JWC Global Guideline

International Surgical Wound Complications Advisory Panel

guideline for post-operative incision care

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ISWCAP
INTERNATIONAL SURGICAL WOUND COMPLICATIONS ADVISORY PANEL

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Contents

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Foreword

Surgical wound complications are an unwanted outcome and may occur following any type of surgical procedure. While there are a number of guidelines for prevention of surgical site infection for tertiary level care, these are designed to be used during the perioperative and intraoperative phases of the patient's surgical journey.[1,2] As such, there is a paucity of clinical guidance for post-operative incision care, in both the acute and home-care settings. Moreover, this deficit is exacerbated by a limited evidence base to draw upon.

This guideline is the first of its kind that demarcates clinical care principles for patients with closed surgical incisions, separate to management of patients with hard-to-heal (chronic) wounds or surgical wounds healing by secondary intention. This is a living guideline, built upon current and emerging evidence and research. The International Surgical Wound Complications Advisory Panel (ISWCAP) will regularly update this guideline's recommendations as new evidence becomes available.

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Introduction

The anticipated normal healing trajectory of an incisional wound is full closure 6-8 weeks following surgery on the provision the wound is not contaminated, tension is minimised at the opposed margins and the patient is relatively healthy.[3] However, both intrinsic and extrinsic factors may confound the healing process and result in surgical wound complications (SWCs), defined as any disruption to normal incisional healing after surgery.[4] Surgical site infections (SSIs) are the most common SWC; other complications include surgical wound dehiscence (SWD),[5] hypergranulation, peri-wound maceration, scarring and medical adhesive-related skin injury (*Table 1*).[1,5,6] Complications are most commonly reported 7–9 days after the procedure, but may occur within 90 days post-operatively, particularly for procedures with implants.[4,7,8]

Need for new guidance

Globally, 310 million major surgeries are performed each year, with 40–50 million in the United States and 20 million in Europe.[9] Of all post-operative patients, around 15% will develop an SWC, and 5–15% will be readmitted to the hospital within 30 days.[9] SSIs occur in an estimated 2.5% of all surgical patients.[10] Higher incidence rates are reported for specific surgical diagnoses, such as 3.1% for spine surgeries[11], 19–29% for head-and-neck cancer surgeries,[12] 8.1% for groin infections after arterial interventions[13] and 16.3% for abdominal surgeries.[14] These numbers tend to be higher in low- or middle-income countries, due to a combination of factors, including access to safer surgery, resources and social determinants of health care.[15–17]

Consensus statement: Given the difference between SSI and SWD, it is highly likely that SWD is significantly underreported.

Unwanted outcomes after surgery affect a patient's wellbeing and return to normal life. SWCs typically extend how long a patient must stay in the hospital or cause a patient to be re-admitted. Extended stays and re-admission increase the risk of hospital-acquired complications, such as infection, falls and pressure injuries. They also require more resources to manage, impacting on the capacity and finances of hospitals, allied health services and social services.

The cost of caring for patients with SWCs places a significant burden on healthcare systems. A Canadian study reported that care for a patient with a primary hip or knee arthroplasty cost five times as much if the patient developed an SSI.[18] In the US, the total annual cost of treating SSIs has been estimated at least $3.5 billion and potentially over $10 billion.[19] An Australian study found that an SWC increased the cost of treating a surgical incision threefold.[20] A subsequent study found that managing SSIs cost the Australian acute care sector A$325 million annually.[21] In the UK, 81% of the district nursing caseload is for the clinical management of unhealed wounds, particularly surgical wounds.[22]

There are several guidelines for the prevention of SSI. However, the implementation of this guidance in clinical practice is limited, with fewer than 10% of respondents to a recent global survey of health professionals reporting using evidence-based guidelines for the prevention of SSI.[23] Moreover, the scope of these guidelines is limited to the pre-operative and peri-operative phases, with a distinct paucity of evidence-based recommendations for incision care in the acute and post-acute post-operative phases.[24] While pre-operative and peri-operative guidelines are based on strong clinical evidence, existing recommendations for post-operative incision care are based on

Table 1. Surgical wound complications, defined by the International Surgical Wound Complications Advisory Panel (ISWCAP)[4]

Complication	Definition
Hypergranulation	Excess granulation tissue extending above the level of the skin[6]
Medical adhesive-related skin injury (MARSI)	Skin damage related to the use of medical adhesive products or devices such as tapes, wound dressings, stoma products, electrodes, medication patches and wound-closure strips[6]
Periwound maceration	Softening or wetting of the skin immediately surrounding the wound due to retention of excessive moisture[6]
Scarring	An area of fibrous tissue that remains after the healing of injured tissue[6]
Surgical site infection	An infection near or at the incision site and/or deeper underlying tissue spaces and organs within 30 days of a surgical procedure (or up to 90 days for implanted prosthetics)[1]
Surgical wound dehiscence	Partial or total separation of previously approximated wound edges, which usually occurs within 3–10 days of surgery[5]

best practices, which may not be evidence-based. This may be due to a paucity of evidence, as well as a focus on peri- and intra-operative tasks within acute care at the expense of guidance on incision care once the patient leaves the hospital.

Global guideline

This global guideline aims to establish evidence-based recommendations on the clinical surveillance and management of surgical incisions to minimise the risk of SWCs, including SSIs and SWD. The recommendations presented are intended to be relevant to all surgical incisions approximated with sutures, staples or surgical glue (healing by primary intention). However, the recommendations exclude incisions left open until healing (healing by secondary intention) or retained with sutures for delayed primary closure (healing by tertiary intention). These recommendations should be relevant across healthcare sectors, including the acute and post-acute care settings. Disciplines considered include obstetric, gynaecological, orthopaedic, colorectal/abdominal, upper gastrointestinal, vascular, cardiothoracic, breast, reconstructive, oncological and spinal surgery.

Recommendations may differ between surgical procedures and classes of surgical wound.

This global guideline presents the outcomes of a consensus meeting between the Chair and author panel, held in London on 29 April 2024. The recommendations were agreed upon after a review of the evidence and an in-depth discussion among the expert panel to reach a consensus. As far as possible, these recommendations are based on the latest relevant research evidence, which was identified through EBSCO, CINHAL and PubMed using topic-specific search terms before undergoing panel review. Where possible, the panel aimed to describe existing evidence for clinical practice across surgical disciplines. Where appropriate, reccomendations have been given a Cochrane GRADEpro evidence level based on available systematic reviews and meta-analyses. Recommendations based on expert experience are presented as consensus statements.

Consensus statement: This global guideline is intended to complement existing best-practice guidelines.

Existing guidelines

There are several evidence-based guidelines for the prevention of SSI (*Box 1*).[3,4,16,23–27]

Consensus statement: Prevention of SSIs should follow guidelines from the World Health Organization (WHO)[25] and the US Centers for Disease Control (CDC).[3]

Implementation of these general guidelines can be informed by relevant research pertaining to specific surgical procedures, such as the following:

- Breast reconstruction[28,29]
- Caesarean section[30]
- Cardiothoracic surgery[31,32]
- Colorectal surgery[33]
- Gynaecological surgery[34]
- Hernia repair[35]
- Spinal surgery[36]
- Joint arthroplasty.[37,38]

Current guidelines build on William Stewart Halsted's original model for training programmes to promote safe surgery, which established the model of graduated responsibilities in medical education and prevention of contamination of the surgical field, including the use of surgical gloves, local anaesthesia, asepsis, silk suturing and elimination of dead space.[39]

Halsted's model of graduated responsibilities remains the basic structure of surgical training in the US.[39] While guidelines for quality assurance of surgical training programmes are universally adopted across institutions, often disparities exist between countries resulting in variability in competence and skill sets.[40,41] Cost implications and resources vary across the world, with inconsistencies in interpretation of evidence and existing guidelines.[42] Some published guidance is specifically focused on resource-limited settings, including from the WHO,[43] National Institute for Health and Care Research (NIHR)[44] and LifeBox Clean Cut programme.[45]

Bundled care guidelines have been developed for different procedures (*Box 2*).[36,46–64] For example, bundled interventions for colorectal surgery include antibiotic prophylaxis, oral antibiotic prophylaxis, mechanical bowel preparation, laparoscopy, normothermia and a wound retractor.[53,54] These bundled care guidelines primarily cover peri-operative and intra-operative procedures and tend not to cover post-operative care.

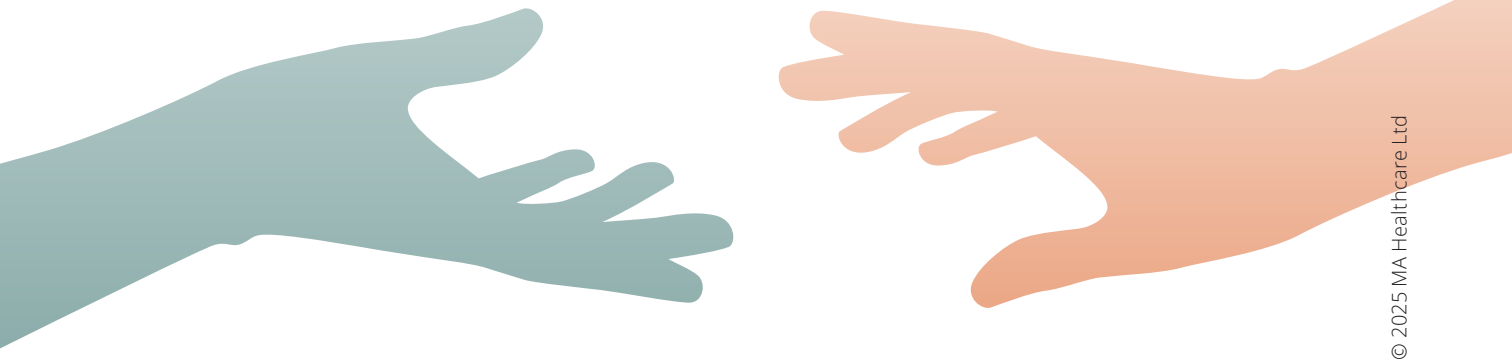
Consensus statement: Surgical wound treatment plans must be individualised.

Box 1. International guidelines for prevention of surgical site infection

- Asia Pacific Society of Infection Control (APSIC), 2019[16]
- European Wound Management Organisation (EWMA), 2020[26]
- International Surgical Wound Complications Advisory Panel (ISWCAP), 2020[4]
- National Institute for Health and Care Excellence (NICE), 2019[27]
- US Centers for Disease Control and Prevention (CDC), 2017[3]
- World Health Organization (WHO), 2018[25]

Box 2. Care bundles by surgical discipline

- Abdominal surgery[63,64]
- Bariatric surgery[48]
- Caesarean and gynaecological surgery[49–52]
- Colorectal surgery[53,54]
- Cranial surgery[55–57]
- Head and neck surgery[58]
- Joint arthroplasty[59–61]
- Lower-extremity vascular surgery [62]
- Spinal surgery[36,46,47]



Pathogenesis and risk factors

To minimise the risk of SWCs in surgical patients, it is necessary to understand their pathogenesis and associated risk factors.

SSIs are most likely to be caused by pathogens originating in sites remote from the incision rather than being caused by intraoperative contamination, known as the Trojan Horse theory.[65] The Trojan Horse hypothesis assumes that SSI pathogenesis occurs when pathogens are transported from areas remote from the surgical incision (e.g., teeth, gums, or gastrointestinal tract) to the surgical site, where they subsequently cause infections.[65] A patient's susceptibility to SSI can be increased by the intrinsic and extrinsic factors that affect the healing trajectory of any wound, including surgical incisions (*Box 3*).[26,66,67] Further risk factors specific to surgical incisions have been identified for particular areas, such as colorectal surgery (*Box 4*).[68] A patient's predisposition to pathogenic activity is influenced by the level of contamination of the surgical procedure, categorised as clean, clean-contaminated, contaminated or dirty/infected.[69]

Consensus statement: Some risk factors for SSI are modifiable. Before and after surgery, patients need to be fully informed about these modifiable factors and supported with cooperative strategies to reduce their risk of SSI. These strategies may include diabetes control, reduced alcohol intake, a healthier diet for weight loss or to address protein-calorie malnutrition and cessation of smoking and/or vaping. Patients should also be helped to manage their medications to optimise the chance of successful surgery and wound healing.

Risk can be formally assessed using specific tools. There are at least 10 validated risk-assessment tools widely available, primarily for cardiothoracic surgery.[70] As an example, the Brompton and Harefield Infection Score (BHIS) includes five weighted variables:

- Diabetes or haemoglobin A1c >7.5%
- BMI >35kg/m2
- Female sex
- Emergency surgery
- Left ventricular ejection fraction <45%.[71]

Another example is the Perth Surgical Wound Dehiscence Risk Tool (PSWDRT) for abdominal procedures, which identifies the following as independent risk predictors for wound complications after colorectal surgery:

- Previous surgery in the same anatomical location
- Duration of surgery
- Diabetes.[72]

Box 3. Risk factors for delayed wound healing[26,66,67]

Intrinsic
- Co-morbidities
  - Diabetes
  - Obesity
  - Protein calorie malnutrition
  - Arterial insufficiency
  - Chronic oedema
- Medications
  - Steroids
  - Nonsteroidal anti-inflammatory drugs
  - Anticoagulants
  - Antirejection medications
- Cancer
  - Chemotherapy
  - Immunotherapy
  - Radiation therapy
- Autoimmune disorders
- Stress
- Immobility
- Psychosocial behaviours
  - Smoking
  - Vaping
  - Alcohol abuse

Extrinsic
- Foreign bodies
- Tension and/or pressure on the wound site
- Lack of adherence and concordance to care plan
- Patient's environment and living conditions
  - Distance from point of care
  - Lack of access to care

Box 4. Risk factors for surgical site infection in colorectal surgery[68]

Patient-related
- Cigarette smoking
- Diabetes
- Male gender
- Obesity (BMI >30 kg/m^2)
- Serum albumin <2.5 g/dL
- Tumour location
- American Association of Anaesthesiologists score >3

Treatment-related
- Blood loss ≥100 mL
- Need for blood transfusion
- Open versus laparoscopic surgery
- Operation time >180 minutes
- Ostomy formation (decreased incidence)
- Previous abdominal surgery

Pre-operative and peri-operative care

There are steps that should be taken in pre-operative and peri-operative care to minimise the risk of SWCs.[38]

Antiseptic skin preparation

Recommendations on protocols for antiseptic skin preparation vary. According to the WHO and CDC, the skin around the surgical site should be prepared with an alcohol-based antiseptic solution.[25] However, the National Institute for Health and Care Excellence (NICE) recommends either an alcohol-based solution or chlorhexidine as a first choice and, if these are unsuitable or not available, an aqueous solution of povidone-iodine.[73]

Recommendation: Chlorhexidine and povidone-iodine can be used for pre-operative antiseptic skin preparation, depending on local protocols and availability.
Evidence grade: strong[2]

The CDC recommends against applying antimicrobial ointments, solutions or powders to the surgical incision.[3] Instead, they advise that the patient shower and wash the full body with soap or an antiseptic agent the night before surgery.[3] The WHO recommends that body hair should only be removed if necessary and only with clippers; shaving is avoided pre- and intra-operatively.[25] If a patient has a positive nasal swab for S. aureus, the WHO also recommends intranasal applications of mupirocin 2% ointment with or without a chlorhexidine gluconate body wash.[25]

Surgical antibiotic prophylaxis

The CDC and WHO recommend surgical antibiotic prophylaxis (SAP) before surgery only when indicated for a specific diagnosis, such as a caesarean section.[3,25] SAP should be administered within 120 minutes before incision, considering the half-life of the antibiotic, and discontinued after completion of surgery.[25] Additional prophylactic antimicrobials should not be administered after the incision is closed if the procedure is clean or clean-contaminated.[3] The use of SAP varies among surgical diagnoses and disciplines, partly due to variations in the intrinsic likelihood of exposure to microbes. In addition, between 38% and 50% of the pathogens that cause SSIs have been shown to be resistant to the antibiotics used for SAP, complicating consistent guidelines.[74]

Patients undergoing elective colorectal surgery should not have mechanical bowel preparation alone without oral antibiotics.[25]

Optimising patient status

According to CDC guidance, normothermia (maintenance of normal core body temperature) must be maintained through the peri-operative period.[3] Meanwhile, patients with or without diabetes require perioperative glycaemic control, with blood glucose target levels <200 mg/dL. [3] Blood transfusion guidelines are specialty-specific, but necessary blood products should not be withheld to prevent SSI.[3]

The WHO recommends that adult patients undergoing general anaesthesia with endotracheal intubation receive an 80% fraction of inspired oxygen intraoperatively and 2–6 hours post-operatively.[25] According to CDC, patients with normal pulmonary function undergoing general anaesthesia with endotracheal intubation should be administered an increased fraction of inspired oxygen during surgery and immediately after post-operative extubation.[38]

Advanced wound dressings for post-operative care

After surgery, the incision should be covered with an advanced wound dressing. These advanced dressings are designed to perform specific functions, such as creating a sealed environment to protect the incision and periwound skin from external contamination.[75] Advanced dressings are also often intended to absorb excess exudate and maintain appropriate moisture balance, both to prevent maceration and to promote moist wound healing, a central tenet of wound care.[75] Appropriate use of advanced wound dressings can optimise the wound environment to promote healing, minimise the risk of SWCs and potentially reduce treatment time and cost.[76]

Undisturbed wound healing

Wound dressings for a post-operative incision should be kept in place for the maximum amount of time. This strategy, known as undisturbed wound healing, aims to maintain the aseptic microclimate of the operating theatre at the surgical incision for as long as possible. This should minimise the risks of external contamination and developing an SSI.[77]

Consensus statement: In general, post-operative dressings should be left in place for around 7 days or until the suture is removed on a clean surgical site. Dressings may be left in place for up to 14 days, depending upon patient circumstances, exudate level and goal of care.

National guidelines, local protocols and recommendations for the surgical specialty will determine the length of time a dressing needs to be in place. Optimal wear time may vary according to the amount of exudate, patient mobility and patient health.[78]

Consensus statement: A dressing should be removed if it ceases to be intact or detaches from the wound edges, thus ceasing to be waterproof and exposing the incision to external contaminants. Dressing removal may also be required if the dressing becomes saturated with exudate or blood, if the incision shows signs of infection or if the patient shows signs of an allergic reaction to the dressing (e.g., itching, pain or erythema).

When necessary, the dressing should be removed and replaced with a new sterile dressing using an aseptic non-touch technique.[79]

Dressing selection

There is a plethora of advanced wound dressings, which vary in composition, size and shape, as well as function and properties. A Cochrane review concluded that it is uncertain if any secondary wound dressing used over a primary dressing is more effective than others in reducing SSIs.[80] Consensus panels have proposed several features for an ideal post-operative dressing (*Box 5*).[76,77,80,81]

Decisions on the type of wound dressings needed for a patient's incision should be protective and consider several factors. These include the goal of care, the location of the incision site and the type of surgical procedure; for example, a patient with a total knee replacement requires a dressing that will adhere during knee flexion during gait, while a patient with a sternal incision requires a dressing that will withstand friction from clothing. Patient condition is important, including mobility, overall health and risk of SWCs.

Dressing selection is also influenced by wound status and the presence of existing SWCs. For example, an incision that is dehisced with moderate purulent exudate requires a more absorbent material (to control the exudate).

Other factors include the post-acute care setting, as well as the patient's preferences and ability to manage the dressing after discharge.[80,82] The cost and availability of dressings and reimbursement policies of the local healthcare system can influence decision-making and may create significant discrepancies in universal care of surgical incisions.[80]

Box 5. Features of an optimal wound dressing for post-operative incisions[76,77,80,81]

- Absence of particulate contaminants left in the wound after removal
- Absorption capability to control exudate
- Adhesion to the skin, whether it is dry after disinfection or moistened by sweat
- Atraumatic removal
- Cosmetic acceptability
- Ease of use to ensure consistent care
- Elimination of dead space between the wound bed and dressing to avoid exudate pooling
- Flexibility to not impede the person's movement and provide elasticity to avoid pulling the skin or blistering (particularly over joints)
- Patient comfort
- Protection of periwound skin
- Suitability for use with different skin closures (e.g., sutures or staples)
- Suppression of scar-tissue formation
- Transparency to allow visualisation of the incision, reducing the need to remove the dressing
- Waterproofing to provide a good seal/barrier function and allow showering

Consensus statement: Although there is a substantial body of evidence for the use of advanced dressings in hard-to-heal wounds, studies on the comparative effectiveness of dressings for surgical wound management and prevention of SSI are lacking.

Transparent dressings

Transparent dressings make it possible to visually observe the wound for post-operative monitoring without having to remove or look under the dressing ('peeking').[83,84] This enables early detection and escalated intervention if an SWC develops. For example, a transparent hydropolymer wound dressing used on hip and knee arthroplasty incisions was found to provide sufficient visibility of the incision, as well as stay in place for 14 days.[84] Work is also underway to determine the clinical utility of full-visibility post-operative dressings for early detection of complications in the discharge period.[83]

Consensus statement: Transparent dressings may be used in dry and intact incisions to allow visual wound monitoring without dressing removal.

Dressings with an antimicrobial effect

Studies of advanced dressings with antimicrobial agents vary in their findings. A meta-analysis of advanced antimicrobial dressings on surgical sites post-caesarean section concluded that dialkylcarbamoyl (DACC)-impregnated dressings potentially reduced the risk of SSIs.[75] Other studies have demonstrated a reduced occurrence of SSI following vascular and orthopedic surgery using DACC-containing dressings.[85–87]

Recommendation: DACC-containing dressings may be considered for people with vascular or caesarean wounds that are expected to have low-to-moderate exudate and may be used as part of usual prevention measures to reduce SSI.
Evidence grade: low[88]

The aforementioned meta-analysis also found no benefit from silver dressings.[75] Studies in cardiac surgery did not support the use of silver dressings to minimise the risk of SSIs in either paediatric or adult populations.[89,90] A meta-analysis found that silver dressings were not more effective than alginate dressings in reducing the risk of developing an SSI in adult cancer patients.[91] In another study, silver dressings compared with silver-free dressings were not associated with a lower incidence of SSIs in clean or clean-contaminated surgical procedures.[92] However, a study on breast cancer patients with high risk for SWCs found that a silver alginate dressing did reduce complications in the first week after surgery.[93]

Recommendation: There is limited evidence to support use of silver-impregnated dressings in post-acute care for patients at risk of SSI. Furthermore, use of silver may increase the cost of care without proven cost-effective benefits.
Evidence grade: low[92]

There is limited evidence supporting the use of topical antibiotics on closed incisions for the prevention of SSI.[94]

Recommendation: Topical antibiotics should be avoided, as should the use of antimicrobial agents and antibiotics in the absence of active infection.
Evidence grade: low to moderate[94]

Incisional negative pressure wound therapy

Incisional negative pressure wound therapy (iNPWT) is an advanced therapy that uses a dressing to create negative pressure at the wound-bed interface to help facilitate healing.[95] A consensus document on the prophylactic use of iNPWT to reduce the incidence of SSI concluded that risk factors for SSI (both patient and surgical aspects) should be considered when making decisions about the use of this intervention.[96]

Consensus statement: Use of iNPWT should be dependent on the patient or caregiver's ability to monitor the device, as well as the patient's goals.

There is considerable discourse on use of iNPWT for prevention of SSI, with conflicting studies. Studies of the impact of iNPWT on SSI incidence in Class I and Class II procedures vary in their results and by surgical discipline. A systematic review evaluating iNPWTs' effect on surgical site healing by primary intention revealed a decrease in incidences of SSI, sero/haematoma formation and need for re-operation, although there was less evidence for impact on SWD incidence.[97] Another study compared iNPWT to other types of dressings used for surgical sites and reported superior subjective and objective outcomes but increased cost.[82] However, a meta-analysis showed that the prophylactic use of NPWT for groin wounds with vascular surgery significantly reduced the incidence of SSIs, revision surgeries and hospital stays.[98] Furthermore, when evaluated for use after spinal surgery, a significant reduction in SSIs was reported.[99,100] An meta-analysis and trial sequential analysis found high-certainty evidence that NPWT is effective in reducing SSI, although this conclusion is general and not specialty-specific and thus should be interpreted with caution.[101,102] Evidence supports use of iNPWT in open colorectal surgery and areolar skin grafts with breast reconstruction.[103–105] A study on use of iNPWT on incisions for major trauma fractures showed no significant difference in the rate of deep SSIs as compared to standard dressings.[106] Studies at the Cleveland Clinic showed similar results in high-risk patients following colorectal surgery[107] and sternotomies.[108] Likewise, a meta-analysis reported that NPWT with absorbent dressings was not effective in reducing the risk of developing an SSI in adult cancer patients compared with standard care.[91]

Recommendation: Despite conflicting evidence, the use of iNPWT may be considered, dependent on the availability of resources and the patient or caregiver's ability to manage the device.
Evidence grade: low[2]

Consensus statement: There is limited evidence on the impact of iNPWT on SWCs in patients with comorbidities (obesity, diabetes, chronic obstructive pulmonary disease), and further studies are needed to determine its clinical efficacy and cost-effectiveness compared with standard care.

Post-operative surveillance

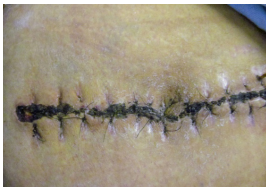
Early detection of a post-operative wound complication has the potential to prevent a wound from escalating into a serious complication. Post-operative surveillance provides opportunities for early assessment, diagnosis and management of an SWC.

Basic assessment

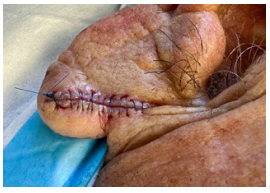
Healthcare professionals should be able to recognise the CCSs of inflamation, infection and dehiscence (*Figures 1–4*). Post-operative surveillance should generally involve assessment for clinical signs and symptoms (CSSs) of inflammation, including pain, heat, swelling and redness (erythema). Other critical signs and symptoms of a potential SWC are skin texture,

Figure 1. Surgical sites without signs of infection

Images courtesy of Rose Hamm

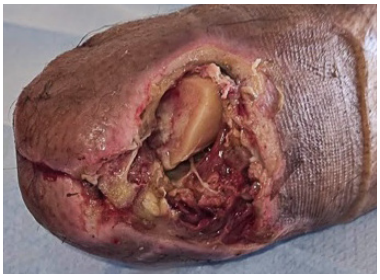


Surgical site with eschar forming along suture line

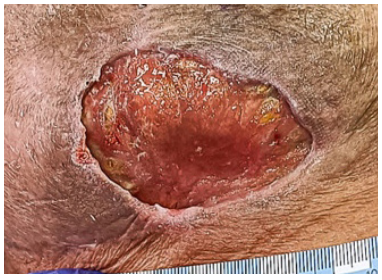


Surgical site closed by primary intention

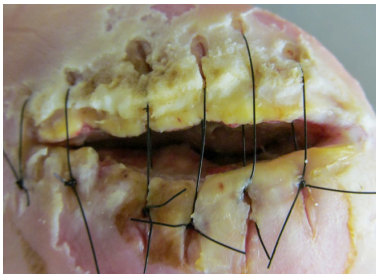
Figure 2. Surgical site infections (SSIs)



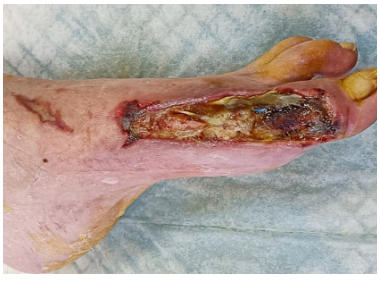
Deep SSI at an amputation site with exposed bone
Courtesy of Zhavandre van der Merwe



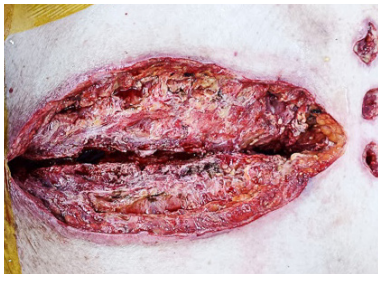
Deep SSI on the breast
Courtesy of Zhavandre van der Merwe



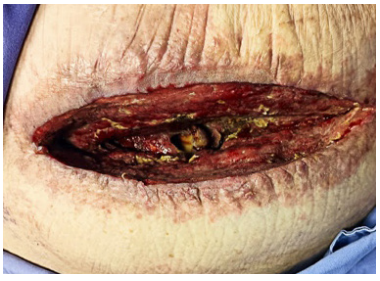
Delayed primary intention, closed with retaining sutures
Courtesy of Rose Hamm



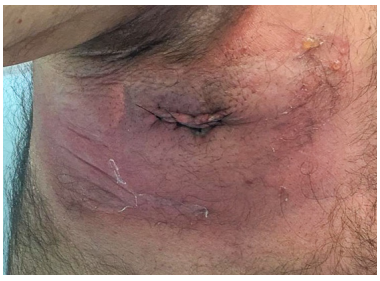
Deep SSI on the foot, with exposed bone and hardware
Courtesy of Zhavandre van der Merwe



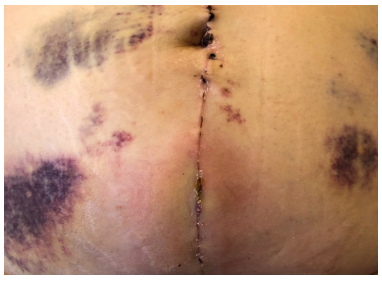
Deep SSI in the sternum
Courtesy of Zhavandre van der Merwe



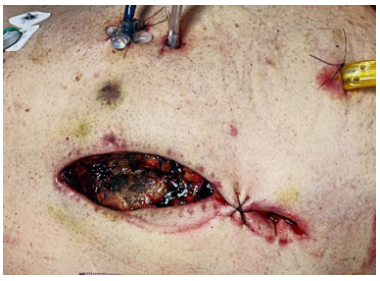
Deep SSI on the right hip
Courtesy of Zhavandre van der Merwe



SSI on the chest, with medical adhesive-related skin injury (MARSI)
Courtesy of Sara Carvalhal

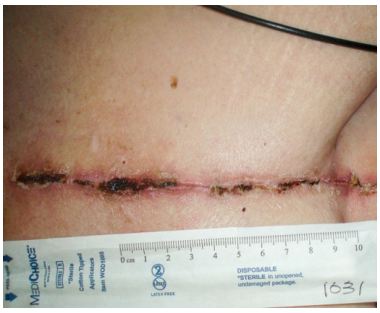


Subcutaneous infection of a midline laparatomy
Courtesy of Ewa K Stuermer

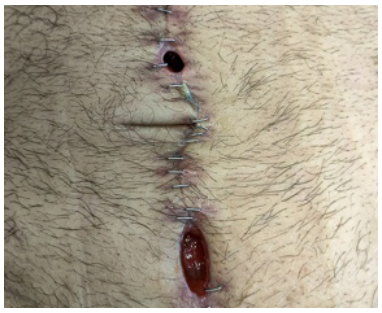


Organ space SSI in the abdomen
Courtesy of Zhavandre van der Merwe

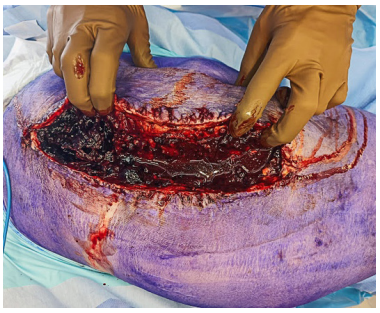
Figure 3. Surgical wound dehiscence



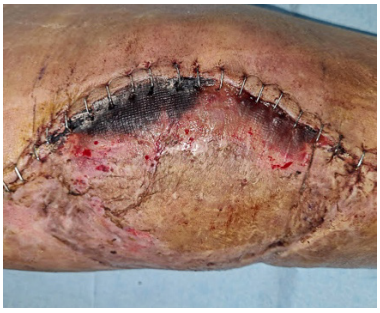
Partial dehiscence without signs of infection
Courtesy of Rose Hamm



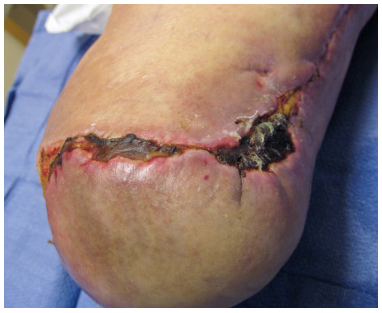
Dehiscence without signs of infection
Courtesy of Sara Carvalhal



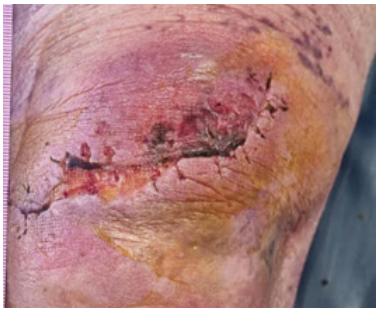
Dehiscence of a haematoma on the hip
Courtesy of Zhavandre van der Merwe



Dehiscence with necrotic tissue after knee surgery
Courtesy of Zhavandre van der Merwe

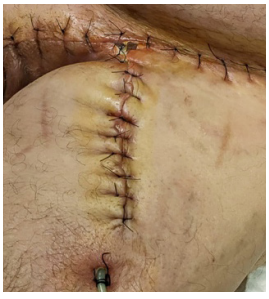


Dehiscence with necrotic tissue at an amputation site
Courtesy of Rose Hamm

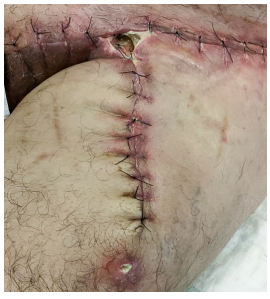


Dehiscence with necrotic tissue after knee surgery
Courtesy of Zhavandre van der Merwe

Figure 4. Surgical site on the groin after vascular surgery closed by primary intention
Images courtesy of Sara Carvalhal



Without dehiscence



Dehiscence 1 week later

oedema, odour, exudate and eschar along the incision site, as well as stalling or regression of healing. Patients need to be instructed to watch for these signs at the surgical site and contact the healthcare provider if any of them appear. Patient vital signs must also be taken into consideration when clinically assessing the wound.

Erythema may be harder to observe visually in patients with dark skin tones, which can result in delayed detection of SSI. Therefore, additional education may be required on the assessment and classification of different skin tones (*Box 6*).[109,110]

Box 6. Classifications for skin colour

Eumelanin Human Skin Colour Scale A five-point scale based on the amount of eumelanin (the human skin's most dominant chromophore) in the skin; designed to be objective, equitable, and easy to understand.[142]
Fitzpatrick Colour Scale A scale of I-VI based on self-reported tendency to sunburn; initially developed to determine the optimal initial dose of UVA for treatment of psoriasis.[143]
Ho and Robinson Colour Bar Tool A colour tool of six bars with 19 colour variations that patients use to identify their skin colour by matching a bar to the inside of the upper arm.[144]
Monk Skin Tone Scale A set of 10 skin tones developed from the social sciences and used mostly by social media to classify skin colour; intended to be more inclusive than the Fitzpatrick scale.[145]
Roberts Skin Type Classification A four-part system to predict the skin response to injury after aesthetic procedures.[146]

Classification and scoring systems

Post-operative surveillance must be based on consistent and appropriate classification and scoring systems.

Box 7. Grading of surgical site infection (SSI)[3]

Superficial incisional SSI
- Occurs within 30 days after the procedure
- Involves only the skin or subcutaneous tissue of the incision
- Includes at least one of the following symptoms:
  - Purulent drainage from the superficial incision
  - Microbes from an aseptically obtained specimen from the superficial incision
  - At least one symptom of infection (pain or tenderness, localised swelling, erythema, warmth and the incision is deliberately opened by the surgeon unless the culture is negative
  - Diagnosis of superficial incisional SSI by a physician or physician designee

Deep incisional SSI
- Occurs within 30 or 90 days after surgery
- Involves deep soft tissue (e.g. fascia or muscle)
- Includes at least one of the following symptoms:
  - Purulent drainage from the deep incision
  - Spontaneous dehiscence or deliberate opening by the surgeon when the patient has fever (more than 38 degrees C) localised pain, or tenderness, unless the culture is negative
  - An abscess or evidence of infection in the deep tissue upon direct examination, during reoperation, or by histopathologic or radiologic examination

Organ/space SSI
- Occurs within 30 or 90 days after surgery
- Involves any part of the body deeper than fascia or muscle manipulated during the surgery
- Includes at least one of the following symptoms:
  - Purulent drainage from a drain placed into the organ/space
  - Microbes identified from an aseptically obtained fluid or tissue in the organ/space culture or nonculture-based microbiologic testing method performed for clinical diagnosis or
  - An abscess or evidence of infection involving the organ/space detected on direct examination or by histopathologic or radiologic examination
- AND meets at least one criterion for a specific organ/space infection site (e.g. mediastinitis, osteomyelitis)

Adapted from Center for Disease Control and Prevention Grading System, available at www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf. The reader is referred to the full guidelines for complete definitions.

SSIs are most often classified by their depth and severity according to the CDC classification (*Box 7*).[16] The healing trajectory of a surgical wound can also be quantified with either the ASEPSIS wound scoring method, based on signs and symptoms of infected sternal wounds after open heart surgery (*Box 8*), or the Southampton system, developed to assess hernia wounds (*Box 9*).[111] These three scoring systems can be adapted to other diagnoses with slight alterations.

Consensus statement: Variations in the classification and scoring systems for SSIs can create inconsistencies in reporting and classifying them. Therefore, centres should aim for consistency where possible and report SSIs using the CDC classification.

Box 8. ASEPSIS Wound Scoring Method[147]

These categories are given points (in brackets):
- Antibiotic treatment (10)
- Drainage of pus under local anaesthetic (5)
- Debridement under general anaesthesia (10)
- Serous drainage (0–5)
- Erythema (0–5)
- Purulent drainage (0–10)
- Separation of deep tissues (0–10)
- Isolation of bacteria (10)
- Stay as an inpatient more than 14 days (5)

Scoring is calculated into the following groups:

0–10	Satisfactory healing
11–20	Disturbance of healing
21–30	Minor SSI
31–40	Moderate SSI
>40	Severe SSI

Box 9. Southampton Wound Score[148]

Grade 0 – Normal healing

Grade I – Normal healing with mild bruising or erythema
- A. Some bruising
- B. Considerable bruising
- C. Mild erythema

Grade II – Erythema plus other signs of inflammation
- A. At one point
- B. Around sutures
- C. Along wound
- D. Around wound

Grade III – Clear or haemoserous discharge
- A. At one point only (<2 cm)
- B. Along wound (> 2 cm)
- C. Large volume
- D. Prolonged (>3 days)

Grade IV – Purulent discharge
- A. At one point only (< 2 cm)
- B. Along wound (> 2 cm)

Grade V – Deep or severe infection with or without tissue breakdown; haematoma requiring aspiration

The wounds are placed into these four categories:
- A. Normal healing
- B. Minor complication
- C. Major complications, wound infection (wounds graded IV or V or wounds treated with antibiotics after discharge from hospital)
- D. Major haematoma (wound or scrotal haematoma requiring aspiration or evacuation)

SWD can be classified with the Sandy Grading System for Surgical Wound Dehiscence (*Box 10*). This internationally recognised grading system is anatomically focused and incorporates both the microbial and non-microbial aspects of SWD.[5]

Box 10. Sandy Grading System for Surgical Wound Dehiscence[5]

Grade 1
- Minor separation of opposed incisional margins at any point along the incision
- <2cm depth
- No visible subcutaneous layer
- No clinical signs and symptoms or microbiological confirmation of infection

Grade 1a
- As above with clinical signs and symptoms and/or confirmed microbiological confirmation of infection

Grade 2
- Medium (single or multiple) separations of opposed incisional margins to expose subcutaneous layer
- >5cm depth
- Bridging or tunnelling of dehiscence evident

Grade 2a
- As above with clinical signs and symptoms and/or confirmed microbiological confirmation of infection

Grade 3
- Major (single or multiple) separation of the incisional margins to expose subcutaneous, fascial/muscle/tendons and or organs

Grade 3a
- As above with clinical signs and symptoms and/or confirmed microbiological confirmation of infection

Grade 4
- Any area of fascial dehiscence with organ space, vicera, implant or bone exposed
- No clinical signs or symptoms of infection

Grade 4a
- As above with clinical signs and symptoms and/or confirmed microbiological confirmation of infection

Consensus statement: SWD is different from SSI and may not involve pathogenic contamination. Appropriate assessment and diagnosis using the Sandy Grading System for Surgical Wound Dehiscence will inform appropriate clinical intervention.

Infrared thermography

Infrared thermography is a rapid point-of-care technique for assessing skin temperature that may provide early warning of infection. It has proved effective in the early detection of inflammation in pressure-injury formation[112,113] alongside subepidermal moisture detection devices.[114,115] Studies using infrared thermography suggest periwound infection is indicated by a temperature difference between the periwound skin and normal skin over 1.5–2.2°C (3°F).[116–118] However, further studies are required to elucidate the clinical validity of this technology.

Fluorescence imaging

Fluorescence imaging is a non-contact, point-of-care method to detect and identify bacteria in the wound bed and periwound skin.[119] The hand-held device visualises red or cyan fluorescence from bacteria metabolites.

A study of 350 patients with wounds of multiple diagnoses compared the diagnostic accuracy of fluorescence imaging with CSSs. Fluorescence imaging significantly increased the detection of bacteria fourfold over CSSs, providing information that influenced wound bed preparation and antimicrobial therapy.[120] A similar study on 138 patients with diabetic foot ulcers found that 89.1% had bacterial loads greater than 10^4 CFU/g tissue, although most of the patients had no CSSs of infection.[121] Another study reported that fluorescence imaging improved the sensitivity of bacterial detection 11-fold compared to CSSs alone, and sensitivity improved if the clinician was highly experienced in the use of the device.[122]

Fluorescence imaging provides a more objective and equitable indicator of contamination than traditional visual assessment and palpation alone. The use of fluorescence imaging to detect bacterial load and track its location can result in improved interventions, informing appropriate wound cleansing and debriding techniques, as well as the use of topical antimicrobial therapies.[123] It can also help reduce the overuse of systemic antibiotics, which may lower antibiotic resistance.[124]

Near-infrared spectroscopy

Near-infrared spectroscopy (NIRS) is used to determine the oxygenation status of tissue by measuring the absorption of near-infrared light (650–1100 nm) by haemoglobin. It can accurately measure the St02 tissue haemoglobin index, perfusion index and tissue water index.[125–127]

Currently used in other disciplines, such as plastic surgery [128] and oncology,[129–131] this technology shows promise as a diagnostic tool in wound care. Spectral imaging allows a clinician to visualise microcirculation related to wound healing and can further assist in the assessment and diagnosis of underlying aetiologies. NIRS can be beneficial in monitoring hypoperfusion, inflammation and venous congestion of the wound and periwound tissue as indicators of how treatment and healing are progressing.[132]

Consensus statement: Infrared thermography, fluorescence imaging and NIRS may not be available in all settings, but they have the potential to improve surgical-site surveillance. These technologies are in their infancy and require further research to determine clinical validity and reliability in SSI prevention.

Digital surveillance tools

Digital telehealth tools have been shown to be beneficial in post-operative surveillance for SSIs, especially in remote or under-served communities.[83,133–136] A digital remote wound surveillance service was piloted in the Tracking Wound Infection With Smartphone Technology (TWIST) randomised control trial, evaluating its readiness for implementation.[137] The authors reported 83% usage by the 223 patients enrolled in the smartphone arm, and 99.4% of the images received were of sufficient quality to provide a degree of clinical insight. However, the quality of communication was rated low.[137] Effective implementation of remote post-operative assessment with photographs requires up-to-date tools, participant training and some mechanism to verify image quality.[138]

Telehealth and remote self-reporting

Patients can be encouraged to use the Bluebelle Wound Healing Questionnaire (WHQ) to self-report wound status without having to return to the clinic or have a home health visit.[139] The questionnaire consists of 16 items: eight regarding CSSs and eight regarding interventions. CSSs are rated on a scale of 0–3, and interventions are reported as 'Yes' or 'No'. Further adaptations of the WHQ have been reported for global research and practice (TALON-1) study, including translations.[140]

Consensus statement: Remote self-reporting could be especially valuable for rural and resource-limited settings. Self-reporting must be supported by health literacy programmes to educate the patient about how to recognise signs and symptoms, as well as when to seek medical attention.

Remote surveillance and monitoring can be assisted with a digital dashboard. This information-management tool allows patient users to ask questions and providers to answer them, informed by high-end information displayed at the provider end. A digital dashboard can be used to provide patient education, monitor follow-up care and track incidence and outcomes.[141]

Consensus statement: Follow-up phone calls to patients within the first 14 days after surgery, along with digital photographs and telemedicine, are helpful in the prevention and early identification of SWCs.

Education

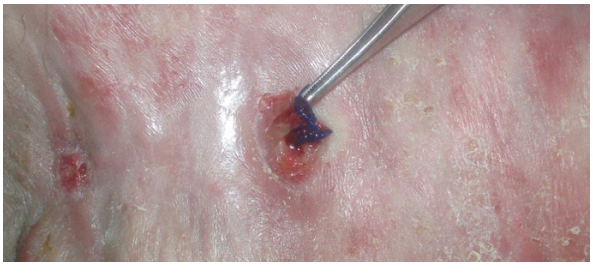
Successful surveillance of surgical sites requires adequately specific and thorough education of healthcare providers, patients and caregivers.

Provider education should include the importance of identifying patients at risk for SWCs, how to identify that risk and how to customise pre- and post-operative care to minimise that risk.[7] It should also cover how to distinguish different types of SWC, including SSI and SWD. The International Surgical Wound Complications Advisory Panel (ISWCAP) provides extensive information for providers on caring for people with surgical wounds.

Provider education should clarify the definition of SWD, emphasising that a dehisced wound is not necessarily infected. For example, the minor dehiscence created on the removal of a suture abscess (*Figure 5*) would not equate to an SSI.

Figure 5. Suture abscess

Image courtesy of Rose Hamm



Consensus statement: It is critical that patients and carers are educated on how to recognise CSSs of infection. Likewise, post-operative instructions and educational materials must include instructions on who to contact in case of a suspected complication, as well as how to contact them. Patients should be empowered to make that contact on an emergent basis without delay in getting care from a wound specialist or the surgical team.

Providers have a significant role in encouraging patient engagement in self-management, as well as implementing an effective educational programme (*Box 11*).[7] Barriers to effective patient education and engagement include poor communication, lack of knowledge and low-quality information from providers, as well as low patient health literacy.[23]

Care plan and goals

A key factor in determining post-operative follow-up is the goals set in the patient's care plan based on the following factors:

- Patient discharge destination (home, skilled nursing facility, acute rehabilitation)
- Who will be providing post-surgical care (patient, family member, caregiver, home health personnel)
- Patient access to follow-up care (remote, rural, local, metropolitan).

Consensus statement: Decisions around care planning require interprofessional engagement across different healthcare settings using timely and effective communication tools to support consistency in care. Goals should be patient-centric and take into consideration the post-operative care setting and access to resources.

Box 11. ISWCAP Consensus recommendations for implementing patient education[7]

- Education should be delivered in conjunction with surgeons, nurses, allied health professionals or other team members
- Education should be tailored for the patient, not clinicians
- Education should be limited to information relevant to the patient's specific wound classification and situation to prevent over-education
- Educational approaches should be individualised to the patient's needs and preferences
- Materials should be concise and simple, without superfluous or complex medical/nursing terms
- Materials should ideally be co-designed and reviewed by patients with relevant experience to ensure that the materials are of value
- Patient education programmes should be able to accommodate the impact of staff turnover
- Pictures and icons should be widely used in educational materials to minimise the impact of language barriers
- Printed written materials remain essential, even where videos and smartphone apps are available

Conclusions

SWCs, including SSI and SWD, are unwanted outcomes after surgery. However, the incidence, duration, and severity of SWCs can be reduced through diligent post-operative incision care. Post-operative care includes patient-centred care goals that incorporate the importance of incision and skin care when the patient is discharged from the hospital. This guideline has provided recommendations based on current evidence and best practices in relation to incision care. While there is a growing body of evidence for several topics within this document, recommendations are based upon a synthesis of research and clinical expertise to provide a living guideline for real-world application. Research continues in the areas of advanced wound dressings, antimicrobials, antibacterial agents and new technologies, such as fluorescent imaging and near-infrared devices. Further advances in effective post-operative monitoring will be essential for early detection and resolution of SWCs.

This guideline is designed for implementation across most surgical disciplines and can be used to inform post-operative incision care decisions in a team environment. The guideline is applicable to all healthcare settings, from hospitals and pharmacies to home and residential care. As a living guideline, this document will be regularly updated by the International Surgical Wound Complications Advisory Panel (ISWCAP) to incorporate new and emerging evidence that enables evidence-based practice for post-operative incisional care.

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