Ten top tips: prevention of surgical site infections

Author:
Jan Stryja

Surgical site infection (SSI) is defined as infection of an operated site developing within 30 days after the operation, or within 1 year if an implant is present. SSIs are classified according to the affected tissue as superficial, deep and organ/space infections (Anderson et al, 2014).

SSIs are common complications in acute healthcare facilities. They affect up to one-third of patients who have undergone a surgical procedure (World Health Organization [WHO}, 2016). They are the most surveyed and frequent type of healthcare-associated infection in low- and middle-income countries. In the US, approximately 160,000–300,000 SSIs occur each year. The incidence of SSIs worldwide is debatable and underestimated; this is due to many factors, one of which is poor surveillance in community or primary care, and although there is surveillance in the acute care setting, its accuracy is questionable.

SSIs seriously impair not only the patient's quality of life, but also have a negative economical impact – they can double the length of a hospital stay. The additional costs of care for an SSI are between £814 and £6,626, depending on the type of surgery and the severity of the infection (Leaper et al, 2004; Kiernan and Leaper, 2014). It is estimated that up to 60% of SSIs are preventable (WHO, 2016).

SSIs are due to two main pathophysiologic factors – organisms being introduced into the wound directly from the patient (endogenous contamination) or organisms originating from the outside environment relating to the length of the surgical procedure or break in asepsis (exogenous contamination). Diminished efficacy of the general or local immune response of the individual due to general (disease, malnutrition, medication) and local factors (perfusion, bioburden, tissue damage) can result in increased susceptibility to SSIs.

These Ten Top Tips outline potential risks, patient assessment, and preventative and management strategies. There is limited evidence for some of these tips, but the lack of strong evidence is more because of a lack of high-quality trials than anything else.

What is clear is that there needs to be a focus on prevention and early detection because of the clinical and economic impact of SSIs.

1 Identify high-risk patients early: The first important step in SSI prevention is identification of patients deemed to be at high risk (National Institute for Health and Care Excellence, 2008). Current guidelines highlight that risk is increased by:

- Age (over 65 years)
- Underlying illness
- Obesity (body mass index over 35 kg/m^2)
- Smoking.
- Untreated peripheral vascular disease.
- Specific surgical procedures – site of the operation (e.g. groin), longer duration of surgery, extensive intra-operative techniques and possible wound contamination.

In the case of underlying illnesses, patients with an American Society of Anesthesiologists' (ASA) physical status classification system score of III or greater have statistically significantly higher SSI incidence (*Box 1*). The ASA's classification of physical health is a widely used grading system for preoperative health of the surgical patients; a subjective assessment of a patient's overall health is based on five classes (I to V). Specific conditions contributing to a higher incidence of SSI include diabetes (two- to three-fold increase in risk), malnourishment (increased incidence of SSI from 1.8% to 16.6%), low serum albumin, cancer therapy, radiotherapy (within 90 days prior to surgery) and using systemic steroids.

2 Remove an individual's risk factors where possible: Do not underestimate the importance of the patient's preoperative preparation. Elimination of risk factors such as malnutrition, smoking or medication is possible. It is worthwhile to try and address them before scheduled surgery.

Encourage patients to reduce weight and stop smoking. There is evidence that preoperative smoking interventions providing behavioural support and offering nicotine replacement therapy increase short-term smoking cessation and may reduce postoperative morbidity (Thomsen et al, 2014). A review should be carried out to identify medications which can be paused for the surgery and recovery period, e.g. consider a break in steroids or anticoagulants, if possible.

3 Achieve and maintain a sterile operating site: SSI prevention is aimed at minimising

***Jan Stryja** is Vascular Surgeon and EWMA Council Member, Salvatella Ltd, Czech Republic*

the number of microorganisms introduced into the operated site by removing microorganisms that normally colonise the skin (antiseptic skin preparation, preoperative soap or antiseptic shower/bath), preventing access of microorganisms during operation from the outside environment into the incision, preventing the multiplication of microorganisms at the operative site (e.g. by using prophylactic systemic antibiotics), enhancing the patient's defences against infection (e.g. minimising tissue damage and maintaining perioperative normothermia) (Jones et al, 2014; Madrid et al, 2016).

The birth of an SSI depends on contamination of the wound site at the end of a surgical procedure. With respect to this, we distinguish endogenous and exogenous surgical site infections.

According to research, the presence of a foreign body (implant, vascular graft after arterial bypass, pacemaker device, etc) reduces the number of pathogenic organisms required to cause an SSI (World Union of Wound Healing Societies, 2008).

4 **Minimise operative trauma:** Some operative trauma is a part of any surgical procedure. It can be caused by the mode of access to the target tissue, by the surgical procedure itself and by the way the surgical site is closed. Minimising operation trauma is a challenge for any surgeon. Sterile, considerate and meticulous surgical technique is part of achieving good surgical results. These conventional features of the surgeon's skills and work in the operating theatre are supplemented by new wound closure suture techniques by primary intention, innovative antibiotic-coated sutures and staples or tissue adhesives, along with precise prevention of desiccation of exposed tissues; however, there is still little evidence to suggest greater efficacy of one closure technique in comparison to the others.

5 **Use advanced wound care treatments**: Advanced wound management techniques such as negative pressure wound therapy (NPWT) and closed incision negative pressure therapy (ciNPT) can be used to reduce SSI incidence (Webster at al, 2014, Apelqvist et al, 2017). ciNPT utilises fluid-absorbing dressings and draining systems over closed incisions and decreases tissue oedema, lateral tension and formation of haematoma or seroma in wounds closed by primary suture. A literature review of the effectiveness of ciNPT in lowering the incidence of SSI compared with standard dressings suggest that ciNPT is a potentially effective method for reducing SSI and may be associated with a decreased incidence of dehiscence (Apelqvist et al, 2017).

A 2014 Cochrane review concluded that the evidence for NPWT reducing SSIs and wound dehiscence remains unclear, as does the effect of NPWT on time to complete healing (Webster et al, 2014). To finally evaluate the effect of NPWT on SSI incidence, it is necessary to conduct further multicentric randomised controlled trials.

6 **Do not rely on the impact of antiseptic wound dressings:** Covering the wound with a proper dressing is a basic step in wound management. An optimal dressing meets the current requirements of the wound, which can change within time and as the wound bed interacts with the surface of dressing. On the primary closed wound the dressing must function as a barrier. A Cochrane review suggests there is little evidence for the postoperative usage of antiseptic wound dressings (Dumville et al, 2016).

It is uncertain whether using dressings to cover surgical wounds healing by primary intention reduces the risk of SSI. It is also unclear whether any particular wound dressing is more effective in reducing the risk of SSI, improving scarring, reducing pain, improving patient acceptability, or is easier to remove.

Decisions about how to dress a wound following surgery should be based on dressing costs and the individual patient's skin condition (e.g. non-adherent dressings and tapes reduce the risk of skin-tear injury).

7 **Practise good hand hygiene:** Hand hygiene is a cheap and powerful method for SSI reduction. Although the clinical impact of hand

Box 1. ASA physical status classification system.

The American Society of Anesthesiologists (ASA) physical status classification system:

ASA I	A normal healthy patient.
ASA II	A patient with mild systemic disease.
ASA III	A patient with severe systemic disease.
ASA IV	A patient with severe systemic disease that is a constant threat to life.
ASA V	A moribund patient who is not expected to survive without the operation.
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes.

washing and hand antisepsis is evident, there is no evidence that one type of hand antisepsis is better than another in reducing SSI (Tanner et al, 2016). Ejemot-Nwadiaro et al (2015) note that handwashing promotion may reduce incidence of diarrhoea by about 30%, so the lack of strong evidence is influenced more by the lack of high-quality clinical trials than the ineffectiveness of the hand hygiene itself.

A review of interventions to improve hand hygiene compliance found that multifaceted campaigns with social marketing or staff involvement appear to have an effect, but there is still insufficient evidence to draw a firm conclusion (Gould et al, 2017).

8 Continue to monitor patients after discharge from inpatient care: The majority of SSIs are diagnosed and recorded during hospitalisation. It is important to focus on outpatient care, because in most countries there are gaps in SSI surveillance programs in outpatient settings. Patients need to continue to be checked for signs of SSI once they are discharged from hospital into the community. Surveillance should be a minimum of 30 days for most procedures and up to 1 year where implants are involved. There is also a need to determine who is responsible for monitoring outpatients and generating the surveillance records.

9 Diagnose SSIs early and look for typical infection signs: The signs and symptoms of SSIs are defined by the European Wound Management Association (EWMA, 2005). These include: pus, abscess or purulent discharge from the wound, local unexpected pain, increase of local skin temperature, erythema and swelling as a clinical manifestation of cellulitis. For high-risk patients, such as people with diabetes and the elderly, SSI signs do not always appear in a typical way. Patients should therefore be carefully examined during any inspection of the wound. Early diagnosis of infection allows clinicians to stop the spread of microorganisms into adjacent tissues and to treat infection more efficiently.

10 Try to improve everyday clinical practice: We should try to identify the relevant shortcomings in our daily clinical practice and focus on our own biases. Some areas to address include staff competency and responsibilities. Consider who will diagnose SSIs, inform the patients of an infection and educate patients and their families and carers. How should your team address ineffective surveillance, shortcomings in forwarding medical information or gaps in implementation of clinical guidelines? We should be able to learn from our mistakes.

Conclusion

SSIs are an important issue affecting many medical specialities and professions. Due to the serious health consequences for patients and clear economical impact, EWMA has established an SSI working group, which is involved in projects focused on the prevention and treatment of SSIs in both outpatient and inpatient settings. Its SSI document is due to be published later in 2018, while the World Union of Wound Healing Societies published its surgical wound dehiscence document in collaboration with *Wounds International* earlier in 2018 and can be found here: *http://www.woundsinternational.com/wuwhs/view/surgical-wound-dehiscence-improving-prevention-and-outcomes* WINT

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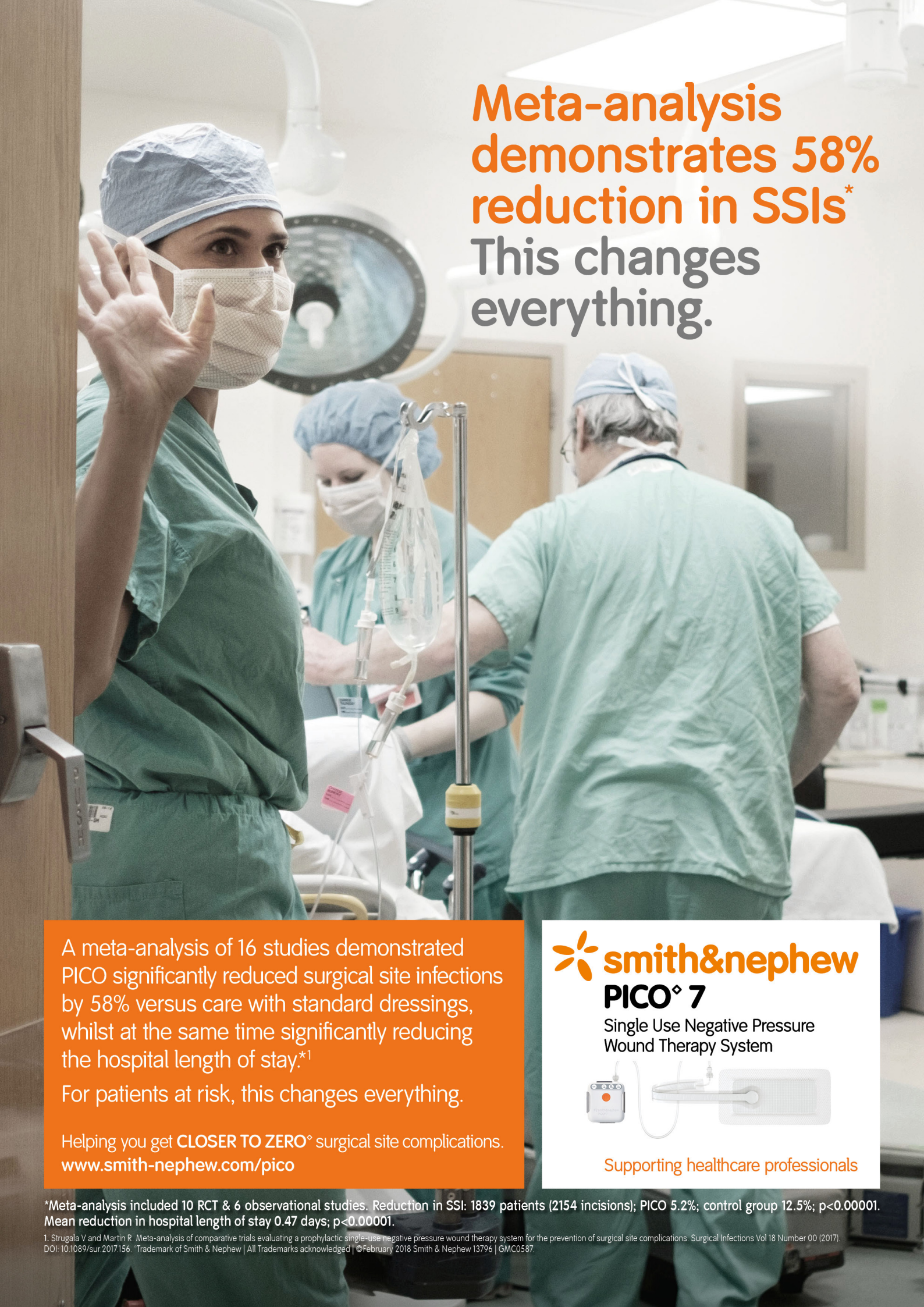

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1. Strugala V and Martin R. Meta-analysis of comparative trials evaluating a prophylactic single-use negative pressure wound therapy system for the prevention of surgical site complications. Surgical Infections Vol 18 Number 00 (2017). DOI: 10.1089/sur.2017.156.