or triclosan-impregnated sutures? **[2019]**

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For a short explanation of why the committee made the recommendation for research, see the rationale section on closure methods.

Full details of the evidence and the committee's discussion are in evidence review D: closure materials and techniques in the prevention of surgical site infection.

Other recommendations for research

Nasal decolonisation: effectiveness

What is the contribution to clinical effectiveness of the timing of nasal decolonisation and body wash for the prevention of surgical site infection? **[2019]**

What is the effectiveness of decolonisation using alternative interventions in combination with nasal decolonisation in the prevention of surgical site infections when chlorhexidine is contraindicated? **[2019]**

Antiseptic skin preparation

What is the clinical and cost effectiveness of a double application of antiseptic to the skin at the surgical site compared with a single application? **[2019]**

What is the clinical and cost effectiveness of different modes of applying skin antiseptic before incision in the prevention of surgical site infection? **[2019]**

Closure methods

Does the use of barbed sutures for wound closure reduce the incidence of surgical site infection? **[2019]**

Which closure method or technique is the most effective for reducing surgical site infections in patients undergoing emergency surgery? **[2019]**

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Rationale and impact

These sections briefly explain why the committee made the recommendations and how they might affect practice. They link to details of the evidence and a full description of the committee's discussion.

Nasal decolonisation

Recommendations 1.2.2 to 1.2.3

Why the committee made the recommendations

Evidence was identified on the use of mupirocin alone and mupirocin in combination with a chlorhexidine body wash. Mupirocin alone was effective in reducing *Staphylococcus aureus* infections caught in hospital in people who were identified as carriers of *S. aureus*. However, mupirocin alone did not reduce surgical site infections across all people undergoing surgery.

The evidence also showed that people identified as carriers of *S. aureus* who used nasal mupirocin in combination with a chlorhexidine body wash before surgery had fewer surgical site infections caused by *S. aureus* (including deep infections, methicillin-sensitive infections and infections caught in hospital) than those who did not have the intervention. However, the evidence was very limited and only covered *S. aureus* carriers.

Economic studies favoured the use of mupirocin alone. However, the studies were not UK-based and could not be applied to NHS practice (for example, because of the high cost of treating surgical site infections in US studies). An economic model based on UK data demonstrated that, compared with no treatment, using mupirocin with a chlorhexidine body wash before all operations was an efficient use of resources in most specialist surgeries. However, there was less certainty of cost effectiveness for surgery with a low risk of surgical site infections caused by *S. aureus*.

Because of the limited evidence, the committee were unable to make strong recommendations on nasal decolonisation before surgery and agreed that it should not be offered to all people having surgery. The committee applied their clinical understanding and experience of current best practice, and recommended that nasal mupirocin with

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chlorhexidine body wash should be considered before procedures that have an increased risk of surgical site infection caused by *S. aureus*, for which there would be the most benefit.

The recommendation does not define the surgical procedures in which *S. aureus* is a likely cause of a surgical site infection. The committee agreed that although cardiac and orthopaedic surgery can be considered high risk, decisions should be made locally through discussions between surgical and infection control teams, and should also take into account patient risk factors, such as whether the person is an *S. aureus* carrier and the potential impact of infection on the person, including the cost of managing the infection. The recommendation does not give an optimal timing for nasal decolonisation because of a lack of evidence. But the committee were aware that mupirocin with chlorhexidine can be given from 2 days before surgery to 3 days after surgery.

The committee also took into consideration the potential side effects of mupirocin (such as a burning sensation and local reactions) and the cautions identified for the use of chlorhexidine solution in people with existing skin conditions and in preterm newborn babies. The committee noted that the Medicines and Healthcare products Regulatory Agency (MHRA) has published MHRA advice on the use of chlorhexidine for skin disinfection in premature babies.

There was also a lack of evidence on antimicrobial resistance associated with the use of mupirocin and chlorhexidine body wash. The committee agreed that it would be helpful to encourage service providers to maintain surveillance on antimicrobial resistance associated with the use of mupirocin. This would allow any increase in resistance to be captured.

The committee developed a recommendation for research on the effectiveness of nasal mupirocin with chlorhexidine body wash across all surgical procedures to help determine whether this should be extended to all people having surgery. Antimicrobial resistance associated with the use of chlorhexidine body wash was also identified by the committee as an important area for research, so the committee made a recommendation for research on nasal decolonisation and antimicrobial resistance.

How the recommendations might affect practice

There is considerable variability in practice. In some services decolonisation is always offered before certain types of surgery, for example, before orthopaedic surgery. In other

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services decolonisation is offered only to people who are identified as methicillin-resistant *S. aureus* (MRSA) or methicillin-sensitive *S. aureus* (MSSA) carriers.

The new recommendation reflects best practice and allows services the flexibility to consider decolonisation for people who are likely to benefit the most. The recommendation may reduce surgical site infections in people undergoing surgical procedures for which the consequences of an infection are severe, such as cardiac surgery. The evidence suggests that any additional costs incurred in providing decontamination are likely to be more than recouped by savings associated with a lower incidence of surgical site infections. However, the committee acknowledged that there may be training implications for those implementing the recommendation.

Maintenance of surveillance systems assessing antimicrobial resistance associated with the use of mupirocin will reinforce good practice.

Return to recommendations

Antiseptic skin preparation

Recommendations 1.3.7 to 1.3.10

Why the committee made the recommendations

Based on their knowledge and experience, the committee agreed that an antiseptic should be used for skin preparation before surgery. Overall, the evidence showed that chlorhexidine in alcohol was associated with the lowest incidence of surgical site infections, whereas aqueous povidone-iodine was associated with the highest incidence. An economic analysis also showed that chlorhexidine in alcohol is likely to be cost effective. Based on the evidence, the committee agreed that an alcohol-based solution of chlorhexidine should usually be the first choice when deciding which antiseptic preparation to use. However, the quality of the studies was not good enough for the committee to make a strong recommendation for the choice of antiseptic preparation.

The committee discussed that alcohol-based solutions should not be applied to mucous membranes because of the risk of burns. For surgical procedures next to mucous membranes, they agreed to recommend an aqueous solution of chlorhexidine as an option for skin preparation. Because of the limited evidence, the committee were unable to make a strong recommendation.

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There was little evidence to support the use of povidone-iodine, but based on their clinical experience the committee agreed that it should be an option when chlorhexidine is contraindicated, for example, in people with hypersensitivity to chlorhexidine.

There was no evidence on the use of skin antiseptics in babies. However, the committee were aware of risks, such as burns, associated with their use in this population, and wished to highlight this. The committee noted that the MHRA has published MHRA advice on the use of chlorhexidine for skin disinfection in premature babies.

The committee also discussed that some operative procedures may require diathermy. This means that precautions must be taken when using alcohol-based antiseptic solutions because they are flammable and can result in burns. Along with using evaporation to dry antiseptic skin preparations and avoiding pooling, the committee also agreed that soaked materials, drapes or gowns should be removed before diathermy, excessive quantities of alcohol antiseptics should not be used and no excess product should be present before applying an occlusive dressing.

The committee agreed that further research is needed to establish the effectiveness of different concentrations of chlorhexidine in reducing the risk of surgical site infections. Therefore, the committee made a recommendation for research on antiseptic skin preparation to examine this further.

How the recommendations might affect practice

Antiseptic skin preparation before skin incision is standard practice although the type of antiseptic used varies depending on the type of surgery.

The recommendations follow current trends in practice and should reduce variation.

Return to recommendations

Antiseptics and antibiotics before wound closure

Recommendations 1.3.18 and 1.3.19

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Why the committee made the recommendations

Limited evidence was identified on the intraoperative use of topical wound antiseptics before wound closure. Although this evidence suggested that topical povidone-iodine was effective in reducing surgical site infections, the studies were dated. This evidence also suggested that topical antiseptics, such as iodine in alcohol solution, are not effective in reducing surgical site infections.

The evidence on topical antibiotics before wound closure was varied, but also included several older studies. Some studies showed that antibiotics, such as ampicillin powder and cephaloridine, reduced the number of surgical site infections. However, the evidence for other antibiotics, such as vancomycin, which is widely used worldwide and commonly used in cardiac, orthopaedic and spine surgery, suggested no reduction in surgical site infections.

The committee agreed that the evidence was not current or clear enough to make a recommendation on the use of topical antiseptics and antibiotics before wound closure. The committee also took into account concerns about antimicrobial resistance and the potential for multidrug resistance, and agreed that without new conclusive evidence, use of intraoperative topical antibiotic and antiseptics should be stopped. They agreed that this is an important area for further research and recommended that they should be considered only in the context of further research to help limit unnecessary use and determine their clinical effectiveness. They also developed a recommendation for research on applying antiseptics and antibiotics before wound closure to determine the clinical and cost effectiveness of applying antiseptics and antibiotics before wound closure in reducing surgical site infection rates.

There was some economic evidence that antibiotic-loaded bone cement was cost effective when compared with plain cement. However, the committee were not confident that the evidence was applicable to current NHS practice. In addition, the clinical evidence suggested that antibiotic-loaded bone cement did not reduce the number of surgical site infections. The committee agreed that the evidence was too limited to make a recommendation for this intervention.

Evidence was also identified on the use of gentamicin implants before skin closure during different surgical procedures. In particular, the evidence suggested that gentamicin-collagen implants reduced the incidence of surgical site infections in people at 1 month and 2 months after cardiac surgery. Although the evidence was limited, cardiac surgery is

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associated with a high risk of surgical site infection, which is expensive to manage. Therefore, the committee agreed that gentamicin-collagen implants should be an option to reduce the risk of infection.

How the recommendations might affect practice

In practice, the use of topical antiseptics and antibiotics before wound closure varies. Limiting their use to clinical trials is likely to reduce their misuse in practice and encourage research in this area.

Although gentamicin-collagen implants are used in cardiac surgery, not all services currently use them. The new recommendation may help to reduce variation and standardise practice. Any additional costs are likely to be balanced by savings from a reduction in the number of surgical site infections.

Return to recommendations

Closure methods

Recommendations 1.3.20 and 1.3.21

Why the committee made the recommendations

Overall, the evidence suggested that staples increase the incidence of wound dehiscence when compared with sutures for wound closure across different types of surgery. However, when the studies were analysed according to the type of surgery, many of the studies showing this difference were found to be on wound closure after caesarean birth. The committee agreed that there was not enough evidence to recommend sutures over staples in all surgery, and decided to focus the recommendation on caesarean birth. The committee agreed that this was important in improving recovery for women having caesarean births, and that it should be reflected in the recommendations. However, the committee noted that the evidence did not capture all populations, for example obese women. Therefore, the recommendation was made to consider sutures rather than staples.

The committee discussed the evidence for antimicrobial triclosan-coated sutures and agreed that the evidence overall favoured triclosan-coated sutures over standard sutures for reducing surgical site infection. However, they noted that the studies covered many

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different types of surgery and were of variable quality, meaning that it was difficult to be confident of the benefit. Further analysis by the type of surgery showed a clear benefit of using triclosan-coated sutures only in paediatric surgery. The committee therefore agreed that they should be considered as an option for wound closure in all types of surgery, and that their use in paediatric surgery should be emphasised in particular. The committee also developed a recommendation for research on closure methods to better clarify which patients should have triclosan-coated sutures and which surgical layers they should be used for.

How the recommendations might affect practice

The recommendations are unlikely to have a major effect on current practice. Current practice in wound closure varies, so the new recommendations may help to reduce variation and standardise practice.

Using sutures rather than staples for wound closure in caesarean birth may lead to a reduction in the number of women experiencing wound dehiscence following surgery, which may reduce the costs of treatment. However, the committee acknowledged that there may be training implications for those implementing the recommendation.

Use of antimicrobial triclosan-coated sutures may increase, which may have cost implications because they are more expensive than standard sutures. However, it is likely that the increased cost will be outweighed by savings from a reduction in the number of surgical site infections, which are costly to treat.

Return to recommendations

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Context

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 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 to 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. Most surgical site infections are preventable. Measures can be taken in the pre-, intra- and postoperative phases of care to reduce the 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.

In 2017, the NICE surveillance team reviewed the guideline and identified new evidence on

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nasal decolonisation, skin antiseptics, the use of antiseptics and antibiotics before wound closure, and closure methods. This evidence has been reviewed and the recommendations in these areas updated.

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Finding more information and committee details

To find NICE guidance on related topics, including guidance in development, see the NICE topic page on healthcare-associated infections.

For full details of the evidence and the guideline committee's discussions, see the evidence reviews. You can also find information about how the guideline was developed, including details of the committee.

NICE has produced tools and resources to help you put this guideline into practice. For general help and advice on putting our guidelines into practice, see resources to help you put NICE guidance into practice.

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Update information

August 2020: We have added a link in recommendations 1.3.14 and 1.3.15 to the NICE guideline on perioperative care in adults to highlight additional guidance on intravenous fluids, cardiac monitoring and blood glucose control for adults.

April 2019: We have reviewed the evidence and made new recommendations on nasal decolonisation, preoperative antiseptic skin preparation, antiseptics and antimicrobials before wound closure, and methods of wound closure to prevent surgical site infections in people having surgery. These recommendations are marked **[2019]**.

Recommendations marked **[2008]** last had an evidence review in 2008. In some cases, minor changes have been made to the wording to bring the language and style up to date, without changing the meaning.

Minor changes since publication

March 2024: We updated the licensed indication for Prevase Stain in table 1.

January 2024: We updated the licensed indication for Prevase and removed Hydrex in table 1.

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Accreditation



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