Targeted literature review:

What are the key infection prevention and control recommendations to inform a surgical site infection (SSI) prevention quality improvement tool?

Part of HAI Delivery Plan 2011-2012:

Task 6.1: Review of existing infection prevention and control quality improvement tools to ensure ongoing need and fitness for purpose

Version 2.0 December 2012
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<th>To present a review of the evidence to inform the content of HAI related quality improvement tools for NHSScotland. This supports the functions of HPS in developing effective guidance, good practice and a competent workforce and translating knowledge to improve health outcomes.</th>
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<td>Target audience:</td>
<td>All NHSScotland staff involved in patient care activities where interventions can lead to HAI, particularly those interventions that can cause bloodstream infections such as line insertion. Infection prevention and control teams in NHS boards and other settings. Partner organisations particularly Healthcare Improvement Scotland and National Education for Scotland to ensure consistent information across similar improvement documentation.</td>
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<tr>
<td>Description:</td>
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1. Executive summary

Surgical site infection (SSI) is one of the most common healthcare associated infections (HAI), estimated to account for 15.9% of inpatient HAI in NHSScotland.\(^1\) SSIs have serious consequences for patients affected as they can result in pain, suffering and in some cases require additional surgical intervention.\(^2\)

SSI can result from the skin prior to surgery, from surgical instruments, from the environment during surgery; or during provision of care post surgery.\(^3\) SSIs are the most preventable of all HAI.\(^1;4;5\) SSI cause excess morbidity and mortality and are estimated on average to double the cost of treatment, mainly due to an increase in length of stay. Most importantly the key interventions focus on removing microorganisms from the skin prior to surgery as well as minimising the chance of multiplication of microorganisms during the surgical procedure; minimising the impact of existing co-morbidities on the immune response of the patient undergoing the surgical procedure; and reducing the risk of microorganisms gaining entry to the wound site post surgery.\(^3\)

This review of current scientific literature aimed to ascertain whether there is any new guidance or evidence which suggests that the key recommendations are still relevant or should be modified to minimise the risk of SSI. One of the main changes which resulted from the review is identification of the benefit in changing the structure of the key recommendations to distinguish at which part of the operative procedure the key recommendations should be to ensure ease of use by different staff groups involved in different stages of the patient care before, during and after surgery.

The recommendations result from the review of scientific evidence and the process of assessing these within a health impact and expert opinion framework. The key recommendations and their scientific grade of evidence for a surgical site infection prevention quality improvement tool that have been separated into three phases are:

**Preoperative phase**

- Ensure that a clinical risk assessment for meticillin resistant *Staphylococcus aureus* (MRSA) screening is undertaken (Category 1B)*
- Ensure that hair is not removed if at all possible; if hair removal is necessary, do not use razors (Category 1A)
- Ensure that the patient has showered (or bathed/washed if unable to shower) on day of or day before surgery using soap (Category 1B)
- Ensure that prophylactic antibiotic is prescribed as per local antibiotic policy/SIGN guideline, for the specific operation category (Category 1A)
- Ensure that the antibiotic is administered within 60 minutes prior to the operation (blade to skin) (Category 1A)
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Perioperative phase

- Ensure that 2% chlorhexidine gluconate in 70% isopropyl alcohol solution is used for skin preparation (if patient sensitive, use povidone-iodine) (Category 1A)
- Ensure that the patient’s body temperature is maintained above 36°C (excludes cardiac patients) (Category 1A)
- Ensure that the diabetic patient’s glucose level is kept <11mmol/l throughout the operation (Category 1B)
- Ensure that the patient’s haemoglobin saturation is maintained above 95% (or as high as possible if there is underlying respiratory insufficiency) (Category 1B)
- Ensure that the wound is covered with a sterile wound dressing at the end of surgery (Category 1A)

Postoperative phase

- Ensure that the wound dressing is kept in place for 48 hours after surgery unless clinically indicated (Category II)
- Ensure that aseptic technique is used if there is excess wound leakage and need for a dressing change (Category 1B)
- Ensure that hand hygiene is performed immediately before every aseptic dressing change (WHO Moment 2) (Category 1A)

* to find out more information on the categories of these recommendations see Appendix 3

Note: this review identifies the resulting key evidence based recommendations and does not aim to identify all the elements of a checklist or standard operating procedure covering surgical procedures. Other locally available procedures and tools should address all steps related to surgical procedures.

In conclusion: it is now advised that the key recommendations listed as a result of this review here and summarised in Appendix 5 are considered for application into practice as supported by quality improvement tools including care bundles. These activities can also be supported by national patient safety/quality improvement work (as directed by Healthcare Improvement Scotland).

Note

All medical and nursing staff involved in the use of all medical devices and medicinal products containing chlorhexidine should be aware of the risk of an anaphylactic reaction due to chlorhexidine allergy. The full details of the alert are available from the following weblink⁷⁴

http://www.mhra.gov.uk/Publications/Safetywarnings/MedicalDeviceAlerts/CON197918
2. Aim of the review

To review the evidence base and expert opinion to ensure that the key recommendations included within a quality improvement tool are the most critical in minimising the risk of SSI and subsequent safety of patients. This is now required as the SSI quality improvement tool and associated tools were first published on the Health Protection Scotland website in March 2008.

3. Background

3.1 The problem

SSIs are defined as infections that occur in a wound following invasive surgical procedures. The definition is important and clinical indications have to be taken into account in addition to microbiological tests as skin ordinarily has a flora of microorganisms. SSI is one of the most common causes of HAI estimated to account for 15.9% of inpatient HAI in NHSScotland. SSIs cause excess morbidity and mortality and are estimated on average to double the cost of treatment, mainly due to an increase in hospital length of stay. SSI have serious consequences for patients affected as they can result in pain, suffering and in some cases require additional surgical intervention. The impact on the individual can be difficult to quantify however a recent study found that following deep SSI, patients experienced pain, isolation and social and economic problems. The occurrence of SSI depends on a number of factors including the specific microorganism which contaminates the wound coupled with the patient’s immune response.

Risk factors associated with the development of SSI primarily include the type of surgical procedure, the duration of the surgical procedure; and whether the patient is immunocompromised, i.e. through existing co-morbidities such as diabetes, or undergoing immunosuppressive therapy such as cancer treatment and obesity. Risks are associated with all stages of the surgical procedure. In this review risks associated with operator competence are not covered.

3.2 How infections associated with surgical procedures can be prevented

SSI can result from contamination of the wound site and microorganisms can gain access via a number of sources including from the skin prior to surgery, from surgical instruments, from the environment during surgery; or during provision of care post surgery. Most importantly the key interventions focus on removing microorganisms from the skin prior to surgery as well as minimising the chance of multiplication of microorganisms during the surgical procedure; minimising the impact of existing co-morbidities on the immune response of the patient undergoing the surgical procedure; and reducing the risk of microorganisms gaining entry to the wound site post surgery.
3.3 Out of scope for this review

This literature review does not address any issues specific to:

- Paediatric patients
- Emergency surgery
- Specific aspects of wound healing
- Surgical scrub procedure
- Management of SSI

3.4 Assumptions – to ensure successful application of recommendations into practice

There are a number of aspects related to healthcare delivery that were not within the remit of this review as it is clear that they are the responsibility of other professionals. These include that:

- Staff are appropriately trained and competent in all aspects of the management of surgical procedures preferably using an approved educational package
- The overall approach to the delivery of healthcare is supported by patient safety and improvement approaches and organisational readiness.
4. Results

The recommendations presented are based on a review of the current evidence. The previous recommended criteria within the HPS bundles and checklists were used as a basis for the question set in Appendix 1. To further aid the process of deciding what final key recommendations to be included, all the recommendations resulting from the review of the evidence were assessed using the ‘health impact and expert opinion framework’ seen in Appendix 2. The final key recommendations were identified as a result of this evaluation as well as being informed by the process of wider consultation.

The methodology for this is described within Appendix 3: the specific search strategy in Appendix 4 and finally a summary page of the resulting recommendations can be found in Appendix 5.

One of the main conclusions from this evidence review and from consultation is that there would be a benefit to changing the structure by separating the recommendations into three phases to distinguish which part of the operative period each action relates to. This should also aid compliance with the quality improvement tools by engagement of the different staff groups at each stage.

The three phases are:

- Preoperative phase
- Perioperative phase
- Postoperative phase

4.1 Review of evidence base

4.1.1 Final recommendation - Ensure that a clinical risk assessment for meticillin resistant *Staphylococcus aureus* (MRSA) screening is undertaken (Category 1B)

Health Protection Scotland (HPS) carried out a large prospective cohort study of MRSA screening that included decolonisation of approximately 80,000 admissions to acute settings within three NHS boards. The findings of this report showed a significant reduction of MRSA colonisation prevalence which fell from 5.5% to 3.5% by the end of this study. This result is consistent with the findings of other studies which have also shown a reduction in MRSA infections when screening for colonisation followed by subsequent decolonisation has taken place. 8,9

The infections which result from MRSA are generally associated with higher morbidity and mortality than those due to meticillin sensitive *Staphylococcus aureus* (MSSA). Furthermore, MRSA has been shown to be one of the most common cause of surgical site infection (SSI) following all surgery and is thought to mainly originate from the patients themselves. The role of pre-screening to identify carriers followed by a decolonisation treatment when required, to reduce the burden of MRSA carried by the patient, is therefore an important factor in reducing the risk of SSI.

A National MRSA Screening Programme was established in Scotland in 2009, resulting from the findings within the MRSA Screening Pathfinder Programme report. 7 The programme recommended a minimum
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screening practice be adopted across NHSScotland in the form of a three question clinical risk assessment (CRA) to be applied on admission or pre-admission.\textsuperscript{7} It also recommended all patients in five high impact specialties (renal, cardiothoracic, vascular, intensive care and orthopaedics) be screened as a matter of course using nasal and perineal swabs, given that limitations exist in identifying all potential MRSA positive cases through CRA alone within specialties where MRSA infection would have a high impact on patients’ mortality.\textsuperscript{16}

This practice means that all patients who are admitted to an acute hospital and are expected to stay overnight will undergo CRA. If the answer to any of the three questions is yes then the patient will then be swabbed on two body sites, the nose and the perineum. In addition to the above category, all patients admitted to the following high-impact specialties will be two body-site swabbed regardless of their CRA response: intensive care, orthopaedics, renal medicine, vascular surgery, cardiothoracic surgery.

The CRA approach also offers the opportunity to apply a consistent risk-based approach to pre-emptive management of patients at high risk of colonisation and infection.

Decolonisation does not aim to eradicate MRSA completely rather it endeavours to reduce the burden of MRSA carried by the patient when they are likely to be at higher risk when undergoing an invasive procedure. The decision to undertake decolonisation should be subject to CRA, patient agreement and local policies. The recommendation given results from all evidence considerations and after applying the framework described in Appendix 2.

4.1.2 Final recommendation - Ensure that hair is not removed if at all possible; if hair removal is necessary, do not use razors (Category 1A)

The adequate preparation of the skin site prior to the surgical procedure is vital to minimise the presence of microorganisms on the surface prior to incision. This historically included the routine removal of hair. Indeed there was a concern that the presence of hair would result in an increased presence of contamination.\textsuperscript{3} This view was challenged citing the possibility that shaving using razors can cause skin damage in the form of micro-abrasions potentially causing multiplication of microorganisms at the surgical site. A systematic review was undertaken which examined the effect of different methods of hair removal on incidence of SSI.\textsuperscript{17} Hair removal methods studied included use of shaving, clippers and depilatory creams. Shaving tends to be frequently used because it is relatively cheap and quick; however the blade cuts the hair very close to the skin surface whereas clippers leave longer hair stubble. Chemical depilatory creams result in a more complete hair removal; however can take up to 20 minutes. The practice of hair removal varies across the world and therefore guidelines vary. However, the main consensus is that the use of razors should be avoided and to ensure that hair removal takes place as close in time to the surgical procedure as possible. It is acknowledged that hair removal prior to surgery may be required in order to enable visualisation of the surgical site during the procedure. If hair removal is necessary then clippers or depilatory creams should be used in preference to razors.\textsuperscript{18} Therefore, it is concluded that hair removal should be avoided when possible but if required for a clinical reason, then the use of razors is contraindicated.\textsuperscript{18,19} The recommendation given results from all evidence considerations and after applying the framework described in Appendix 2.
4.1.3 Final recommendation - Ensure that the patient has showered (or bathed/washed if unable to shower) on day of or day before surgery using soap (Category 1B)

As patients’ skin will have transient and resident microorganisms present, it is a reasonable precaution to ensure that the skin is as free as possible of microbial flora prior to surgery. A Cochrane review has been produced which specifically examined the evidence for preoperative bathing or showering with antiseptics for the prevention of SSI. They concluded that while there was evidence to support the efficacy of preoperative showering as a measure to reduce the rate of SSI, there was no evidence of difference on SSI rates following use of chlorhexidine as a cleansing agent rather than a plain detergent or soap, and that chlorhexidine has not been found to be cost-effective. The Department of Health (DH) high impact intervention found a lack of evidence to support the use of antiseptics for preoperative showering but do recommend the patient has showered (or bathed/washed if unable to shower) preoperatively using soap. The NICE guidelines also conclude that while there is a consensus of evidence that demonstrates that preoperative showering with detergents or soap is associated with a reduction in SSI there is no evidence to suggest that antiseptics are more effective.

No evidence was identified with respect to the optimal timing of preoperative showers prior to surgery or whether more than one shower resulted in increased effect. It was therefore concluded based on best practice and expert opinion, that showering should take place on the day of the surgery if possible or otherwise the day before.

The recommendation given results from all evidence considerations and after applying the framework described in Appendix 2.

4.1.4 Final recommendation - Ensure that prophylactic antibiotic is prescribed as per local antibiotic policy/SIGN guideline, for the specific operation category (Category 1A)

Antibiotic prophylaxis has been used as a method to prevent SSI for some time, particularly for surgical procedures deemed as higher risk. Antibiotic prophylaxis differs from treatment as it typically involves a single dose of antibiotic which is administered prior to surgery. There is a consensus of evidence that the use of prophylactic antibiotics is associated with a reduction in SSI. The usefulness of this technique varies across the types of surgical procedures and potential consequences of SSI following them. However the potential benefits must be assessed alongside an increased risk of adverse drug reactions and the potential for an increase in antimicrobial resistance. The Scottish Intercollegiate Guideline Network (SIGN) produce evidence based guidelines to promote best clinical practice. SIGN Guideline 104, ‘Antibiotic Prophylaxis in Surgery’, aimed to give clear recommendations for practice on the use of antibiotic prophylaxis to reduce the overall risk of SSI during specific procedures while minimising the possibility of adverse events occurring. This guideline emphasised that although the use of prophylaxis is not a way of overcoming shortcomings in surgical technique it is recommended as an addition for specific procedures when the individuals’ risk of adverse reaction has been considered. It is recommended that this guideline should be consulted for recommendations on when the use of prophylaxis is appropriate.
There is robust evidence to support the effectiveness of administration of prophylactic antibiotic prior to certain surgical procedures and therefore it is concluded that this is a key recommendation. The recommendation given results from all evidence considerations and after applying the framework described in Appendix 2.

4.1.5 Final recommendation - Ensure that the antibiotic is administered within 60 minutes prior to the operation (blade to skin) (Category 1A)

It is currently recommended that an antibiotic is administered within 60 minutes prior to the operation. The timing of this intervention is critical to ensure maximum benefit i.e. when the antibiotic is at the most effective concentration within the tissues at the time of the surgical procedure.24-25 The timing, to an extent, depends on the antibiotic itself and the type of surgery; however general consensus is that prophylaxis should be administered within 60 minutes prior to surgery.24-26 The SIGN guidelines however, recommend ‘intravenous prophylactic antibiotics should be given ≤30 minutes before the skin is incised’.23 Due to the ambiguous nature of these recommendations, a targeted systematic review was conducted and this included reviewing the specific evidence which underpins the recommendation within the SIGN guideline, which was also critically appraised. This particular reference is from the Guideline for Prevention of Surgical Site Infection, 199920 and which refers to studies published in 1992 and 1993.27,28 One study Classen et al27 showed that there was an association between the timing of the prophylactic antibiotic and subsequent rates of SSI. This study concluded that antibiotics should be administered at least two hours prior to surgery to maximise this effect. On review of the studies it was found that the timing of administration of prophylactic antibiotic resulting from these studies concluded that prophylaxis should be given < 2 hours prior to a surgical procedure; however the considerable variation of timing of administration in practice was noted. A systematic review conducted specifically to further assess the evidence identified a number of more recent studies and guidelines which showed some variation in the timing recommended and which often depended on the operative procedure.25 A committee opinion document which was published by the American College of Obstetricians and Gynaecologists in 2010 concurred that the timing of administration should be within 60 minutes of surgery29 and this echoed a review paper published in 2008.30 The recommendation is also consistent with all current evidence, guidelines and the Department of Health (DH) bundle.3,20,22,24-26,29-31

There is a consensus of evidence to support the effectiveness of administration of prophylactic antibiotic within 60 minutes of certain surgical procedures and therefore it is concluded that this is a key recommendation. The recommendation given results from all evidence considerations and after applying the framework described in Appendix 2.

4.1.6 Final recommendation - Ensure that 2% chlorhexidine gluconate in 70% isopropyl alcohol solution is used for skin preparation (if patient sensitive, use povidone-iodine) (Category 1A)

For most SSIs, a source of invading pathogens is thought to be the patient's skin.32 Consequently, optimisation of preoperative skin antisepsis is required to decrease postoperative infections. The focus of this intervention is the removal of both the transient and resident flora on the skin. Although transient
microorganisms can be readily removed by soap and water, the use of antiseptics is required to remove the resident flora prior to surgery. This can involve the use of antiseptics such as chlorhexidine and povidone-iodine. The antimicrobial activity of different antiseptics needs to be considered as there may be a requirement for a residual action to provide additional protection during the surgical procedure itself. Chlorhexidine is known to have a persistent effect and combined with alcohol which is fast drying make 2% chlorhexidine in 70% isopropyl alcohol a suitable product. The National Institute of Health and Clinical Excellence (NICE) guideline recommends that the site is prepared immediately prior to incision using a suitable antiseptic such as chlorhexidine or povidone iodine.

The antimicrobial activity of different antiseptics needs to be considered as there may be a requirement for a residual action to provide additional protection during the surgical procedure itself. Chlorhexidine is known to have a persistent effect and combined with alcohol which is fast drying make 2% chlorhexidine in 70% isopropyl alcohol a suitable product. The National Institute of Health and Clinical Excellence (NICE) guideline recommends that the site is prepared immediately prior to incision using a suitable antiseptic such as chlorhexidine or povidone iodine.

The DH high impact intervention, states that 'Patient’s skin has been prepared with 2% chlorhexidine gluconate in 70% isopropyl alcohol solution and allowed to air dry. (If the patient has a sensitivity povidone-iodine application is used)'. On reviewing the background evidence, this recommendation is based on evidence from Darouiche et al ‘Chlorhexidine–Alcohol versus Povidone–Iodine for Surgical-Site Antisepsis’. In this study a total of 849 subjects (409 in the chlorhexidine–alcohol group and 440 in the povidone–iodine group) were involved with the overall rate of SSI being significantly lower in the chlorhexidine–alcohol group than in the povidone-iodine group. The suitability and benefits of using 2% chlorhexidine gluconate in 70% isopropyl alcohol solution have also been demonstrated in other studies. It is concluded therefore that this is a key recommendation to minimise SSI.

Further review specifically on whether the solution should be single use or from multi-use containers

A further rapid review was conducted to provide clarity with regards to whether the 2% chlorhexidine gluconate in 70% isopropyl alcohol skin preparation solution should be single use or from a multi use container. A number of key studies were identified from this search. One systematic review and cost analysis comparing use of chlorhexidine with use of iodine for preoperative skin antisepsis to prevent surgical skin infection and concluded that the use of 2% chlorhexidine 70% isopropyl alcohol although more expensive resulted in cost savings in terms of reduction of SSI. This Review was further assessed by the Centre for Reviews and Dissemination (NHS National Institute for Health Research) for relevance to the NHS in the UK and it was concluded that the findings were valid and applicable.

A Cochrane review on preoperative skin antiseptics for preventing surgical wound infections after clean surgery (updated in 2009) noted that multiuse bottles of antiseptic can become contaminated once opened. This evidence has been added to by reports of outbreaks of HAI associated with contaminated aqueous solutions of chlorhexidine. There were no reports identified in this search specifically associated with contaminated 2% chlorhexidine 70% isopropyl alcohol however outbreaks of infection have been associated with 70% isopropyl alcohol skin preparation pads, which may show a potential for this solution to become contaminated.

Conclusion

There is robust evidence to support the use of 2% chlorhexidine 70% isopropyl alcohol to minimise and prevent the development of SSI. This has been added to by a recent assessment by the Centre for Reviews and Dissemination (NHS National Institute for Health Research) which concluded that a systematic review...
and meta-analysis which demonstrated the clinical and cost effectiveness of 2% chlorhexidine 70% isopropyl alcohol over iodine was valid and applicable for the NHS. No studies were identified as a result of this rapid review which compared the use of single use and multi-use containers of this skin preparation, which may be due to the fact that the multi-use containers are currently unlicensed for this use in the UK. However, there have been outbreaks of HAI associated with contaminated multi-use bottles of aqueous chlorhexidine and of 70% isopropyl alcohol skin preparation. Therefore for the purposes of skin preparation prior to surgical procedures, the use of single use sterile containers of 2% chlorhexidine 70% isopropyl alcohol should be considered best practice.

Note

All medical and nursing staff involved in the use of all medical devices and medicinal products containing chlorhexidine should be aware of the risk of an anaphylactic reaction due to chlorhexidine allergy. The full details of the alert are available from the following weblink

http://www.mhra.gov.uk/Publications/Safetywarnings/MedicalDeviceAlerts/CON197918

4.1.7 Final recommendation - Ensure that the patient’s body temperature is maintained above 36°C (excludes cardiac patients) (Category 1A)

It is known that promotion of effective tissue healing results in better outcomes in terms of SSI. The requirement to ensure that patient homeostasis is maintained during general anaesthetic is vital for the health and wellbeing of the patient for most categories of surgical procedure. This includes ensuring optimal oxygenation, perfusion and body temperature during surgical procedures. There is a consensus of evidence that supports the importance of maintaining body temperature during the perioperative period. The DH High Impact intervention recommends that 'Body temperature is maintained above 36°C in the perioperative period (excludes cardiac patients).' An evidence based guideline produced by NICE; Inadvertent perioperative hypothermia (2008) defines normothermia as the body temperature being within the range of 36.0°C and 37.5°C.

It is concluded therefore that this is a key recommendation to minimise SSI. The recommendation given results from all evidence considerations and after applying the framework described in Appendix 2.

4.1.8 Final recommendation - Ensure that the diabetic patient’s glucose level is kept <11mmol/l throughout the operation (Category 1B)

The complication of infection is an additional risk for diabetic patients following surgery as the metabolic response to surgery can include insulin-resistant hyperglycaemia. Ensuring that the patient’s blood glucose is controlled throughout the procedure is therefore vital, however application of this recommendation has previously tended to be restricted to operative procedures which are carried out within intensive care settings. The underpinning evidence is part of the review of evidence within the NICE guideline which informed the DH High Impact Intervention. The DH High Impact intervention, recommends that ‘A glucose
level of <11mmol/l has been maintained in diabetic patients'. It is concluded that this is a key recommendation and that the blood glucose level is presented to ensure clarity of the action required. The recommendation given results from all evidence considerations and after applying the framework described in Appendix 2.

4.1.9 Final recommendation - Ensure that patient’s haemoglobin saturation is maintained above 95% (or as high as possible if there is underlying respiratory insufficiency) (Category 1B)

It is known that all tissues heal most effectively in optimal conditions of oxygenation, perfusion and body temperature. Therefore during surgical procedures, particularly with a general anaesthetic, patient homeostasis has to be maintained by the operating team.

The possibility of reducing SSI by the use of perioperative oxygenation has been examined in some studies however there has been variation in the conclusions resulting from the available data. Whereas some studies have shown significant reduction in SSI following perioperative inhalation of an oxygen-enriched (80%) mixture, conversely, other studies reported a lack of association of improved rates of SSI. On further review and critical appraisal of these studies, it is apparent that these mixed results may be due to studies having a heterogeneous population of patients and procedures, which therefore may have overlooked the possibility of small but statistically significant differences.

The DH high impact intervention recommends that ‘Patients’ haemoglobin saturation is maintained above 95% (or as high as possible if there is underlying respiratory insufficiency) in the peri and post operative stages (recovery room). This is based on evidence from NICE which state ‘The physiological mechanisms underlying the use of a FiO2 of 80% to reduce the incidence of SSI are unclear. However, optimisation of perioperative oxygen delivery by careful regard to fluid balance, inotropes, blood glucose control and warming has been shown as a benefit in secondary outcome measures such as reduction of length of stay and this may form the basis of future research, in particular in relation to the incidence of SSI.’ The NICE guideline further examines the evidence alongside expert opinion and concludes that optimal oxygenation should be maintained during and post surgery to ensure maintenance of >95% saturation of haemoglobin.

It is therefore concluded that this is a key recommendation. The recommendation given results from all evidence considerations and after applying the framework described in Appendix 2.

4.1.10 Final recommendation - Ensure that the wound is covered with a sterile wound dressing at the end of surgery (Category 1A)

Final recommendation - Ensure that the wound dressing is kept in place for 48 hours after surgery unless clinically indicated (Category II)

As the majority of surgical procedures result in wounds, there is often a requirement that they are covered with a dressing that acts as a barrier between the wound and the outside environment. Wound dressings are important to absorb leakage as protection from microorganisms and should ideally promote or maintain an optimal environment to aid the healing process. There are many products available now for use in chronic
wound care and there have been numerous studies which have examined their appropriateness and effectiveness for surgical wounds and their potential to reduce SSI. The NICE guideline conducted a review of the evidence of a number of dressing types including hydroactive, hydrocolloid, polyurethane and absorbent dressings.\(^3\) It was concluded that although there was a lack of quality evidence to support the use of a postoperative dressing in reduction of SSI, it was clearly good clinical practice that a wound should be covered with an appropriate dressing. There is insufficient consensus of evidence to recommend one particular dressing type, however dressings such as semi-permeable film membrane which are in general use would be appropriate. This was substantiated by the findings of a Cochrane systematic review of dressings for reduction of SSI which concluded that decisions on wound dressing should be based on cost and/or patient preference.\(^4\) The DH high impact intervention \(^2\) recommends for a surgical dressing that ‘the wound is covered with an interactive dressing at the end of surgery and while the wound is healing’. A sterile dressing is taken as standard.

The other aspect of wound dressing which has been examined is the time that they should be left in place post surgery with periods of time of 12-48 hours studied. There was no statistical differences found within any of the studies, however it is generally concluded based on best practice and expert opinion that the wound should remain covered for 48 hours following surgery as this is period where initial healing over the wound takes place.

It is therefore concluded that these are key recommendations. The recommendation given results from all evidence considerations and after applying the framework described in Appendix 2.

### 4.1.11 Final recommendation - Ensure that aseptic technique is used, if there is excess wound leakage and need for a dressing change (Category 1B)

**Final recommendation - Ensure that hand hygiene is performed immediately before every aseptic dressing change (WHO Moment 2) (Category 1A)**

There is consensus of evidence that the use of an aseptic technique should be used when there is a need to change a dressing of a surgical wound. \(^2,22,46\)

This can include the use of aseptic non-touch technique (\(\text{ANTT}^{\text{TM}}\)) as this is used in some parts of the UK. \(^47,48\) Aseptic technique is a broad term for a number of actions which prevent cross transmission of microorganisms. \(^48,49\) These include requirements not to touch ‘critical parts’; preparation of a surface area which prevents touch contamination of equipment; use of sterile equipment; use of personal protective equipment.

The importance of hand hygiene performance, is consistent with all current evidence, guidelines and the DH high impact intervention.\(^3,22,50\) The World Health Organization (WHO) Guidelines on Hand Hygiene in Health Care (2009)\(^51\) clearly describe the indications for hand hygiene and present these within the WHO ‘My 5 Moments for Hand Hygiene’ approach, including emphasising the importance of performing hand hygiene before clean/aseptic procedures to prevent HAI. These 5 Moments have been widely promoted within NHSScotland for a number of years and hand hygiene performance is measured against these Moments. This recommendation now provides two opportunities: to identify the hand hygiene Moment when risk is
highest in relation to aseptic dressing change, rather than attempting to use this quality improvement tool as a means of general hand hygiene promotion; and to allow for monitoring of hand hygiene practices to be consistent across all hand hygiene audits and quality improvement tool monitoring.

In summary, in relation to the risk associated with aseptic dressing change, the clearest indication for hand hygiene is Moment 2 ‘before clean/aseptic procedures’. The recommendation given results from all evidence considerations and after applying the framework described in Appendix 2.

(Note: surgical scrub procedure does not form part of this review)

4.2 **Review of additional evidence based on initial search findings (perioperative phase)**

4.2.1 **The use of incise drapes in the prevention of surgical site infection (SSI) (Category II)**

One of the commonly used operative strategies to reduce SSI is the use of a plastic adhesive incise drape. Preoperative skin preparation is intended to leave the skin as free as possible from microorganisms which may potentially access the surgical wound. Incise drapes are an additional intervention and comprise of adhesive films which cover the skin at the incision site to further minimise the risk of contamination of the wound by acting as a barrier to microorganisms. A Cochrane review found that there was insufficient evidence that the use of plastic adhesive drapes are associated with a reduction of SSI rate but there was some evidence that they increase infection rates. Following the use of plastic adhesive, there was a move towards use of antiseptic impregnated incise drapes such as iodophor impregnated drapes. An evaluation of their effectiveness undertaken in a systematic review however found no additional benefit in terms of reducing the SSI rate, although there was no association of increased risk. The DH High Impact Intervention and NICE guidelines recommend that ‘If incise drapes are used they are impregnated with an antiseptic’. In summary, there is insufficient evidence that the use of incise drapes will help to prevent SSI. It is concluded that this is not a key recommendation.

**In conclusion:** it is now advised that the key recommendations listed as a result of this review and summarised in Appendix 5 are considered for application into practice as supported by quality improvement tools including care bundles. These activities can also be supported by national patient safety/quality improvement work (as directed by Healthcare Improvement Scotland).
5. **Implications for research**

A number of gaps in current evidence have been identified as a result of this review, which may have implications for future research priorities. These are summarised below:

- A review of evidence should be carried out to evaluate further the role of meticillin sensitive *Staphylococcus aureus* (MSSA) screening in the reduction of SSI.

- Although not part of this review, further research on antiseptics for surgical scrub would be beneficial to provide a more robust evidence base for optimal preoperative skin antisepsis to decrease postoperative infections.

- Further research on the role of incise drapes in reduction of SSI would be useful to inform practice.
6. References


(33) Maiwald M, Widmer AF, Rotter ML. Chlorhexidine is not the main active ingredient in skin antiseptics that reduce blood culture contamination rates. Infect Control Hosp Epidemiol 2010 Oct;31(10):1095-6.

Targeted literature review: What are the key infection prevention and control recommendations to inform a surgical site infection (SSI) prevention quality improvement tool?


(67) Centre for Reviews and Dissemination. Systematic review and cost analysis comparing the use of chlorhexidine with use of iodine for preoperative skin antisepsis to prevent surgical site infection. CRD 2011 [cited 12 A.D. Nov 21];Available from: URL: http://www.crd.york.ac.uk/CRDWeb/ShowRecord.asp?ID=22011000059


(74) Medical Device Alert: All medical devices and medicinal products containing chlorhexidine (MDA/2012/075) [http://www.mhra.gov.uk/Publications/Safetywarnings/MedicalDeviceAlerts/CON197918]

**Note:** A number of references listed above are cited within the literature review methodology which has been placed in Appendix 3 for ease of reading of this document.
Appendix 1: Previous criteria under review

The SSI prevention care bundle and associated tools were first published on the HPS website in 2008.

The criteria below were used as the question set to frame this review of the evidence base:

- If at all possible avoid hair removal; if hair removal is necessary, avoid the use of razors
- Ensure prophylactic antibiotic was prescribed as per local antibiotic policy/SIGN guideline, for the specific operation category
- Ensure the antibiotic was been administered within 60 minutes prior to the operation
- Ensure the patient's body temperature was normal throughout the operation (excludes cardiac patients)
- Ensure the patient’s blood glucose level was normal throughout the operation (diabetic patients only).
Appendix 2: A framework tool to evaluate evidence based recommendations alongside the health impact contribution & expert opinion (based on the target group covered by this review)

<table>
<thead>
<tr>
<th>Recommendation for review</th>
<th>Ensure that a clinical risk assessment for meticillin resistant <em>Staphylococcus aureus</em> (MRSA) screening is undertaken</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade of recommendation (based on review of evidence)</td>
<td>Category 1B</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Health impact contribution (based on Healthcare Quality Strategy for NHSScotland)</th>
<th>Safe: This recommendation supports reducing the risk of harm to the patient resulting from surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Effective: This step is a suitable and accepted method of supporting the reduction of risk of SSI resulting from MRSA which may be colonising the patient</td>
</tr>
<tr>
<td></td>
<td>Efficient: This recommendation may reduce complications and therefore NHS costs associated with complications resulting from MRSA</td>
</tr>
<tr>
<td></td>
<td>Equitable: This assessment promotes a standard of care for all patients that may result in avoidable personal and NHS costs resulting from elective surgery</td>
</tr>
<tr>
<td></td>
<td>Timely: The recommendation should form part of the natural flow of perioperative patient care</td>
</tr>
<tr>
<td></td>
<td>Person Centred: This is a person centred recommendation aimed at reducing risk of SSI occurring in every patient and allows for communication with the patient</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expert opinion/consultation and practical considerations</th>
<th>Measurement and feedback (Y/N/?</th>
<th>Feasibility and sustainability (Y/N/?</th>
<th>Applicability and reach (Y/N/?</th>
<th>Training and informing (Y/N/?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Potential for measurement through e.g. observation</td>
<td>Easily implemented within current culture and will improve the quality of care now</td>
<td>Potential for consistent delivery</td>
<td>Easily implemented based on reliably available resources/products/prompts</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

| Is this a key recommendation? | Yes |

Health Protection Scotland

v2.0. December 2012
<table>
<thead>
<tr>
<th>Recommendation for review</th>
<th>Ensure that hair is not removed if at all possible; if hair removal is necessary, do not use razors.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade of recommendation (based on review of evidence)</td>
<td>Category 1A</td>
</tr>
</tbody>
</table>
| Health impact contribution (based on Healthcare Quality Strategy for NHSScotland) | **Safe:** Not implementing this may put the patient at risk of harm  
**Effective:** This recommendation reduces the risk of infection complications from surgery  
**Efficient:** This recommendation reduces the risk of SSI and therefore results in releasing time for other aspects of care delivery and a reduction in avoidable NHS costs  
**Equitable:** This recommendation promotes a standard of care for all patients that may result in a reduction in avoidable personal and NHS costs applicable to all patients and should positively manage avoidable NHS costs, which is also beneficial to all  
**Timely:** This recommendation should form part of the natural flow of preoperative care  
**Person Centred:** This is a person centred recommendation aimed at reducing risk of SS in every patient and allows for communication with the patient including their role in supporting this action |
| **Expert opinion/consultation and practical considerations** | **Measurement and feedback (Y/N/?)** | **Feasibility and sustainability (Y/N/?)** | **Applicability and reach (Y/N/?)** | **Training and informing (Y/N/?)** |
| | Potential for measurement through e.g. observation | Easily implemented within current culture and will improve the quality of care now | Potential for consistent delivery | Easily implemented based on reliably available resources/products/prompts | Stealth integration into natural workflow/logical clarity of concept (also see Cause & Effect Chart) | Unambiguous | Potential for applicability to a wide range of settings | Avoids unintended consequences/perverse behaviour | Potential for congruency in design and meaning, with HCW, trainer and observer training and education |
| | Y | Y | Y | Y | Y | ? | Y | ? | Y |
| Is this a key recommendation? | Yes |
### Targeted literature review: What are the key infection prevention and control recommendations to inform a surgical site infection (SSI) prevention quality improvement tool?

<table>
<thead>
<tr>
<th>Recommendation for review</th>
<th>Ensure that the patient has showered (or bathed/washed if unable to shower) on day of or day before surgery using soap.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Grade of recommendation (based on review of evidence)</th>
<th>Category 1A</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Health impact contribution (based on Healthcare Quality Strategy for NHSScotland)</th>
<th>Safe: Not implementing this recommendation may put the patient at increased risk of harm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Effective: This recommendation reduces the risk of introducing infection complications, resulting in releasing time for other care and a reduction in associated NHS costs</td>
</tr>
<tr>
<td></td>
<td>Efficient: This recommendation reduces the risk of SSI resulting in releasing time for other care and a reduction in NHS costs</td>
</tr>
<tr>
<td></td>
<td>Equitable: This recommendation promotes a standard of care for all patients that may result in a reduction in avoidable personal and NHS costs applicable to all patients and should positively manage avoidable NHS costs, which is also beneficial to all</td>
</tr>
<tr>
<td></td>
<td>Timely: This recommendation fits with the natural flow of care and aspects of routine personal hygiene</td>
</tr>
</tbody>
</table>

| Person Centred: | This is a fundamental care activity that allows for meaningful and beneficial interaction between patient and healthcare worker |

### Expert opinion/consultation and practical considerations

<table>
<thead>
<tr>
<th>Measurement and feedback (Y/N/?)</th>
<th>Feasibility and sustainability (Y/N/?)</th>
<th>Applicability and reach (Y/N/?)</th>
<th>Training and informing (Y/N/?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential for measurement through e.g. observation</td>
<td>Easily implemented within current culture and will improve the quality of care now</td>
<td>Stealth integration into natural workflow/logical clarity of concept (also see Cause &amp; Effect Chart)</td>
<td>Unambiguous</td>
</tr>
<tr>
<td>Easily implemented based on reliably available resources/products/prompts</td>
<td>Potential for consistent delivery</td>
<td>Potential for applicability to a wide range of settings</td>
<td>Avoids unintended consequences/perverse behaviour</td>
</tr>
<tr>
<td>Easily implemented based on reliably available resources/products/prompts</td>
<td>Potential for consistent delivery</td>
<td>Potential for applicability to a wide range of settings</td>
<td>Avoids unintended consequences/perverse behaviour</td>
</tr>
</tbody>
</table>

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</thead>
<tbody>
<tr>
<td>Y</td>
<td>?</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

| Is this a key recommendation? | Yes |

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Health Protection Scotland v2.0. December 2012
<table>
<thead>
<tr>
<th>Recommendation for review</th>
<th>Ensure that prophylactic antibiotic is prescribed as per local antibiotic policy/SIGN guideline, for the specific operation category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade of recommendation (based on review of evidence)</td>
<td>Category 1A</td>
</tr>
</tbody>
</table>
| **Health impact contribution (based on Healthcare Quality Strategy for NHSScotland)** | **Safe**: Not implementing this recommendation may put the patient at risk of harm.  
**Effective**: This recommendation could reduce the risk of SSI  
**Efficient**: This recommendation reduces the risk of infectious complications resulting in releasing time for other care and a reduction in NHS costs  
**Equitable**: This recommendation promotes a standard of care for all patients that may result in a reduction in avoidable personal and NHS costs which is also beneficial to all  
**Timely**: This recommendation fits within the natural flow of patient care and other medication administration  
**Person Centred**: This is a person centred recommendation for every patient undergoing a specific operation category |
<p>| <strong>Expert opinion/consultation and practical considerations</strong> | <strong>Measurement and feedback (Y/N/?)</strong> | <strong>Feasibility and sustainability (Y/N/?)</strong> | <strong>Applicability and reach (Y/N/?)</strong> | <strong>Training and informing (Y/N/?)</strong> |
| Potential for measurement through e.g. observation | Easily implemented within current culture and will improve the quality of care now | Potential for consistent delivery | Easily implemented based on reliably available resources/products/prompt | Stealth integration into natural workflow/logical clarity of concept (also see Cause &amp; Effect Chart) | Unambiguous | Potential for applicability to a wide range of settings | Avoids unintended consequences/perverse behaviour | Potential for congruency in design and meaning, with HCW, trainer and observer training and education |
| Y | Y | ? | Y | Y | ? | Y | Y | Y |
| <strong>Is this a key recommendation?</strong> | Yes |</p>
<table>
<thead>
<tr>
<th>Recommendation for review</th>
<th>Ensure that the antibiotic is administered within 60 minutes prior to the operation (blade to skin).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade of recommendation (based on review of evidence)</td>
<td>Category 1A</td>
</tr>
<tr>
<td>Health impact contribution (based on Healthcare Quality Strategy for NHSScotland)</td>
<td>Safe: Not implementing this recommendation may put the patient at risk of harm</td>
</tr>
<tr>
<td></td>
<td>Effective: This recommendation reduces the risk of SSI</td>
</tr>
<tr>
<td></td>
<td>Efficient: This recommendation will reduce the risk of infection complications resulting in releasing time for other care and reduction in associated NHS cost</td>
</tr>
<tr>
<td></td>
<td>Equitable: This recommendation promotes a standard of care for all patients that may result in a reduction in avoidable personal and NHS costs</td>
</tr>
<tr>
<td></td>
<td>Timely: This recommendation fits within the natural flow of patient care and other medication administration</td>
</tr>
<tr>
<td></td>
<td>Person Centred: This is a person centred action to reduce infection complications in every patient undergoing a specific operation category</td>
</tr>
<tr>
<td>Expert opinion/consultation and practical considerations</td>
<td>Measurement and feedback (Y/N/?): Easily implemented within current culture and will improve the quality of care now</td>
</tr>
<tr>
<td></td>
<td>Feasibility and sustainability (Y/N/?): Potential for consistent delivery</td>
</tr>
<tr>
<td></td>
<td>Applicability and reach (Y/N/?): Stealth integration into natural workflow/logical clarity of concept (also see Cause &amp; Effect Chart)</td>
</tr>
<tr>
<td></td>
<td>Training and informing (Y/N/?): Potential for congruency in design and meaning, with HCW, trainer and observer training and education</td>
</tr>
<tr>
<td>Potential for measurement through e.g. observation</td>
<td>Y</td>
</tr>
<tr>
<td>Potential for consistent delivery</td>
<td>Y</td>
</tr>
<tr>
<td>Easily implemented based on reliably available resources/products/prompts</td>
<td>Y</td>
</tr>
<tr>
<td>Stealth integration into natural workflow/logical clarity of concept (also see Cause &amp; Effect Chart)</td>
<td>Y</td>
</tr>
<tr>
<td>Unambiguous</td>
<td>Y</td>
</tr>
<tr>
<td>Potential for applicability to a wide range of settings</td>
<td>Y</td>
</tr>
<tr>
<td>Avoids unintended consequences/perverse behaviour</td>
<td>Y</td>
</tr>
<tr>
<td>Potential for congruency in design and meaning, with HCW, trainer and observer training and education</td>
<td>Y</td>
</tr>
<tr>
<td>Is this a key recommendation?</td>
<td>Yes</td>
</tr>
</tbody>
</table>
## Recommendation for review

Ensure that 2% chlorhexidine gluconate in 70% isopropyl alcohol solution is used for skin preparation (if patient sensitive, use povidone-iodine).

### Grade of recommendation (based on review of evidence)

Category 1B

### Health impact contribution (based on Healthcare Quality Strategy for NHSScotland)

**Safe:** Not implementing this recommendation may put the patient at risk of harm  
**Effective:** This recommendation reduces the risk of SSI  
**Efficient:** This recommendation reduces the risk of introducing infection complications, resulting in releasing time for other care and a reduction in associated NHS costs  
**Equitable:** This recommendation promotes a standard of care for all patients that may result in a reduction in avoidable personal and NHS costs which is beneficial to all  
**Timely:** This recommendation fits with the natural flow of preoperative patient care  
**Person Centred:** This is a person centred activity to reduce harm and that allows for meaningful and beneficial interaction between the patient and healthcare worker

### Expert opinion/consultation and practical considerations

<table>
<thead>
<tr>
<th>Measurement and feedback (Y/N/?</th>
<th>Feasibility and sustainability (Y/N/?</th>
<th>Applicability and reach (Y/N/?</th>
<th>Training and informing (Y/N/?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential for measurement through e.g. observation</td>
<td>Easily implemented within current culture and will improve the quality of care now</td>
<td>Potential for consistent delivery</td>
<td>Easily implemented based on reliably available resources/products/prompts</td>
</tr>
<tr>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

### Is this a key recommendation?

Yes
<table>
<thead>
<tr>
<th>Recommendation for review</th>
<th>Ensure that the patient’s body temperature is maintained above 36°C in the perioperative period (excludes cardiac patients)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade of recommendation (based on review of evidence)</td>
<td>Category 1A</td>
</tr>
<tr>
<td>Health impact contribution (based on Healthcare Quality Strategy for NHSScotland)</td>
<td>Safe: Not implementing this recommendation may put the patient at risk of harm</td>
</tr>
<tr>
<td>Effective: This recommendation reduces the risk of infection complications occurring</td>
<td></td>
</tr>
<tr>
<td>Efficient: This recommendation fits within the natural flow of perioperative patient care</td>
<td></td>
</tr>
<tr>
<td>Equitable: This recommendation promotes a standard of perioperative care for all patients that may result in avoidable personal and NHS costs</td>
<td></td>
</tr>
<tr>
<td>Timely: This recommendation fits with the natural flow of perioperative patient care</td>
<td></td>
</tr>
<tr>
<td>Person Centred: This is a person centred action to reduce harm; in every patient receiving surgery</td>
<td></td>
</tr>
</tbody>
</table>

### Expert opinion/consultation and practical considerations

<table>
<thead>
<tr>
<th>Measurement and feedback (Y/N/?)</th>
<th>Feasibility and sustainability (Y/N/?)</th>
<th>Applicability and reach (Y/N/?)</th>
<th>Training and informing (Y/N/?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential for measurement through e.g. observation</td>
<td>Easily implemented within current culture and will improve the quality of care now</td>
<td>Potential for consistent delivery</td>
<td>Easily implemented based on reliably available resources/products/prompts</td>
</tr>
<tr>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

### Is this a key recommendation?

Yes
**Recommendation for review**

Ensure that the diabetic patient’s glucose level is kept <11mmol/l throughout the operation.

**Grade of recommendation (based on review of evidence)**

Category 1B

---

**Health impact contribution (based on Healthcare Quality Strategy for NHSScotland)**

- **Safe:** Not implementing this recommendation may put certain patients at risk of harm
- **Effective:** This recommendation may reduce the risk of SSI in certain patients
- **Efficient:** This recommendation fits with the perioperative care for certain patients and reduces the risk of SSI associated increased effects on vulnerable diabetic patients
- **Equitable:** All diabetic patients should be supported by this recommendation
- **Timely:** This recommendation fits with the flow of perioperative patient care

**Person Centred:** This is a patient centred action to reduce harm; in every diabetic patient receiving surgery

---

**Expert opinion/consultation and practical considerations**

<table>
<thead>
<tr>
<th>Measurement and feedback (Y/N/?)</th>
<th>Feasibility and sustainability (Y/N/?)</th>
<th>Applicability and reach (Y/N/?)</th>
<th>Training and informing (Y/N/?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential for measurement through e.g. observation</td>
<td>Easily implemented within current culture and will improve the quality of care now</td>
<td>Potential for consistent delivery</td>
<td>Stealth integration into natural workflow/logical clarity of concept (also see Cause &amp; Effect Chart)</td>
</tr>
<tr>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>?</td>
</tr>
</tbody>
</table>

**Is this a key recommendation?**

Yes
<table>
<thead>
<tr>
<th>Recommendation for review</th>
<th>Ensure that patient’s haemoglobin saturation is maintained above 95% (or as high as possible if there is underlying respiratory insufficiency).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade of recommendation (based on review of evidence)</td>
<td>Category 1B</td>
</tr>
</tbody>
</table>

### Health impact contribution (based on Healthcare Quality Strategy for NHSScotland)

**Safe:** Not implementing this recommendation may put patients at risk of harm

**Effective:** This recommendation reduces the risk of SSI occurring particularly in certain patient groups

**Efficient:** This recommendation reduces the risk of infection complications resulting an releasing time for other care activity and a reduction in the associated NHS cost

**Equitable:** This recommendation promotes a standard of care for all patients that may result in a reduction in avoidable personal and NHS costs

**Timely:** This recommendation fits with the flow of perioperative patient care

**Person Centred:** This is a patient centred action to reduce harm; in every patient receiving surgery

### Expert opinion/consultation and practical considerations

<table>
<thead>
<tr>
<th>Measurement and feedback (Y/N/?)</th>
<th>Feasibility and sustainability (Y/N/?)</th>
<th>Applicability and reach (Y/N/?)</th>
<th>Training and informing (Y/N/?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential for measurement through e.g. observation</td>
<td>Easily implemented within current culture and will improve the quality of care now</td>
<td>Stealth integration into natural workflow/logical clarity of concept (also see Cause &amp; Effect Chart)</td>
<td>Potential for congruency in design and meaning, with HCW, trainer and observer training and education</td>
</tr>
<tr>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

**Is this a key recommendation?** Yes
<table>
<thead>
<tr>
<th>Recommendation for review</th>
<th>Ensure that the wound is covered with a sterile wound dressing at the end of surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade of recommendation (based on review of evidence)</td>
<td>Category 1A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Health impact contribution (based on Healthcare Quality Strategy for NHSScotland)</th>
<th>Safe: Not implementing this recommendation may put certain patients at risk of harm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Effective: Based on available evidence, not implementing this recommendation may lead to an increase in infections in certain patients and implementing it leads to increased comfort and quality patient experience</td>
</tr>
<tr>
<td></td>
<td>Efficient: This recommendation fits within the flow of perioperative care for surgical patients</td>
</tr>
<tr>
<td></td>
<td>Equitable: All patients should be supported by this recommendation</td>
</tr>
<tr>
<td></td>
<td>Timely: This recommendation fits with the flow of perioperative patient care</td>
</tr>
<tr>
<td></td>
<td>Person Centred: This is a patient centred action to reduce harm and increase comfort following surgery</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expert opinion/consultation and practical considerations</th>
<th>Measurement and feedback (Y/N/? )</th>
<th>Feasibility and sustainability (Y/N/? )</th>
<th>Applicability and reach (Y/N/? )</th>
<th>Training and informing (Y/N/? )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Potential for measurement through e.g. observation</td>
<td>Easily implemented within current culture and will improve the quality of care now</td>
<td>Potential for consistent delivery</td>
<td>Easily implemented based on reliably available resources/products/prompts</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

<p>| Is this a key recommendation? | Yes |</p>
<table>
<thead>
<tr>
<th>Recommendation for review</th>
<th>Ensure that the wound dressing is kept in place for 48 hours after surgery unless clinically indicated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade of recommendation (based on review of evidence)</td>
<td>Category II</td>
</tr>
<tr>
<td>Health impact contribution (based on Healthcare Quality Strategy for NHSScotland)</td>
<td>Safe: Not implementing this recommendation may put certain patients at risk of harm</td>
</tr>
<tr>
<td></td>
<td>Effective: Based on available evidence, not implementing this recommendation may lead to an increase in infections in certain patients and implementing it leads to increased comfort and quality patient experience</td>
</tr>
<tr>
<td></td>
<td>Efficient: This recommendation fits within the flow of postoperative care for surgical patients</td>
</tr>
<tr>
<td></td>
<td>Equitable: All patients should be supported by this recommendation</td>
</tr>
<tr>
<td></td>
<td>Timely: This recommendation fits with the flow of postoperative patient care</td>
</tr>
<tr>
<td></td>
<td>Person Centred: This is a care activity that allows for meaningful and beneficial interaction between patient and healthcare worker</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expert opinion/consultation and practical considerations</th>
<th>Measurement and feedback (Y/N/?)</th>
<th>Feasibility and sustainability (Y/N/?)</th>
<th>Applicability and reach (Y/N/?)</th>
<th>Training and informing (Y/N/?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential for measurement through e.g. observation</td>
<td>Easily implemented within current culture and will improve the quality of care now</td>
<td>Potential for consistent delivery</td>
<td>Easily implemented based on reliably available resources/products/prompts</td>
<td>Stealth integration into natural workflow/logical clarity of concept (also see Cause &amp; Effect Chart)</td>
</tr>
<tr>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>?</td>
</tr>
</tbody>
</table>

| Is this a key recommendation? | Yes |
Targeted literature review: What are the key infection prevention and control recommendations to inform a surgical site infection (SSI) prevention quality improvement tool?

<table>
<thead>
<tr>
<th>Recommendation for review</th>
<th>Ensure that aseptic technique is used, if there is excess wound leakage and need for a dressing change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade of recommendation (based on review of evidence)</td>
<td>Category 1B</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Health impact contribution (based on Healthcare Quality Strategy for NHSScotland)</th>
<th>Safe: Not implementing this recommendation may put certain patients at risk of harm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Effective: Not implementing this recommendation may lead to an increase in infections in patients</td>
</tr>
<tr>
<td></td>
<td>Efficient: This recommendation fits with the postoperative care for patients and reduces the risk of SSI</td>
</tr>
<tr>
<td></td>
<td>Equitable: All patients should be supported by this recommendation</td>
</tr>
<tr>
<td></td>
<td>Timely: This recommendation fits with the flow of postoperative patient care</td>
</tr>
<tr>
<td></td>
<td>Person Centred: This is a care activity that allows for meaningful and beneficial interaction between patient and healthcare worker</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Expert opinion/consultation and practical considerations</th>
<th>Measurement and feedback (Y/N/?)</th>
<th>Feasibility and sustainability (Y/N/?)</th>
<th>Applicability and reach (Y/N/?)</th>
<th>Training and informing (Y/N/?)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Potential for measurement through e.g. observation</td>
<td>Easily implemented within current culture and will improve the quality of care now</td>
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<td>Easily implemented based on reliably available resources/products/prompts</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

Is this a key recommendation? Yes
<table>
<thead>
<tr>
<th>Recommendation for review</th>
<th>Ensure that hand hygiene is performed immediately before every aseptic dressing change (WHO Moment 2).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade of recommendation (based on review of evidence)</td>
<td>Category 1A</td>
</tr>
</tbody>
</table>

**Health impact contribution (based on Healthcare Quality Strategy for NHSScotland)**

- **Safe**: Not implementing this recommendation may put certain patients at risk of harm
- **Effective**: There is substantial consensus of evidence that the contamination on hands of healthcare workers is associated with transmission of infection and could lead to postoperative complications to patients and the healthcare setting
- **Efficient**: The simple action of hand hygiene results in a reduction of complications and therefore in the NHS cost associated by avoiding further complications and in releasing time for other care
- **Equitable**: All patients receiving care can have safer care if supported by application of this recommendation
- **Timely**: Hand hygiene is an integral part of patient care and this recommendation fits with best practice in management of postoperative wounds, already recognised by healthcare workers
- **Person Centred**: This is a person centred action to reduce harm in every patient who has had a surgical procedure and allows for communication with patients as well as engaging individuals on the importance of hand hygiene and their role in this

**Expert opinion/consultation and practical considerations**

<table>
<thead>
<tr>
<th>Measurement and feedback (Y/N/?)</th>
<th>Feasibility and sustainability (Y/N/?)</th>
<th>Applicability and reach (Y/N/?)</th>
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<td>Potential for consistent delivery</td>
<td>Stealth integration into natural workflow/logical clarity of concept (also see Cause &amp; Effect Chart)</td>
</tr>
<tr>
<td>E</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

**Is this a key recommendation?** Yes
<table>
<thead>
<tr>
<th>Recommendation for review</th>
<th>Use of incise drapes in the prevention of SSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade of recommendation (based on review of evidence)</td>
<td>Category II</td>
</tr>
</tbody>
</table>
| Health impact contribution (based on Healthcare Quality Strategy for NHSScotland) | **Safe:** Not implementing this recommendation may put certain patients at risk of harm  
**Effective:** Not sufficient evidence to support the effectiveness of this recommendation  
**Efficient:** This recommendation could fit with the perioperative care  
**Equitable:** If proven to have an impact this recommendation would be important for all patients but currently there is insufficient evidence  
**Timely:** This recommendation could fit with the flow of perioperative patient care  
**Person Centred:** Not sufficient evidence to support the use of this recommendation |

**Expert opinion/consultation and practical considerations**

<table>
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<tr>
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<th>Feasibility and sustainability (Y/N/?)</th>
<th>Applicability and reach (Y/N/?)</th>
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<tr>
<td>Y</td>
<td>N</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>

| Is this a key recommendation? | No |

---
Appendix 3: Literature review methodology

The evidence underpinning the criteria for a quality improvement tool was reviewed using a targeted systematic approach to enable input and resource to be concentrated where needed. This methodology is fully described within a separate HPS paper ‘Rapid method for development of evidence based/expert opinion key recommendations, based on health protection network guidelines’.

Initial rapid search and review

The initial search rapid literature search was carried out to identify mandatory guidance, or recent national or international evidence based guidance which either agrees or refutes that the current key recommendations are the most important to ensure optimal PVC care:

- The main public health websites were searched to source any existing quality improvement tools
- Relevant guidance and quality improvement tools e.g. Department of Health (DH), Centers for Disease Control and Prevention (CDC) etc were reviewed
- Additional literature identified and sourced e.g. from the relevant Cochrane reviews.

The quality of evidence based guidance was assessed using the AGREE instrument and only guidance which achieved either a strongly recommend or recommend rating was included.

Targeted systematic review

As a result of initial rapid search and review, recommendations requiring a more in depth review were identified. This involved searching of relevant databases including OVID Medline, CINAHL, EMBASE. All literature pertaining to recommendations where evidence was either conflicting or where new evidence was available were critically appraised using SIGN checklists and a ‘considered judgement’ process used to formulate recommendations based on the current evidence for presentation and discussion with the National HAI Quality Improvement Tools Group in Scotland.

Grading of recommendations

Grading of the evidence is using the Healthcare Infection Control Practices Advisory Committee (HICPAC) method. In addition to the overall assessment of the evidence underpinning the recommendation, other factors are considered which affect the overall strength of the recommendation such as the health impact and expert opinion on the potential critical outcomes.

The HICPAC categories are as follows:

<p>| Category 1A – strong recommendation based on high to moderate quality evidence |
| Category 1B – strong recommendation based on low quality of evidence which suggest net clinical benefits |</p>
<table>
<thead>
<tr>
<th>or harms or an accepted practice (e.g. aseptic technique)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 1C – a mandatory recommendation</td>
</tr>
<tr>
<td>Category II – a weak recommendation which shows evidence of clinical benefit over harm</td>
</tr>
<tr>
<td>No recommendation – not sufficient evidence to recommend one way or another</td>
</tr>
</tbody>
</table>

**Framework for identifying final key recommendations**

One way of improving implementation of evidence based guidance is by the identification of key recommendations which if applied will improve practice and outcome.\(^57-63\) This is the foundation of ‘care bundles’ and other quality improvement tools which rely on the identification of key evidence based recommendations to ensure application in practice.\(^64\)

A method has been developed which aims to reflect graded recommendations in line with ensuring healthcare quality, attention to cost and practical application. It combines approaches used by the Institute of Healthcare Improvement (IHI) and World Health Organisation, among others, in identifying the critical factors from the evidence to ensure patient safety in a range of fields.\(^63;65\) The method considers the current NHSScotland Quality Strategy dimensions and finally expert opinion applied within a formal framework. This framework includes a range of practical considerations under the headings measurement and feedback, feasibility and sustainability, applicability and reach, training and informing.

Ultimately, HPS key recommendations are presented taking all of these factors into account, with the aim of improving practice and outcome.
Appendix 4: Search Strategies

Key literature from e.g. the relevant Cochrane reviews were also sourced and critically appraised using SIGN methodology.

SSI antibiotic prophylaxis timing

Database: Ovid MEDLINE(R) <1948 to July Week 4 2011>
Search Strategy:

1 exp Surgical Procedures, Operative/ (2082785)
2 exp Arthroplasty, Replacement, Hip/ or exp Hip Prosthesis/ (24670)
3 exp Cesarean Section/ (30978)
4 exp Colorectal Surgery/ (1571)
5 Knee Prosthesis/ or Arthroplasty, Replacement, Knee/ (13979)
6 1 or 2 or 3 or 4 or 5 (2094209)
7 exp Antibiotic Prophylaxis/ (7128)
8 timing.mp. (62431)
9 6 and 7 and 8 (129)
10 limit 9 to (english language and humans) (110)
11 limit 10 to yr="2000 -Current" (96)

Skin prep to prevent SSI

Database: Ovid MEDLINE(R) <1948 to July Week 4 2011>
Search Strategy:

1 exp Surgical Procedures, Operative/ (2082785)
2 exp Cesarean Section/ (30978)
3 exp Arthroplasty, Replacement, Hip/ or exp Hip Prosthesis/ or exp Arthroplasty/ (40826)
4 Knee Prosthesis/ or Arthroplasty, Replacement, Knee/ or Joint Prosthesis/ or Arthroplasty/ (26258)
5 exp Colorectal Surgery/ (1571)
6 1 or 2 or 3 or 4 or 5 (2098174)
7 exp Povidone/ or exp Chlorhexidine/ or exp Anti-Infective Agents, Local/ or exp Povidone-Iodine/ or exp Antisepsis/ (166142)
8 exp Surgical Wound Infection/ (25598)
9 exp Bacteremia/ (17709)
10 8 or 9 (43118)
11 6 and 7 and 10 (848)
12 exp Preoperative Period/ or exp Preoperative Care/ (54030)
13 11 and 12 (213)
14 limit 13 to english language (168)
15 limit 14 to yr="1995 -Current" (90)
Targeted literature review: What are the key infection prevention and control recommendations to inform a surgical site infection (SSI) prevention quality improvement tool?

**MRSA Screening**

Database: Ovid MEDLINE® <1948 to July Week 4 2011>

Search Strategy:

1. exp Cesarean Section/ (30978)
2. exp Surgical Procedures, Operative/ (2082785)
3. Arthroplasty, Replacement, Hip/ or Hip Prosthesis/ or Arthroplasty/ or Hip Joint/ (43389)
4. Knee Prosthesis/ or Arthroplasty, Replacement, Knee/ (13979)
5. exp Colorectal Surgery/ (1571)
6. 1 or 2 or 3 or 4 or 5 (2104275)
7. Surgical Wound Infection/ (25598)
8. Bacteremia/ (14767)
9. 7 or 8 (40179)
10. mrsa screening.mp. (140)
11. 6 and 9 and 10 (12)

**Pre-op showering**

Database: Ovid MEDLINE® <1948 to July Week 4 2011>

Search Strategy:

1. exp Cesarean Section/ (30978)
2. exp Surgical Procedures, Operative/ (2082785)
3. Arthroplasty, Replacement, Hip/ or Hip Prosthesis/ or Arthroplasty/ or Hip Joint/ (43389)
4. Knee Prosthesis/ or Arthroplasty, Replacement, Knee/ (13979)
5. exp Colorectal Surgery/ (1571)
6. 1 or 2 or 3 or 4 or 5 (2104275)
7. Surgical Wound Infection/ (25598)
8. Bacteremia/ (14767)
9. 7 or 8 (40179)
10. shower.mp. (890)
11. exp Baths/ (3853)
12. bathing.mp. (8026)
13. 10 or 11 or 12 (12006)
14. 6 and 9 and 13 (68)
Targeted literature review: What are the key infection prevention and control recommendations to inform a surgical site infection (SSI) prevention quality improvement tool?

Oxygenation to prevent SSI

Database: Ovid MEDLINE(R) <1948 to July Week 4 2011>
Search Strategy:

1 exp Cesarean Section/ (30978)
2 exp Surgical Procedures, Operative/ (2082785)
3 Arthroplasty, Replacement, Hip/ or Hip Prosthesis/ or Arthroplasty/ or Hip Joint/ (43389)
4 Knee Prosthesis/ or Arthroplasty, Replacement, Knee/ (13979)
5 exp Colorectal Surgery/ (1571)
6 1 or 2 or 3 or 4 or 5 (2104275)
7 Perioperative Care/ or Oxygen/ or Postoperative Complications/ (388914)
8 Hemoglobins/ or Hemoglobins, Abnormal/ (60603)
9 Homeostasis/ (37883)
10 7 or 8 or 9 (478015)
11 Surgical Wound Infection/ (25598)
12 Bacteremia/ (14767)
13 11 or 12 (40179)
14 6 and 10 and 13 (4133)
15 limit 14 to (english language and yr="2000 -Current") (1264)
16 perioperative oxygenation.mp. (6)
17 oxygen supplementation.mp. (584)
18 hyperoxegenation.mp. (271)
19 Hyperoxia/ (2063)
20 oxygen therapy.mp. (6108)
21 16 or 17 or 18 or 19 or 20 (8876)
22 15 and 21 (14)

Surgical dressings

Database: Ovid MEDLINE(R) <1948 to July Week 4 2011>
Search Strategy:

1 exp Cesarean Section/ (30978)
2 exp Surgical Procedures, Operative/ (2082785)
3 Arthroplasty, Replacement, Hip/ or Hip Prosthesis/ or Arthroplasty/ or Hip Joint/ (43389)
4 Knee Prosthesis/ or Arthroplasty, Replacement, Knee/ (13979)
5 exp Colorectal Surgery/ (1571)
6 1 or 2 or 3 or 4 or 5 (2104275)
7 Surgical Wound Infection/ (25598)
8 Bacteremia/ (14767)
Hand hygiene to prevent SSI

Database: Ovid MEDLINE(R) <1948 to July Week 4 2011>
Search Strategy:

1  exp Cesarean Section/ (30978)
2  exp Surgical Procedures, Operative/ (2082785)
3  Arthroplasty, Replacement, Hip/ or Hip Prosthesis/ or Arthroplasty/ or Hip Joint/ (43389)
4  Knee Prosthesis/ or Arthroplasty, Replacement, Knee/ (13979)
5  exp Colorectal Surgery/ (1571)
6  1 or 2 or 3 or 4 or 5 (2104275)
7  Surgical Wound Infection/ (25598)
8  Bacteremia/ (14767)
9  7 or 8 (40179)
10  hand hygiene.mp. (1269)
11  6 and 9 and 10 (17)

Incise drapes

Database: Ovid MEDLINE(R) <1948 to July Week 4 2011>
Search Strategy:

1  exp Cesarean Section/ (30978)
2  exp Surgical Procedures, Operative/ (2082785)
3  Arthroplasty, Replacement, Hip/ or Hip Prosthesis/ or Arthroplasty/ or Hip Joint/ (43389)
4  Knee Prosthesis/ or Arthroplasty, Replacement, Knee/ (13979)
5  exp Colorectal Surgery/ (1571)
6  1 or 2 or 3 or 4 or 5 (2104275)
7  Surgical Wound Infection/ (25598)
8  Bacteremia/ (14767)
9  7 or 8 (40179)
10  Adhesives/ or incise drapes.mp. (3884)
11  6 and 9 and 10 (10)
Preventing surgical site infections

**Preoperative**
- Ensure that:
  - A clinical risk assessment for meticillin resistant Staphylococcus aureus (MRSA) screening is undertaken.
  - Hair is not removed if at all possible; if hair removal is necessary, do not use razors.
  - The patient has showered (or bathed/washed if unable to shower) on day of or day before surgery using soap.
  - Prophylactic antibiotic is prescribed as per local antibiotic policy/SIGN guideline, for the specific operation category.
  - The antibiotic is administered within 60 minutes prior to the operation (blade to skin).

**Perioperative**
- Ensure that:
  - 2% chlorhexidine gluconate in 70% isopropyl alcohol solution is used for skin preparation (if patient sensitive, use povidone-iodine)\(^a\).
  - The patient’s body temperature is maintained above 36°C in the perioperative period (excludes cardiac patients).
  - The diabetic patient’s glucose level is kept at <11 mmol/l throughout the operation.
  - The patient’s haemoglobin saturation is maintained above 95% (or as high as possible if there is underlying respiratory insufficiency).
  - The wound is covered with a sterile wound dressing at the end of surgery.

**Postoperative**
- Ensure that:
  - The wound dressing is kept in place for 48 hours after surgery unless clinically indicated.
  - Aseptic technique is used, if there is excess wound leakage and need for a dressing change.
  - Hand hygiene is performed immediately before every aseptic dressing change (WHO Moment 2).

---

**Practice points**
The use of personal protective equipment (PPE) including gloves is important in all procedures where blood and body fluid risk exists.
The featured recommendation on hand hygiene does not detract from other times when hand hygiene is recommended and will be monitored against (namely the 5 Moments for Hand Hygiene).
The featured recommendations do not aim to cover emergency situations, which require clinical judgement for patient care actions.

**Further information**
(Click on highlighted text in the box(es) above to link to evidence underpinning each recommendation)
For further information on the background to these recommendations and the literature reviews that informed these please visit http://www.hps.scot.nhs.uk as well as referring to your local teams and policies.


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\(^a\) All medical and nursing staff involved in the use of all medical devices and medicinal products containing chlorhexidine should be aware of the risk of an anaphylactic reaction due to chlorhexidine allergy. The full details of the alert are available from the following web link: http://www.nhra.gov.uk/Publications/Safetywarnings/MedicalDeviceAlerts/CON197918