

## Ten top tips: managing surgical site infections



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The definition of surgical site infection (SSI) by the Centres for Disease Control and Prevention (CDC)<sup>[1]</sup> of North America [Table 1] is the most commonly used and comprehensive. Leaper and Fry<sup>[2]</sup> state that an SSI is the most preventable healthcare-associated infection. According to hospital data in Canada, SSIs are the third leading cause of hospital-acquired infections.<sup>[3]</sup> Currently, inpatient surgical procedures involve shorter hospital stays, sicker patients and more complex surgical procedures that contribute to this statistic. However, it is estimated that 75% of surgical procedures are now performed in the outpatient setting, thereby, increasing concerns about SSI detection in the community<sup>[4]</sup>. The most common reasons for a community-nursing visit in the province of Ontario in Canada are post-operative wound infections and cellulitis. Unpublished Canadian prevalence data suggest that in selected community care sites approximately 30–40%

of nursing visits involve wound care. Surgical wound care accounts for as much 50% of these visits<sup>[5]</sup>. Community costs for the care of SSIs have been estimated as being between C\$1 and \$10 billion for direct and indirect medical costs<sup>[6]</sup>. Recognition of the potential for a SSI may be the most important issue when the discharge of a post surgical patient is planned, yet there is often no formal connection or linkage between in-hospital and community surveillance<sup>[7]</sup>. The actual incidence of SSI is debatable; this is due to many factors, one of which is poor surveillance in the community or primary care, and although there is surveillance in the acute care setting the accuracy is questionable.

As with all infections, SSIs are due to three main factors:

- Bacteria being introduced from the patient his- or herself (endogenous contamination)
- The surgical environment relating to the length of the procedure or break in asepsis

**Table 1. Definition of surgical site infections (SSIs). Adapted from Horan et al<sup>[1]</sup> and Leaper and Fry<sup>[2]</sup>.**

| Type                       | Definition  | Sign or symptoms   |
|----------------------------|---|--|
| Superficial incisional SSI | <ul style="list-style-type: none"> <li>■ Infection occurs within 30 days after operation</li> <li>■ Involves only the skin or subcutaneous tissue.</li> </ul>   | At least one of the following: <ul style="list-style-type: none"> <li>■ Purulent drainage (with or without laboratory confirmation)</li> <li>■ Organisms isolated from the fluid/tissue of the superficial incision</li> <li>■ At least one sign of inflammation or classic signs and symptoms of infection (pain, tenderness, local oedema, warmth)</li> <li>■ Wound deliberately opened by the surgeon</li> <li>■ Surgeon/medical team declare/diagnose as infected.</li> </ul>  |
| Deep incisional SSI        | <ul style="list-style-type: none"> <li>■ Infection occurs within 30 days after operation or within 1 year if an implant is present</li> <li>■ Infection involves deep soft tissue (e.g. fascia and/or muscle).</li> </ul>                   | At least one of the following: <ul style="list-style-type: none"> <li>■ Purulent drainage from the deep incision but not from the organ/space component of the surgical site (with or without laboratory confirmation)</li> <li>■ A spontaneous fascial dehiscence or fascia is deliberately opened by the surgeon</li> <li>■ A deep abscess or other evidence of infection involving the deep incision is identified: by direct examination, during reoperation, histopathology or radiologic examination</li> <li>■ Surgeon/medical team declare/diagnose as deep incisional infection.</li> </ul> |
| Organ/space SSI            | <ul style="list-style-type: none"> <li>■ Infection occurs within 30 days after operation or within 1 year if an implant is present</li> <li>■ Infection involves anatomic structures not opened or manipulated by the operation.</li> </ul> | At least one of the following <ul style="list-style-type: none"> <li>■ Purulent drainage from a drain placed through a stab wound into the organ/space</li> <li>■ Organisms isolated from the organ/space by wound culture</li> <li>■ Abscess or other evidence of infection involving the organ/space is identified: by direct examination, during reoperation, histopathology or radiologic examination</li> <li>■ Surgeon/medical team declare/diagnose as organ/space SSI.</li> </ul>  |

(exogenous contamination)

- Diminished immune capacity of the individual due to general factors (disease, malnutrition, medication) and local factors (perfusion, bioburden, damage).

These Top Ten Tips will therefore focus on identifying the risks, patient assessment, and preventative and management strategies. The authors, from the International Wound Infection Institute, acknowledge that there is limited evidence for some of these areas but, because of the morbidity and mortality that a SSI causes, prevention and early detection is imperative.

There are numerous guidelines that summarise evidence and provide recommendations for clinicians regarding SSI (e.g., the National Institute for Health and Care Excellence in the UK, the Surgical Care Improvement Project and National Surgical Quality Improvement Program in the USA, and National Health and Medical Research Council in Australia). Healthcare professionals should be familiar with the relevant information.

**1 Complete a holistic assessment to identify risk factors that may affect surgical wound healing pre-operatively, intra-operatively and postoperatively:** Although not all risk factors have been determined with a level one evidence rating, there is some evidence to suggest that the patient's age, weight, general health and medication usage may increase the risk of SSI. It is therefore important that these factors be assessed before an elective procedure and discussed with the patient so that informed decisions can be made. The pre-operative assessment needs to focus on the patient's general health and coexisting health conditions, glycaemic control, recent weight loss or gain, overweight or obesity category, physical activity levels, present and past smoking history, and previous experiences with anaesthetic.

**2 Manage pre-operative risk factors:** As previously stated, there are both intrinsic and extrinsic factors that increase the risk of an SSI. In particular, there is growing evidence that a patient's age is a risk factor that relates to decreased healing potential and diminished immune factors with aging<sup>[8]</sup>. For an elective procedure it is imperative that the nutritional status of the patient be determined through a simple nutritional risk assessment and/or laboratory analysis, such as serum albumin and total protein. Determination of the presence and level of obesity prior to elective surgery is necessary for several reasons, such as planning for any bariatric and hygiene requirements<sup>[9]</sup>. Some

surgical procedures may require that the patient reduce weight prior to proceeding<sup>[10,11]</sup>.

The presence and severity of all chronic illness, comorbidity, medication use, smoking, and alcohol and drug intake should also be explored in the pre-admission interview. This is the perfect time to educate the patient on lifestyle choices and management strategies. Verbal and written information should be given in the surgeon's office when the type of procedure is determined and reinforced and reviewed at the pre-admission interview.

Specific pre-operative recommendations will depend on the type of surgery, patient risk factors and surgeon preferences. Some guidelines recommend when to cease or commence certain medications, nasal decontamination, skin preparation or bowel preparation. It is always recommended that the patient cease smoking. Smoking impacts in many ways on the body<sup>[12]</sup>: nicotine causes vasoconstriction, carbon monoxide reduces oxygen-carrying capacity, and hydrogen cyanide inhibits the enzyme system necessary for oxidative metabolism and oxygen transport at cellular level, where there is evidence that this increases the risk of surgical site infections.

**3 Manage intra-operative risk factors:** The two primary intra-operative factors involved in the prevention of SSIs are maintenance of patient homeostasis and consistent staff practice of effective operating room (OR) safety techniques. This includes the maintenance of normal patient body temperature and blood glucose<sup>[13]</sup> levels as well as blood oxygen saturation of  $\geq 95\%$  throughout the surgical intervention<sup>[14]</sup>. OR staff must have good hand hygiene practices, wear sterile gowns, prepare the surgical site using an antiseptic skin preparation and use drapes that prevent liquid penetration. There is some debate in the literature as to whether impregnated incise drapes decrease SSIs<sup>[8]</sup>. The OR staff should change surgical gloves if perforation is observed and double glove if the risk of perforation is high<sup>[15]</sup>. It is recommended that the site of incision and that closure devices be positioned to minimise the risk of associated dehiscence and that antimicrobial sutures be used<sup>[16,17]</sup>. Finally, it is recommended that dead space, within or below the skin, be minimised where possible and that wound trauma be minimised by gentle tissue handling and limited use of electrocautery<sup>[16,17]</sup>.

Antibiotic prophylaxis has been shown to decrease SSI (level one evidence) and there are many protocols on the timing, type of procedure and type of antibiotic to be used<sup>[18]</sup>.

#### **4 Manage postoperative risk factors:**

Managing postoperative risk factors involves a continuation of the intra-operative measures, which include:

- Maintenance of body temperature
- Adequate oxygenation
- Clean, intact wound dressing
- Well-controlled pain.

The literature does not provide enough evidence to promote one dressing over another but there is some evidence that negative pressure wound therapy may reduce SSI after trauma and in high-risk groups<sup>[19,20]</sup>. Patients should be informed that a waterproof dressing is to be maintained for 48 hours post surgery and if the dressing requires changing then a surgical aseptic technique is required.

#### **5 Educate patients and families on the signs and symptoms of SSIs:**

It is important that patient and family education on not only the operative procedure but also the possibility of surgical site infection begins prior to surgery<sup>[21]</sup>. This information should be provided in verbal and written form and include how to recognise SSI and who to contact if they suspect infection<sup>[19]</sup>. The information should be in a language that is easy to understand and translated into other languages for those who do not speak English<sup>[21]</sup>. Provision of information on how to care for the patient's wound once he or she is discharged home is required for family members and carers. Patients should be informed if they have been given antibiotics and how to take them most appropriately to maximise effectiveness<sup>[19]</sup>.

Educate patients that a little redness around the wound edge is normal and can be expected for the first few days after surgery. However, redness spreading more than 2 cm out from the incision, increasing pain and swelling or pus coming from the suture line are danger signs that should be reported to their doctor immediately<sup>[21]</sup>.

#### **6 Identify and treat SSIs:**

SSIs have been divided into categories (superficial incisional, deep incisional and organ/space) according to their location, timing of onset, and local signs and symptoms<sup>[3]</sup>. Diagnosis largely depends on the subjective assessment of pain or tenderness, swelling, erythema and purulent discharge from the wound, although no consensus on criteria has been established<sup>[21]</sup>. Indicators normally manifest at least 48 hours after surgery and within 30 days, or up to 1 year following insertion of a prosthesis such as a total hip or knee replacement. Evidence of an SSI can be delayed

in obese patients, and poorly defined and difficult to recognise in immune-compromised patients. Early diagnosis is imperative for effective management. Incision sites should be opened to remove sutures and infected material, and to facilitate drainage. Dressings should be used to encourage secondary healing. Recommendations for the use of antibiotics in SSI have recently been published<sup>[23]</sup>; empirical antimicrobial choice is influenced by location and clinical presentation.

**7 Debride necrotic tissue:** Necrotic tissue can prolong inflammation and may harbour both aerobic and anaerobic bacteria and toxins, therefore removal of necrotic tissue is a key component of wound management. There are several options for debridement and the option(s) chosen will depend on the wound condition, goal of treatment, resources and patient considerations.

- Surgical debridement: conducted in the operating theatre for patients that require anaesthesia, positioning and assistants for cautery, suction, and suture ties
- Conservative sharp: can be conducted in a clinic, at the bedside or in the home environment as long as asepsis is provided using scalpel, scissors or curette
- Mechanical: includes therapeutic irrigation (4–15 psi), ultrasound debridement, debriding pads, and hydrosurgery
- Enzymatic: for small to moderate amounts of necrotic tissue in patients who cannot tolerate sharp debridement and do not have obvious infection
- Chemical: use of antiseptics (i.e., polyhexanide and octenidine), but preferably one that is non-cytotoxic to fibroblasts
- Autolytic: a slow degradation of tissue using the interaction of the host enzymes and wound dressings.
- Larvae: selective debridement with the use of medical-grade fly larvae.

As the wound progresses, shifting from one method of debridement to another may be necessary to obtain better results<sup>[24]</sup>.

#### **8 Choose an appropriate dressing or device to manage exudate and bacterial burden:**

Excessive exudate may be indicative of SSI or predispose to increased bioburden. Select a dressing or device to manage the amount and type of exudate. The exudate management ability of dressings or devices is subject to the absorptive and evaporative materials used, or their ability to drain or suction fluid from the wound. Select the antiseptic solution or impregnated dressing

based on clinical efficacy, duration of action and safety profile. Antiseptic impregnated dressings can be actively bacteriostatic when organisms are killed by release of the antiseptic into the wound or on contact with the antiseptic when absorbed into the dressing<sup>[26]</sup>. Some dressings utilise passive antimicrobial methods when organisms bind to dressings and are physically removed from the wound on dressing change<sup>[27]</sup>.

Choose the dressing on the basis of patient and wound needs, i.e. exudate level, wound depth, need for conformability, antimicrobial efficacy, odour control, ease of removal, safety and patient comfort<sup>[28]</sup>.

If the wound deteriorates or fails to improve after 14 days, it is recommended that an alternative antiseptic/antimicrobial agent is used<sup>[29]</sup>.

## 9 Consider adjunctive therapies:

Consultation and collaboration with the attending physician/surgeon and specialists in wound care related to the use of adjunctive therapy interventions is recommended. In 2008, NICE identified the following adjunctive therapies that may be considered including: topical negative pressure wound therapy (NPWT), growth factors (such as platelet-derived growth factor), antibacterial honey, larva therapy (maggots), anti-scarring agents (such as transforming growth factors), antiseptic-impregnated sutures (such as triclosan coating)<sup>[30]</sup>. Dehisced surgical wounds, usually secondary to SSI may benefit from NPWT. Examples include dehisced sternal split and abdominal incisions<sup>[29]</sup>. In particular the treatment of open abdominal wounds (laparostomy) has improved survival and enabled a higher rate of total abdominal wall closure. The role of hyperbaric oxygen therapy (HBOT) in open surgical wounds may be beneficial. Consideration of HBOT must include costs to clients/families, including travel costs, reimbursement fees for the cost of HBOT treatments<sup>[21]</sup>.

## 10 Implement a surgical site surveillance program that crosses setting boundaries:

The epidemiology of SSIs was first studied in the 1960s and a system for classifying surgical wounds, according to their risk of microbial contamination (clean, clean-contaminated, contaminated and dirty), has been used for reporting postoperative infections since 1980<sup>[31]</sup>. Many countries monitor SSIs; collating infection rates for

individual surgeons, as well as for surgical procedures, has been shown to reduce infection rates<sup>[32,33]</sup>. SSI surveillance programs allow the identification of trends in infection rates and causative agents. They also provide a means to evaluate the effectiveness of preventative and/or control strategies, which can be utilised in the development of guidelines. Guidelines to prevent SSIs using the bundle approach have been devised in many countries. However, compliance has been shown to depend on teamwork, collaboration and effective communication between practitioners and it is often less than optimal. Standardised methodology would allow comparison between different countries. With more and more surgical procedures occurring as outpatients, surveillance programs need to continue into the community and should extend a minimum of 30 days for most procedures and up to one year when implants are involved

## Conclusion

Prevention and management of SSI needs to be of great concern to patients, healthcare professionals and administrators. In these times of rationalization of health care funds, it is important to ensure that patients receive the appropriate screening and care beginning at the pre-operative assessment to postoperative care and monitoring in the community. By using the information presented here, clinicians can begin to develop skills and tools to identify those at high risk for infection and develop plans with the patient to ensure a best-practice approach. **WINT**

## References

- Horan TC, Gaynes RP, Marone WJ et al. CDC definitions of nosocomial surgical site infections 1992: A modification of CDC definitions of surgical site infections. *Infection Control Hosp Epidemiol* 1992; 13(10): 606–8
- Leaper D, Fry D. Management of surgical site infections. In: Granick M, Teot L (Eds). *Surgical Wound Healing and Management* (2nd edn). Informa Healthcare, 2012
- London Laboratory Services Group: A Joint Venture of London Health Sciences Centre and St. Joseph's Health Care London, *Infection Control Newsletter*, Fall 2004
- Mangram AJ, Horan TC, Pearson ML et al; the Hospital Infection Control Practices Advisory Committee. Guideline for prevention of surgical site infection, 1999. *Infect Control Hosp Epidemiol* 1999; 20(2): 247–78
- Mclsaac C. How an Outcomes Model and Government Awareness Lead to Changing Practice in Wound Care. Symposium conducted at the 2nd World Union of Wound Healing Societies' Meeting, Paris, France, 2004
- Cantrell S. Help for the wounded: caring for surgical sites. *Healthcare Purchasing News* 2006; 30(3): 24

7. Orsted HL, McNaughton V, Whitehead C. Management and care of clients with surgical wounds in the community. In: Krasner DL, Rodheaver RG, Sibbald (Eds). *Chronic Wound Care: a Clinical Source Book for Healthcare Professionals* (4th edn). HMP Communications, 2007
8. Teija-Kaisa A, Eija M, Marja S, Outi L. Risk factors for surgical site infection in breast surgery. *J Clin Nurs* 2013; 22(7/8): 948–57
9. Lobley SN. Factors affecting the risk of surgical site infection and methods of reducing it. *J Perioper Pract* 2013; 23(4): 77–81
10. Abdallah DY, Jadaan MM, McCabe JP. Body mass index and risk of surgical site infection following spine surgery: a meta-analysis. *Eur Spine J* 2013; 22(12): 2800–9
11. Watanabe M, Suzuki H, Nomura S et al (2014). Risk factors for surgical site infection in emergency colorectal surgery: a retrospective analysis. *Surg Infect (Larchmt)* 2014; 15(3), 256–61
12. Durand F, Berthelot P, Cazorla C et al. Smoking is a risk factor of organ/space surgical site infection in orthopaedic surgery with implant materials. *Int Orthop* 2013; 37(4): 723–7
13. Brick N. Cochrane Nursing Corner: Perioperative glycaemic control regimens for preventing surgical site infections in adults. *AORN* 2013; 93(4): 491–2.
14. Belda, FJ, Aguilera L, García de la Asunción J et al; Spanish Reduccion de la Tasa de Infeccion Quirurgica Group. Supplemental perioperative oxygen and the risk of surgical wound infection: a randomized controlled trial. *JAMA* 2005; 294(16): 2035–42
15. Alexander JW, Solomkin JS, Edwards MJ. Updated recommendations for control of surgical site infections. *Ann Surg* 2011; 253(6): 1082–93
16. Spruce L. Back to basics: preventing surgical site infections. *AORN Journal* (2014) 99(5): 601–8
17. Leaper D, Fry D. Management of surgical site infections. Chapter 12 In: *Surgical Wound Healing and Management*. 2nd Ed. Editors Granick M and Teot L. (2012) *Informa Healthcare*. 110-19
18. Bratzler DW, Dellinger EP, Olsen KM et al; American Society of Health-System Pharmacists; Infectious Disease Society of America; Society for Healthcare Epidemiology of America. Clinical practice guidelines for antimicrobial prophylaxis in surgery. *Am J Health Syst Pharm* 2013; 70(3): 195–283
19. National Institute of Health and Clinical Excellence (2008). Clinical Guideline 74. Surgical Site Infection. Prevention and treatment of surgical site infection. <http://www.nice.org.uk/guidance/cg74/resources/guidance-surgical-site-infection-pdf>, accessed on 19 September 2014
20. Baharestani M, Gabriel A. Use of negative pressure wound therapy in the management of infected abdominal wounds containing mesh: an analysis of outcomes. *Int Wound J* 2011; 8(2): 118–25
21. Orsted HL, Keast DK, Kuhnke J et al. Best practice recommendations for the prevention and management of open surgical wounds. *Wound Care Canada* 2010; 8(1): 6–34
22. Surgical Site Infection Surveillance Service. Protocol for the Surveillance of Surgical Site Infection. Version 6 [June 2013]. Internal Policy Document. London: Public Health England, 2013.
23. Stevens D, Bisno AL, Chambers HF et al. Practice guidelines for the diagnosis and management of skin and soft tissue infections: 2014 update by the Infectious Diseases Society of America. *Clin Infect Dis* 2014; 59(2): 1373–406
24. Madhok BM, Vowden K, Vowden P. New techniques for wound debridement. *Int Wound J* 2013; 10(3): 247–51
25. Romanelli M, Vowden K, Weir D. Exudate management made easy. *Wounds International* 2010; 1(2). <http://www.woundsinternational.com>, accessed 18 September 2014
26. Vowden P, Vowden K, Carville K. Antimicrobial dressings made easy. *Wounds International* 2011; 2(1). <http://www.woundsinternational.com>, accessed 18 September 2014
27. Gottrup, F., Apelqvist, J., Bjansholt, T. et al. EWMA Document: Antimicrobials and non-healing wounds — evidence, controversies and suggestions. *J Wound Car.* 2013; 22 (5 Suppl.): S1–S92
28. International consensus. Appropriate use of Silver Dressings in Wounds. An expert working group consensus. *Wounds International*, 2012. [http://www.woundsinternational.com/pdf/content\\_10381.pdf](http://www.woundsinternational.com/pdf/content_10381.pdf), accessed 18 September 2014
29. Best Practice Statement. The use of topical antiseptic/antimicrobial agents in wound management. *Wounds UK*, 2010. [http://www.wounds-uk.com/pdf/content\\_9627.pdf](http://www.wounds-uk.com/pdf/content_9627.pdf), accessed 18 September 2014
30. Sibbald GR, Mahoney J; V.A.C. Therapy Canadian Consensus Group. A consensus report on the use of vacuum-assisted closure in chronic, difficult-to-heal wounds. *Ostomy Wound Manage* 2003; 49(11): 52–66
31. Cruse PJ, Foord R. The epidemiology of wound infection. A 10-year prospective study. *Surg Clin North Am* 1980; 60(1): 27–40
32. Schneeberger PM, Smits MH, Zick RE et al. Surveillance as a starting point to reduce surgical-site infection rates in elective orthopaedic surgery. *J Hosp Infect* 2002; 51(3): 179–84
33. Greene LR. Guide to the elimination of orthopaedic surgery surgical site infections: an executive summary of the Association for Professionals in Infection Control and Epidemiology elimination guide. *Am J Infect Control* 2012; 40(4): 384–6