Methods of skin antisepsis for preventing SSIs

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Surgical site infections increase morbidity and mortality rates and raise costs to healthcare providers. Surgical skin antisepsis is one element in a bundle of interventions designed to prevent SSIs. This article summarises the most recent evidence and guidance on skin antisepsis.

Between 1% and 10% of patients develop a wound infection following surgery, according to data from the national surgical site infection (SSI) surveillance programme in England (Health Protection Agency, 2011). The rate of infection may be higher as the national programme does not cover post-discharge follow-up, where many SSIs develop (European Centre for Disease Prevention and Control, 2011; Tanner, 2009).

These infections cause patients great physical and emotional pain; several quantitative studies found patients’ quality of life is significantly reduced and a recent qualitative study found patients with SSIs said they wanted to die and spoke of feeling utter despair (Tanner et al, in press; Cahill et al, 2008).

The cost of SSIs is an additional concern. To date, no studies have identified the cost in the UK, but a Spanish study found the total cost of an SSI to be US$97,000 (Alfonso et al, 2007). This included the costs to the hospital, primary care, the patient and the economy.

An SSI occurs when bacteria enter a surgical wound. This most commonly happens in the operating room, where bacteria can come from several sources, including the environment, the staff and the patient. Most SSIs are said to originate from the patient’s own bacteria, which enter the wound during the surgical procedure (Ayliffe, 1991).

Reducing the number of bacteria on the skin around the incision site reduces the risk of a patient developing an SSI. This can be achieved through surgical skin antisepsis, which will remove transient bacteria and reduce resident bacteria through a combination of mechanical friction and chemical killing (Edwards et al, 2009). This practice is known as prepping the skin.

There are two key components to the surgical prep; the antiseptic solution and the application method.

Antiseptic solutions

Several solutions are available, though the two main active agents used in the UK are chlorhexidine gluconate and povidone iodine. These may be prepared as either alcoholic or aqueous solutions. The ideal antiseptic solution should:

- Be active against a broad range of Gram positive and Gram negative bacteria, viruses and fungi;
- Be fast acting;
- Have a residual effect;
- Not be inactivated by organic material such as blood or dirt;
- Be non irritant and non toxic (Tanner, 2009; Hardin, 1997).

Chlorhexidine gluconate kills a range of Gram positive and Gram negative bacteria, viruses and fungi, and binds to the top layer of the skin, which results in persistent activity (Tanner, 2009). Povidone iodine also kills a range of pathogens and is often used in combination with chlorhexidine gluconate.

Key points

1. Surgical site infections are costly for health healthcare providers
2. These infections cause great distress to patients
3. Use of antiseptic solutions helps to prevent SSIs
4. Pathogens can grow in multi-use prep solution bottles, so single-use applicators are recommended
5. There is little high-quality research on skin preparation before surgery, and guidelines offer little advice

Keywords: Surgical site infection, Surgical skin antisepsis, Infection control, Hospital-acquired infections

This article has been double-blind peer reviewed.
Gram positive and Gram negative bacteria, viruses and fungi. The povidone carrier releases its iodine slowly; the iodine kills bacteria quickly but does not have a residual effect. Iodine is inactivated by organic material so should be applied only to clean skin (Tanner, 2009).

Alcohol kills a range of Gram positive and Gram negative bacteria and many viruses and fungi. It kills more quickly than chlorhexidine gluconate or povidone iodine, but has little residual effect (Tanner, 2009).

Until recently, there has been no recommendation for the use of one solution over another. The National Institute for Health and Clinical Excellence SSI prevention guideline stated that aqueous or alcohol-based solutions containing either chlorhexidine or iodine could be used (NICE, 2008).

This recommendation was based on a review of studies similar to those included in the Cochrane systematic review of surgical skin antisepsis (Edwards et al, 2009). The Cochrane review found seven high-quality randomised control trials of preoperative antisepsics, of which only one compared iodine with chlorhexidine. In this study of 371 patients, published in 1982, significantly more SSIs were detected in the iodine group than in the chlorhexidine group (Berry et al, 1982). However, the Cochrane review concluded that, overall, there was insufficient evidence in favour of one solution and more research was needed.

Since the publication of the NICE guideline in 2008 and the Cochrane update in 2009, one relevant trial has been published. In Darouiche et al’s (2010) study of 849 patients, 2% chlorhexidine gluconate in 70% alcohol was compared with 10% povidone iodine in an aqueous solution, and patients were followed up for 30 days. The study found alcoholic chlorhexidine solution to be significantly more effective in reducing SSIs than povidone iodine. Some 16% of patients in the iodine group had SSIs, compared with 9.5% of patients in the chlorhexidine group.

There are some concerns with the Darouiche study; the main one is that researchers used an aqueous solution of iodine. In the UK, the most widely used skin preps are alcohol-based solutions of 0.5% chlorhexidine or 10% iodine. Aqueous-based solutions are considered to be less effective than alcohol-based solutions (Association for Perioperative Practice, 2007). For the findings of the study to be relevant to the UK, 2% chlorhexidine in alcohol should have been compared with 0.5% chlorhexidine in alcohol or 10% povidone iodine in alcohol.

Despite its limitations, the Darouiche study has been influential and the updated High Impact Interventions published by the Department of Health (2010) recommend the use of 2% chlorhexidine in 70% alcohol (DH, 2010). To date, there is no published research on the number of trusts that use the recommended skin prep solution or what effect it has had on SSIs.

**Application methods**

There is little research evidence to inform the method of application for antiseptic solutions. However, a few key points can be gleaned from expert opinion (Box 1).

The only recent development in skin antisepsis application has been the move towards single-use applications such as individual sachets or all-in-one solution applicators. The impetus behind this move is the fact that organisms can grow inside multi-use prep solution bottles (Hospital Infection Society, 2002). The all-in-one “paint-pad” style applicator contains a single-use dose of prep solution. The sponge pad applies a thin layer of prep solution that dries quickly. This prevents practitioners wiping away excess solution to speed up drying. It also prevents any solution pooling underneath the patient.

Mechanical friction, such as rubbing the skin with a sponge, is necessary to remove bacteria and enable antiseptic solutions to penetrate the deeper layers of the dermis where there are resident microorganisms (Hinchliffe, 1988). Paint-pad style applicators are claimed to provide an appropriate amount of friction, gently rubbing the skin to help the antiseptic solution penetrate the first five layers of the skin (Infection Control Today, 2010).

While theatre practitioners may be concerned about the cost of single-use application products, this should be compared with the hospital cost of treating SSIs (although such costs are not immediately apparent). For example, one study demonstrated that keeping one patient in hospital to treat an SSI prevented 33 other patients from being admitted (Alfonso et al, 2007). The result is that hospitals lose money through lost income generation (Graf, 2010).

**Conclusion**

Despite the fundamental importance of the surgical patient skin prep, there has been little high-quality research in this field and guidelines can offer little advice. Global interest in the Darouiche et al (2010) study shows that clinicians are desperate for evidence to shape best practice. Research is still needed on antiseptic solutions and their application.