NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

Guideline

Surgical site infections: prevention and treatment

Draft for consultation, November 2018

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 recommends effective methods to use 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

We have reviewed the evidence on nasal decolonisation, preoperative antiseptic skin preparation, antiseptics and antimicrobials before wound closure, and methods of wound closure. You are invited to comment on the new and updated recommendations. These are marked as **[2019]**.

You are also invited to comment on recommendations that NICE proposes to delete from the 2008 guideline.

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

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

This draft guideline contains:

- the draft recommendations
- recommendations for research
- rationale and impact sections that explain why the committee made the 2019 recommendations and how they might affect practice.
- the guideline context.

Information about how the guideline was developed is on the guideline's page on the NICE website. This includes the evidence reviews, the scope, and details of the committee and any declarations of interest.

Full details of the evidence and the committee's discussion on the 2019 recommendations are in the evidence reviews. Evidence for the 2008 recommendations is in the full version of the 2008 guideline.

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Recommendations

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

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

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]**

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. **[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]**

To find out why the committee made the 2019 recommendations on nasal decolonisation and how they might affect practice, see rationale and impact.

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]**

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 section, see the section on surgical techniques: timing of antibiotic administration in NICE's guideline on caesarean section. 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]**

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]**

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. **[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[1]
If the surgical site is next to a mucous membrane	Aqueous solution of chlorhexidine
If chlorhexidine is contraindicated	Alcohol-based solution of povidone-iodine
If both an alcohol-based solution and chlorhexidine are unsuitable	Aqueous solution of povidone-iodine

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]**

To find out why the committee made the 2019 recommendations on antiseptic skin preparation and how they might affect practice, see rationale and impact.

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] At the time of consultation (November 2018), 0.5% chlorhexidine in 70% alcohol solution (Hydrex) had a UK marketing authorisation for 'pre-operative skin disinfection prior to minor surgical procedures' and 2.0% chlorhexidine in 70% alcohol applicators (ChloraPrep) had a UK marketing authorisation for 'disinfection of the skin prior to invasive medical procedures'. Other formulations of chlorhexidine in alcohol did not have UK marketing authorisation for these uses. The prescriber should follow relevant professional guidance, taking full responsibility for the decision. Informed consent should be obtained and documented. See the General Medical Council's Prescribing guidance: prescribing unlicensed medicines for further information.

1.3.14 Maintain adequate perfusion during surgery. **[2008]**

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. **[2008]**

Wound irrigation and intracavity lavage

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

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]**

To find out why the committee made the 2019 recommendations on antiseptics and antimicrobials before wound closure and how they might affect practice, see rationale and impact.

Closure methods

1.3.20 Consider using sutures rather than staples to close the skin after caesarean section to reduce the risk of superficial wound dehiscence. [2] **[2019]**

1.3.21 Consider using triclosan-coated sutures, especially for paediatric surgery, to reduce the risk of surgical site infection. **[2019]**

To find out why the committee made the 2019 recommendations on closure methods and how they might affect practice, see rationale and impact.

[2] When this guideline is published, it is planned that this recommendation will replace recommendation 1.4.6.17 of the NICE guideline on caesarean section, which will be stood down and replaced with a cross-reference to the this guideline.

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]**

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]**

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 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.

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

Recommendations for research

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

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

Key recommendations for research

1 Nasal decolonisation: effectiveness

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

2 Nasal decolonisation: antimicrobial resistance

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

To find out why the committee made the research recommendations on nasal decolonisation see rationale and impact.

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]**

To find out why the committee made the research recommendation on antiseptic skin preparation see rationale and impact.

4 Maintaining patient homeostasis: 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? **[2008]**

5 Maintaining patient homeostasis: perioperative blood glucose control

What are the possible benefits of improved postoperative blood glucose control on the incidence of surgical site infection? **[2008]**

6 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]**

To find out why the committee made the research recommendation on antiseptics and antibiotics before wound closure see rationale and impact.

7 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]**

To find out why the committee made the research recommendation on closure methods see rationale and impact.

8 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? **[2008]**

9 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? **[2008]**

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?

What is the effectiveness of decolonisation using alternative interventions in combination with nasal decolonisation in the prevention of surgical site infections, in people who present with contraindication to chlorhexidine?

Antiseptic skin preparation

What is the clinical and cost effectiveness of double application of antiseptics to the skin at the surgical site compared to single application?

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

Closure methods

Does the use of barbed sutures for wound closure reduce the incidence of SSI?

Which closure method or technique is the most effective for reducing SSI in patients undergoing emergency surgery?

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 did not reduce surgical site infections in all people having 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 practice, and recommended that nasal mupirocin with 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 committee were aware that the recommendation does not fully reflect the clinical and economic analysis but agreed that any new recommendations should reflect current practice.

The recommendation does not define which procedures are associated with a higher risk, but the committee agreed that centres will be aware of these procedures, which include cardiac and orthopaedic surgery. Furthermore, the recommendation does not state timing of nasal decolonisation due to lack of evidence. But the committee were aware that mupirocin with chlorhexidine can be given 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 cautions for the use of chlorhexidine solution in people with existing skin conditions and in preterm newborn 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 research recommendation 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 of research.

How the recommendations might affect practice

There is considerable variability in practice. In some centres decolonisation is always offered before certain types of surgery, for example, before orthopaedic surgery. In other centres 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 better reflects current practice and allow centres more flexibility to change practice and consider decolonisation for people who are likely to benefit the most. The recommendation may reduce surgical site infections in people having surgery with a high risk of infection, such as cardiac surgery.

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

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

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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, due to the quality of the studies, the committee were unable to make a strong recommendation on the choice antiseptic preparation.

The committee discussed that alcohol-based solutions should not be applied to mucous membranes because of the risk of burns. For surgeries next to mucus 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.

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 Medicines and Healthcare products Regulatory Agency (MHRA) has published advice on the use of chlorhexidine for skin disinfection in premature babies (see MHRA chlorhexidine solutions: reminder of the risk of chemical burns in premature infants).

The committee also discussed that some surgeries may need diathermy. However, care should be taken when using alcohol antiseptic solutions because they are flammable and can result in burns. Although this happens rarely, the committee agreed that precautions should be taken to reduce the risk of burns.

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 research recommendation 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.

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

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Antiseptics and antibiotics before wound closure

Recommendations 1.3.18 to 1.3.19

Why the committee made the recommendations

Limited evidence was identified on the intraoperative use of 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 of 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 research recommendation to determine the clinical and cost effectiveness of applying antiseptics and antibiotics before wound closure.

There was some economic evidence that antibiotic-loaded bone cement was cost effective 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 associated with a high risk of surgical site infection. 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.

Currently, gentamicin-collagen implants are considered best practice in cardiac surgery, however not all centres currently use them. The new recommendation may help to reduce variation and standardise practice. Any resource impact is likely to be balanced by savings from a reduction in the number of surgical site infections.

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

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Closure methods

Recommendations 1.3.20 to 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 section. 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 section. The committee agreed that this was important in improving recovery for women having caesarean sections, 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. It was also noted that the NICE guideline on caesarean section was published before this evidence was available, and currently states that the effects of different methods of skin closure are not certain.

The committee discussed the evidence for 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 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 that only paediatric surgery showed a clear benefit of using triclosan-coated sutures. 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 research recommendation 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 section may lead to a reduction in the number of women experiencing wound dehiscence following surgery, which may reduce the costs of treatment.

Use of 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.

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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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 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.

In 2017, the NICE surveillance team reviewed the guideline and identified new evidence on nasal decolonisation, skin antiseptics, the use of antiseptics and antibiotics before wound closure, and closure methods. This prompted a partial update of the guideline to review the new evidence.

Finding more information and resources

To find out what NICE has said on topics related to this guideline, see our web page on healthcare-associated infections.

Update information

April 2019

We have reviewed the evidence 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.

Recommendations are marked **[2019]** if the evidence has been reviewed.

Recommendations that have been deleted or changed

We propose to delete some recommendations from the 2008 guideline. Table 2 sets out these recommendations and includes details of replacement recommendations. If there is no replacement recommendation, an explanation for the proposed deletion is given.

In recommendations shaded in grey and ending **[2008]**, we have not reviewed the evidence. In some cases minor changes have been made – for example, to update links, or bring the language and style up to date – without changing the intent of the recommendation. Minor changes are listed in table 3.

See also the previous NICE guideline and supporting documents.

Table 2 Recommendations that have been deleted

Recommendation in 2008 guideline	Comment
Do not use nasal decontamination with topical antimicrobial agents aimed at eliminating *Staphylococcus aureus* routinely to reduce the risk of surgical site infection. (1.2.7)	This recommendation was replaced following an evidence review on nasal decolonisation in the prevention of surgical site infection. Replaced by recommendations 1.2.2 and 1.2.3.
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. (1.3.7)	This recommendation was replaced following an evidence review on skin antiseptics in the prevention of surgical site infection. Replaced by recommendations 1.3.7 to 1.3.9
Do not use intraoperative skin re-disinfection or topical cefotaxime in abdominal surgery to reduce the risk of surgical site infection. (1.3.16)	This recommendation was replaced following an evidence review on intraoperative antiseptics and antibiotics before wound closure. Replaced by recommendations 1.3.18 and 1.3.19.

Table 3 Minor changes to recommendation wording (no change to intent)

Recommendation numbers in current guideline	Comment
All recommendations except those labelled [2019]	Recommendations have been edited into the direct style (in line with current NICE style for recommendations in guidelines) where possible.
1.1.1	A cross reference was added to the NICE guideline on patient experience in adult NHS services.
1.2.3	A cross reference was added to the NICE guideline on antimicrobial stewardship: systems and processes for effective antimicrobial medicine use.
1.2.6	Wording was amended from 'Consider' to 'Take into account' to avoid confusion over the strength of the recommendation.
1.2.12	Cross reference to the NICE guideline on caesarean section was moved to the recommendation from a footnote and the wording amended. A cross reference was added to the NICE guideline on antimicrobial stewardship: systems and processes for effective antimicrobial medicine use.
1.2.14	Wording was amended from 'Consider' to 'Take into account' to avoid confusion over the strength of the recommendation.
1.2.16	Wording was amended from 'Consider' to 'Take into account' to avoid confusion over the strength of the recommendation.
1.3.12	Cross reference updated for NICE guideline on hypothermia prevention and management.
1.4.8	Wording changed from 'Refer to a tissue viability nurse … for advice' to 'Ask a tissue viability nurse' to simplify language and avoid confusion about referral.
1.4.9	Wording simplified in line with plain English style used for current NICE recommendations. A cross reference was added to the NICE guideline on antimicrobial stewardship: systems and processes for effective antimicrobial medicine use.
1.4.11	Wording simplified in line with plain English direct style used for current NICE recommendations.