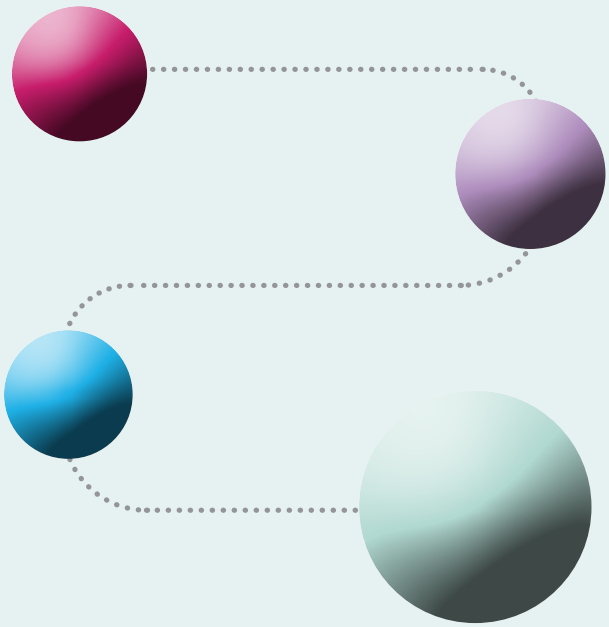
Wounds International

# Best Practice Statement

## SSI Surveillance: Promoting a seamless patient journey from surgery to community

2023



**Surgical site infection**

**Defining SSI and principles of SSI surveillance**

**Recommendations for the prevention of SSI**

**Post-discharge SSI surveillance**

**Implementing SSI surveillance in practice**

Wounds International

**BEST PRACTICE STATEMENT: SSI SURVEILLANCE: PROMOTING A SEAMLESS PATIENT JOURNEY FROM SURGERY TO COMMUNITY**

**PUBLISHED BY:**

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This document has been developed by Wounds International and is supported by an unrestricted educational grant from Essity.

This publication was coordinated by Wounds International with the Expert Working Group. The views presented in this document are the work of the authors and do not necessarily reflect the views of Essity.

**Suggested citation:**
Wounds International (2023) *SSI Surveillance: Promoting a seamless patient journey from surgery to community.* Wounds International, London

Available to download from:
www.woundsinternational.com

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# Foreword

Surgical site infections (SSIs) are consistently identified as the most frequent type of healthcare-associated infection (HAI) in low- and middle-income countries (LMICs; WHO, 2016) and they are associated with considerable morbidity, mortality, and financial burden (Cassini et al, 2016). SSIs have a negative impact on physical and mental health, and may lead to a loss of productivity (Badia et al, 2017). Additionally, in response to the rising incidence of antimicrobial resistance (AMR), antimicrobial stewardship (AMS) strategies are essential to reduce antibiotic overuse within post-operative management.

Preventing SSIs from occurring in the first instance involves pre-, intra-, and post-operative initiatives alongside a robust surveillance system to measure rates of SSI. There is a wealth of evidence to suggest that surveillance is critical to drive good clinical practice and reduce rates of SSI (Wilson, 2013; Sandy-Hodgetts et al, 2020). Moreover, evidence reveals that gaps in care can leave patients feeling disconnected from their healthcare providers, and that engaged patients can benefit from improved clinical outcomes and emotional health, and reduced healthcare utilisation (Sanger et al, 2014).

The UK Health Security Agency (UKHSA) programme has surveillance data on almost 2.5 million operations and more than 50,000 SSIs since its inception in 1997, and recognition of the national service could draw attention and resources to support monitoring and prevention of SSI.

SSI monitoring requires an active patient-focused approach to promote consistency in the patient care journey from surgery to community. Post-discharge data collection is an essential part of SSI monitoring that can be conducted at outpatient clinics or in primary care by surgeons, general practitioners and surveillance teams, or by patients themselves using self-assessment questionnaires (Tanner et al, 2013).

This document focuses on surgical wounds that have been primarily closed, rather than open wounds healing by secondary intention. Obtaining SSI surveillance data that is sufficiently accurate to drive improvement is challenging, as it is a resource-heavy activity involving correct infection identification and recording as per local surveillance systems (Wilson, 2017). Surveillance methods should be used to detect SSI during the post-operative hospital stay and post-discharge. Rates of SSI should be regularly reported to those in the surgical team who can take action to ensure that best practice is achieved to prevent SSI.

The purpose of this Best Practice Statement is to provide multidisciplinary teams with practical tips to help integrate surveillance within routine practice and prevent further infections.

*Jacqui Fletcher (Chair)*

# Surgical site infection

It is important to be aware of potential causes of infection, and to minimise these wherever possible.

**Best Practice Statement**

Bear in mind that signs and symptoms of SSI may develop after discharge.

**Reminder Statement**

While there are several non-modifiable risk factors for SSI, the majority of SSIs are considered preventable, so the focus should be on preventing SSIs from developing.

**Best Practice Statement**

Surgical site infections (SSIs) are caused by microorganisms (Table 1) that enter wounds during the operation or subsequently through attachment to unhealed or unhealthy tissue along the surgical incision or drains, which can occur at any point in the patient's surgical journey (Mellinghoff et al, 2018; Sandy-Hodgetts et al, 2018; Giacobbe et al, 2020; Ali and Al-Jaff, 2021). Over time, the bacteria multiply and trigger an activation of the host immune response, leading to signs such as erythema and tenderness, or symptoms such as increasing pain or fever. The acute inflammatory response may resolve within 2–3 weeks after surgery (Young and McNaught, 2011; Reinke and Sorg, 2012). Signs and symptoms of an infection develop in the days to weeks following surgery, by which time many patients have already been discharged from hospital (Woelber et al, 2016). Accurate wound assessment and recording of clinical signs and symptoms, the use of standardised testing (such as wound culture and serology), and post-discharge surveillance are critical in diagnosing wound infection and conducting active surveillance (Li et al, 2021; Sandy-Hodgetts et al, 2022).

SSIs have been defined by the Centers for Disease Control and Prevention (CDC) as infection related to an operative procedure, that occurs at, or near, the surgical incision. SSIs usually develop within 30 days of the procedure (Horan et al, 2008); however, if non-human material is left in the wound, such as a prosthetic joint, infection can occur several months later. SSIs are categorised according to the depth of infection (Table 2).

Globally, SSIs are the third-most common surgical wound complication and the most frequent type of healthcare-associated infection (HAI) on hospital admission (European Centre for Disease Prevention and Control [ECDC], 2018; Box 1). The occurrence of SSI differs widely between surgical procedures. The likelihood of an SSI occurring can depend on the degree of microbial contamination in the wound at the time of surgery. This is influenced both by the part of the body where the surgery was performed and other factors that increase microbial contamination, such as trauma.

Within the CDC-National Healthcare Safety Network (NHSN), wounds are classified as clean, clean-contaminated, contaminated, or dirty or infected, based on the presence and degree of contamination (Table 3).

Surgical wounds are classified as clean if tracts are not involved and sterility has not been compromised, and clean-contaminated if they involve body tract (e.g. the alimentary or genitourinary tract). If there is a break in sterile technique during the operation, and gross spillage from the gastrointestinal tract or a sterile site has been exposed to external

**Table 1. Common pathogens in SSIs (adapted from Mellinghoff et al, 2018; Giacobbe et al, 2020; Ali and Al-Jaff, 2021)**

| Common pathogens | Considerations |
|---|---|
| Gram-negative bacteria (GNB) – e.g. *Pseudomonas aeruginosa, Escherichia coli, Acinetobacter, Bacteroides* | ■ Commonly derived from the gut where they are part of the normal flora<br>■ May transiently colonise skin<br>■ Can colonise moist sites on the body and environmental surfaces. |
| Gram-positive bacteria (GPB) – e.g. *Staphylococcus aureus, Staphylococci epidermidis, Streptococci, Clostridia* | ■ Colonise human skin and mucous membranes<br>■ Trauma wounds can be contaminated from the environment. |

**Table 2. Classification of SSIs (Horan et al, 1992)**

| Depth of infection | Description |
|---|---|
| Superficial incisional | Involve the skin and subcutaneous tissue of the incision only |
| Deep incisional | Affect the soft tissue (e.g. fascia or muscle) of the incision |
| Organ/space | Affect any part of the anatomy (e.g. joint or peritoneal cavity) other than the incision that was opened or manipulated during an operation |

The likelihood of an SSI developing can depend on the degree of contamination at the time of surgery.

**Reminder Statement**

SSIs should be categorised depending on the depth of infection (superficial incisional, deep incisional or organ/space [including specific site]).

**Best Practice Statement**

Bear in mind that the incidence of SSI varies between pre-existing medical/operating theatre conditions and surgical procedures.

**Reminder Statement**

**Box 1. SSI global facts**

- In Europe, SSI affects more than 500,000 people per year, resulting in 16,000 deaths and costing up to €19 billion (Allegranzi et al, 2011). In the USA, SSI contributes to patients spending more than 400,000 extra days in hospital (Sievert et al, 2013)
- SSIs are the most frequent type of HAI in low- and middle-income countries (LMICs; WHO, 2016)
- Approximately 1 in 10 people who have surgery in LMICs acquire an SSI (WHO, 2016)
- In the USA, 39–51% SSI pathogens are resistant to standard prophylactic antibiotics (WHO, 2018a).

contamination (e.g. compound fracture), the wound is classified as contaminated. If surgery is performed on a traumatic wound with retained devitalised tissue, there is existing clinical infection or perforated viscera, the wound is classified as infected/dirty.

Risk factors for SSI include patient-related factors (e.g. age, body mass index [BMI], tobacco use, diabetes, and malnutrition) and operation-specific factors (e.g. bacterial contamination of the surgical wound, the duration of the operation, and emergency surgery). While many of these risk factors are incapable of being modified, many SSIs can be prevented by ensuring best practice is implemented throughout the surgical care pathway.

Only 1-5% of clean surgical wounds are expected to develop an SSI, whereas contaminated or dirty wounds have a much higher risk of developing SSI (Mangram et al, 1999).

Where infection may not be involved in the breakdown of a wound, the surgical wound dehiscence (SWD) grading system is applicable (Table 4). SWD is defined as the separation of opposed incisional margins that may not involve an infection (Sandy-Hodgetts, 2013; 2016; 2018; WUWHS, 2018). It is of paramount importance to confirm whether the patient's incision site has incurred an SSI or SWD, as this will inform the wound care plan and the use of antibiotic or antimicrobial therapies.

**Table 3. Classification of surgical wounds (Centers for Disease Control and Prevention, 2016)**

| Degree of contamination |
|---|
| **Clean (C):** an incision in which no contamination is encountered in a surgical procedure, without a break in sterile technique, and during which the respiratory, alimentary or genitourinary tracts are not entered (e.g. joint replacement surgery, neurosurgery). |
| **Clean–contaminated (CC):** an incision through which the respiratory, alimentary, or genitourinary tract is entered under controlled conditions but with no contamination encountered (e.g. hysterectomy, some bowel surgery, cholecystectomy). |
| **Contaminated (CO):** an incision undertaken during an operation in which there is a major break in sterile technique or gross spillage from the gastrointestinal tract, or an incision in which acute, non-purulent inflammation is encountered (e.g. some colorectal surgery). Open traumatic wounds that are more than 12 to 24 hours old also fall into this category. |
| **Dirty or infected (D):** an incision undertaken during an operation in which the viscera are perforated or when acute inflammation with pus is encountered (e.g. emergency surgery for faecal peritonitis), and for traumatic wounds if treatment is delayed, there is faecal contamination, or devitalised tissue is present (e.g. burns, diabetic foot ulcers – drainage of abscess, faecal peritonitis). |

**Table 4. WUWHS SWD Sandy Grading System (WUWHS, 2018)**

Definition: Surgical wound dehiscence (SWD) is the separation of the margins of a closed surgical incision that has been made in the skin, with or without exposure or protrusion of underlying tissue, organs or implants. Separation may occur at single or multiple regions, or involve the full length of the incision, and may affect some or all tissue layers. A dehisced incision may, or may not, display clinical signs and symptoms of infection.

| WUWHS SWD Grade* | | Descriptors |
|---|---|---|
| Increasing severity ↓ Single/multiple regions† or full-length separation of the margins of a closed surgical incision; occurring up to 30 days after the procedure‡ | 1 | **Epidermis only, no visible subcutaneous tissue**<br>■ No clinical signs or symptoms of infection |
| | 1a | As Grade 1 plus clinical signs and symptoms of infection |
| | 2 | **Subcutaneous layer exposed, fascia not visible**<br>■ No clinical signs or symptoms of infection |
| | 2a | As Grade 2 plus clinical signs and symptoms of infection |
| | 3 | **Subcutaneous layers and fascia exposed**<br>■ No clinical signs and symptoms of infection |
| | 3a | As Grade 3 plus clinical signs and symptoms of infection |
| | 4 | **Any area of fascial dehiscence with organ space, viscera, implant or bone exposed**<br>■ No clinical signs or symptoms of infection |
| | 4a | As Grade 4 plus clinical signs and symptoms of infection= (e.g. organ/space SSI) |

*Grading should take place after full assessment including probing or exploration of the affected area as appropriate by a clinician with suitable competency
†Where this is >1 region of separation of the wound margins, SWD should be graded according to the deepest point of separation
‡Where day 1 = the day of the procedure ^Grade 4/4a dehiscence of an abdominal incision may be called 'burst abdomen'

# Risk factors for SSI

**Reminder Statement**

It is important to be aware that infection is not the only reason why a post-operative site may deteriorate – tension and shear can also contribute to wound breakdown. Wounds that break down are at increased risk of infection, as the skin (natural defense against bacterial ingress) is breached, and opportunistic pathogens may bind to unhealthy tissue (Sandy-Hodgetts et al, 2018).

Level of risk for SSI is determined by differing factors relating to the patient, procedure, hospital setting or surgical practice team (Figure 1). Interventions to reduce a patient's risk of SSI in hospital, pre-, intra- or post-surgery, should take place within the context of a full assessment of the patient.

Data on these risk factors can be collected in order to analyse SSI outcomes by subgroup, to identify high-risk patients, and to control for differences in a patient's risk level. Risk factors can be adjusted for when comparing SSI rates between hospitals; however, risk factors fail to explain variations in rates. The main patient-related risk factors for infection are obesity (BMI ≥35kg/m$^2$), diabetes mellitus, current or recent smoking, and age >65 years (UKHSA, 2022). Factors affecting healthcare delivery are not taken into account. Major treatment-related factors include extended duration of surgery, inadequate surgical closure, and intra-operative hypothermia (Cheng et al, 2017; Saeed et al, 2017).

Important data to be collected for all patients included in SSI surveillance are (UKHSA, 2022):

- Patient age
- Patient sex
- Patient BMI
- Patient American Society of Anaesthesiologists (ASA) score
- Wound class
- Operation duration
- Pre-operative stay
- Operative urgency
- Trauma surgery
- Primary indication for surgery.

The NHSN risk index combines three major risk factors (duration of the operation, wound contamination class, and ASA score) to stratify SSI risk across all types of surgery (ECDC, 2017). Each risk factor represents 1 point, enabling the NHSN SSI risk index to assign all patients to one of four categories from 0 (lowest risk) to 3 (greatest risk). The NHSN risk index is used for risk adjustment by most national surveillance systems.

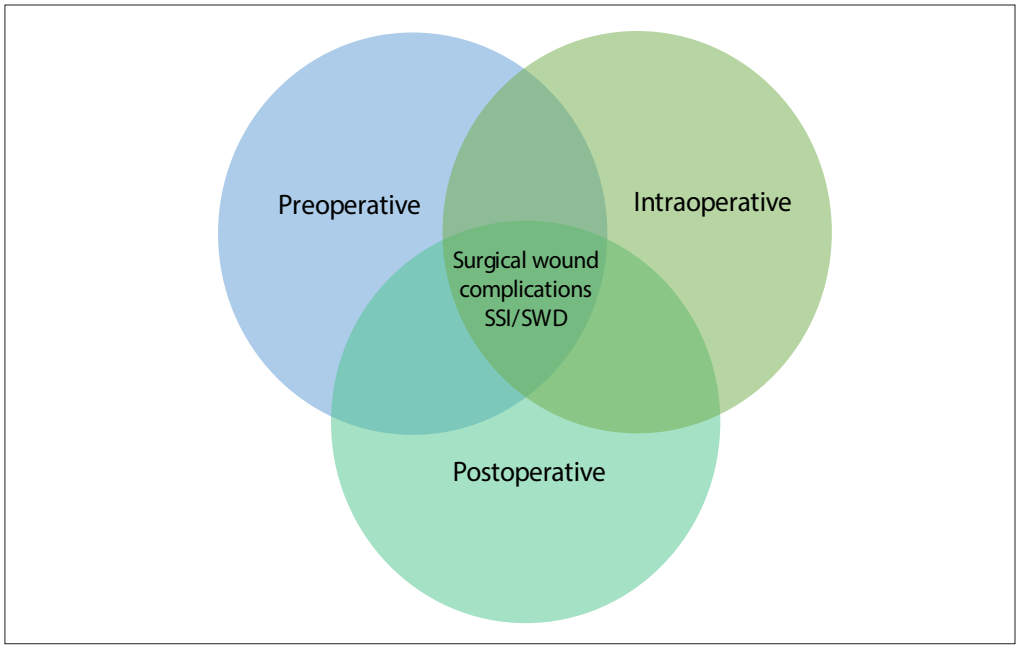


**Figure 1: Domains of risk for the surgical patient (Sandy-Hodgetts et al, 2018)**

# Defining SSI and principles of SSI surveillance

Accurate recording of SSI incidence rate relies on clear and widely recognised definitions related to wound infection and SSI, as described by the CDC.

**Best Practice Statement**

While patient-based (standard) surveillance methods include data on risk factors that can be adjusted for, a simpler hospital/unit-based protocol has been described by the CDC for SSI surveillance without risk factors.

**Reminder Statement**

SSI surveillance is defined as the systematic collection, analysis, interpretation, and evaluation of health data that is disseminated to those who respond to the data and make changes in a timely manner (WHO, 2018a). A wealth of evidence exists suggesting that surveillance and feedback of data on rates of SSI to surgeons and the surgical team is essential to reduce infection rates (Wilson, 2013). The UK Health Security Agency's HAI and AMR department run the surgical site infection surveillance service (SSISS), which conducts surveillance targeted on selected groups of clinically similar procedures, with each category containing a specific set of surgical operations (UK Health Security Agency, 2022). Therefore, SSI rates are reported by surgical procedure type and inter-hospital comparisons should be restricted to these categories when submitting to external programmes. In the UK, procedures eligible for inclusion in SSI surveillance are defined by the Office of Population Census and Surveys (OPCS) as operational procedure codes used by clinical coders, and procedures included in these categories are aligned to those used for SSI surveillance by the CDC-NHSN in the United States.

To perform SSI surveillance, data needs to be captured, including the total number of patients who have had an operation in a specific surgical category, the total number of SSIs, and the SSI incidence per number of operations. If the centre is participating in national surveillance, they are required to have staff trained in the methodology to maintain quality. The period of time in which surveillance is going to be carried out also needs to be determined. The surveillance period chosen needs to be long enough to capture sufficient data to calculate a reliable rate of SSI. For example, the risk of SSI can be reported as number of SSIs per 100 operative procedures, calculated by dividing the number of SSIs in a specific category by the number of operative procedures and multiplying the result by 100.

Data can also be collected on key risk factors, SSI type, and causative microorganisms for patients who have had the relevant operation to enable risk adjustment. All patients should be followed up for up to 30 days post-operation (both as an inpatient and post-discharge) to facilitate detection of SSI. Likewise, it is essential to implement systematic methods of finding SSI cases, for example by reviewing patients and their wounds at outpatient clinics or in the community and assessing them on a regular basis for clinical signs and symptoms (e.g. swelling, erythema, heat, elevated body temperature, purulent drainage), which meet the definition of SSI. Specific criteria for defining SSI have been described by the CDC-NHSN and are widely used for surveillance systems (CDC-NHSN, 2017; Table 5), including by the UKHSA, which uses a modified version of CDC definitions. Notably, CDC and UKHSA have different definitions for SSI detected post-discharge.

## PATIENT AND UNIT-BASED PROTOCOLS OF SSI SURVEILLANCE

Active, prospective methods of SSI surveillance enabling inter-hospital comparisons of SSI incidence include patient-based (standard) surveillance and a simpler hospital/unit-based protocol (ECDC, 2012). Patient-based surveillance collects data at an individual level on all patients at risk of acquiring SSI, with active follow-up to identify those who develop SSI (UK Health Security Agency, 2013). Both protocols contain four levels, including hospital-unit data, one record per operation (patient-based version) or aggregated denominator per operation category (unit-based version), infection data, and microorganism data (ECDC, 2012).

While the patient-based protocol allows for risk adjustment of SSI rates through the use of the NHSN risk index, the unit-based version provides a less labour-intensive solution for following up trends and adjusting differences in post-discharge surveillance (ECDC, 2012). Also, whereas the patient-based protocol includes patient- and operation-related variables and risk

# Defining SSI and principles of SSI surveillance

factors, the unit-based protocol only includes variables relating to the operation and not data on risk factors (e.g. ASA score, wound contamination class). Although risk adjustment is not possible with the unit-based version, this protocol enables rates of SSI to be reported and descriptive results about causative pathogens.

**Table 5. United States Centers for Disease Control and Prevention – National Healthcare Safety Network surgical site infection (SSI) definition criteria (CDC/NHSN, 2017; WHO, 2018b)**

| |
|---|
| **Superficial incisional SSI** |
| Date of event for infection occurs within 30 days after surgical procedure (where day 1=procedure date)<br>**AND**<br>involves only skin and subcutaneous tissue of the incision<br>**AND**<br>patient has at least *one* of the following:<br>a. Purulent drainage from the superficial incision.<br>b. Organisms identified from an aseptically-obtained specimen from the superficial incision or subcutaneous tissue by a culture or non-culture based microbiologic testing method which is performed for purpose of clinical diagnosis or treatment.<br>c. Superficial incision that is deliberately opened by a surgeon or attending physician or other designee and culture or non-culture based testing is not performed.<br>**AND**<br>Patient has at least one of the following signs or symptoms: pain or tenderness; localised swelling; erythema; or heat.<br>d. Diagnosis of a superficial incisional SSI by the surgeon or attending physician or other designee. |
| **Deep incisional SSI** |
| Date of event for infection occurs within 30 days or 90 days after the surgical procedure (where day 1=procedure date)<br>**AND**<br>involves deep soft tissues of the incision (for example, fascial and muscle layers)<br>**AND**<br>patient has at least *one* of the following:<br>a. Purulent drainage from the deep incision.<br>b. A deep incision that spontaneously dehisces, or is deliberately opened or aspirated by a surgeon or attending physician or other designee and organism is identified by a culture or non-culture based microbiologic testing method which is performed for purpose of clinical diagnosis or treatment or culture or non-culture based microbiological method is not performed patient has at least one of the following symptoms: fever (>38°C); localised pain or tenderness. A culture or non-culture based test that has a negative finding does not meet this criterion.<br>c. An abscess or other evidence of infection involving the deep incision that is detected on gross anatomical or histopathologic exam, or imaging test. |
| **Organ/Space SSI** |
| Date of event for infection occurs within 30 days or 90 days after the surgical procedure (where day 1=procedure date) according to the list that can be found at https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf<br>**AND**<br>infection involves any part of the body deeper than the fascial/muscle layers, that is opened or manipulated during the operative procedure<br>**AND**<br>patient has at least one of the following:<br>a. Purulent drainage from the drain that is placed into the organ/space (for example, closed suction drainage system, open drain, T-tube drain, CT guided drainage)<br>b. Organism identified from an aseptically-obtained fluid or tissue in the organ/space by a culture or non-culture based microbiologic testing method which is performed for purpose of clinical diagnosis or treatment.<br>c. An abscess or other evidence of infection involving the organ/space that is detected on gross anatomical or histopathologic exam, or imaging test evidence suggestive of infection.<br>**AND**<br>meets at least one criterion for a specific organ/space infection site listed at https://www.cdc.gov/nhsn/PDFs/pscManual/17pscNosInfDef_current.pdf |

# Recommendations for the prevention of SSI

Good clinical practice in the pre-operative stage includes reminding patients to bathe or shower before surgery, avoiding unnecessary hair removal, following guidance on antibiotic prophylaxis, providing patients with appropriate theatre wear, and ensuring that all surgical staff wear non-sterile theatre attire.

**Best Practice Statement**

Clinicians should speak to patients about the ways in which they can reduce their risk of SSI according to each phase of surgery (pre-, intra- and post-operative).

**Reminder Statement**

While advances have been made in infection control practices, including improved operating room ventilation, sterilisation methods, drapes, surgical techniques, and availability of antimicrobial prophylaxis, SSIs remain a substantial cause of morbidity, prolonged hospitalisation, and death. Care bundles have also been implemented to reduce SSI incidence.

A variety of patient- and procedure-related factors in the patient's journey through surgery have been identified as contributors to SSI. SSIs can be caused by the presence of microorganisms, their number and virulence, surgical procedure type, and the site on the patient's body where tools or equipment will be used. While most SSIs are caused by the migration of microorganisms from the patient's own microbial flora (on the skin and in the body) to the operative site, infection can also be caused by pathogens from the skin or mucous membranes of operating personnel, the operating room environment, and contaminated medical devices and surgical instruments. Evidence-based recommendations and strategies on the prevention of SSI have been described in relevant guidelines including NICE, WHO and CDC (Berríos-Torres et al, 2017; WHO, 2018b; NICE, 2019).

## PRE-OPERATIVE PHASE

Guidelines from NICE and WHO describe several recommendations in the pre-operative phase related to preparing the skin for surgery to prevent SSI, including guidance on washing, hair removal, administration of prophylactic antibiotics, reducing skin and nasal colonisation, and pre-operative warming.

Cleansing of the skin prior to surgery, using plain or antimicrobial soap with water, is considered good clinical practice and helps to physically remove dirt, sweat, skin secretions and microorganisms, which live deep in skin folds, sebaceous glands, and hair follicles. On the day of surgery, or the day before, patients are advised to shower, bathe or be given a bed bath. Though harmless on the surface of the skin, microorganisms can enter surgical incision sites and cause infection. Besides soap and water, antiseptic agents (e.g. alcohol, chlorhexidine, triclosan, iodine-containing antiseptics) can be used to rapidly kill both resident and transient microorganisms.

In the pre-operative stage, hair may be removed to provide access to the operative site, for reduced dry time for surgical skin preparation solution or for patient comfort if high tack/strong adherent dressings are used. However, it is recommended not to use hair removal techniques routinely, as there is no evidence to suggest that hair at the surgical site increases microbial contamination or SSI risk (NICE, 2019). Patients are also advised not to shave the surgical site area in the days leading up to surgery. If hair needs to be removed, evidence-based guidance recommends that hair removal be conducted as close to the time of surgery as possible and preferably on the day. Use of razors is discouraged since they cause micro-abrasions, which may encourage proliferation of microorganisms on the skin surrounding the incision site. Where unavoidable, hair should be removed by clippers with disposable heads as they are less likely to cause abrasions.

NICE recommends implementation of a local guide to improve quality of antibiotic prescribing, including advice on appropriate surgical prophylaxis. Prophylactic antibiotic therapy is recommended before some surgery and is usually given as a single dose on induction of anaesthesia; however, it should not be continued after surgery (WHO, 2018a). Surgical prophylaxis, with a long enough half-life to achieve activity throughout the operation, should be given intravenously within 60 (NICE, 2019) to 120 minutes (WHO, 2018b) before the incision is made.

To reduce nasal colonisation in people carrying *Staphylococcus aureus* bacteria, NICE recommends application of nasal mupirocin in combination with a chlorhexidine body wash before procedures that are locally determined, and taking into

# Recommendations for the prevention of SSI

In the intra-operative phase, clinicians should prepare and disinfect the skin at the incision site, and take measures to reduce skin and nasal colonisation.

**Best Practice Statement**

Clinicians should refer to the evidence-based recommendations from NICE, WHO and CDC for guidance on pre-, intra- and post-operative measures for the prevention of SSI.

**Reminder Statement**

consideration the type of operation, possible side-effects in preterm infants, individual patient risk factors, and potential impact of infection.

Furthermore, it is advised that all patients are assessed an hour before surgery, and then every 30 minutes until the end of surgery, for the risk of intra-operative hypothermia by having their core temperature measured. Except in the case of life-threatening emergencies, surgery should not take place unless core temperature is 36°C or above. Active warming should commence on the ward/emergency department at least 30 minutes before induction of anaesthesia, and warming should continue intra-operatively for patients having anaesthesia for longer than 30 minutes or at a higher risk of intra-operative hypothermia. Furthermore, intravenous fluids and blood products should be warmed to 37°C using a fluid-warming device, and irrigation fluids should be warmed to 38°C to 40°C in a thermostatically controlled cabinet. Additional recommendations include:

- Clean hands with antimicrobial soap and water or an alcohol-based hand rub
- Avoid using mechanical bowel preparation (MBP) alone for the purpose of reducing SSI risk
- Give the patient theatre wear that is appropriate for the procedure and clinical setting, provides easy access to the surgical site and areas for intravenous cannulas, and meets the patient's needs for comfort, dignity and respect
- Surgical staff should wear non-sterile theatre attire (cap, hat, bonnet, and mask), remove all hand jewellery, artificial nails, and nail polish before the operation and keep movements in and out of the operating area to a minimum
- Use pre-operative oral antibiotics in combination with MBP to reduce SSI risk in adults undergoing elective colorectal surgery.

## PRE-OPERATIVE/INTRA-OPERATIVE MEASURES

NICE and WHO make a number of recommendations for good clinical practice and the prevention of SSI between the pre- and intra-operative phases:

- Provide underweight patients undergoing major surgical operations with enhanced nutritional support by administering oral or enteral multiple nutrient-enhanced nutritional formulas (containing any combination of arginine, glutamine, omega-3 fatty acids and nucleotides)
- Do not discontinue immunosuppressive medication prior to surgery
- In adult patients undergoing general anaesthesia with tracheal intubation for surgical procedures, deliver an 80% fraction of inspired oxygen intra-operatively and, if feasible, in the immediate post-operative period for 2–6 hours
- Maintain the patient's normal body temperature by using warming devices in the operating room during the procedure
- In both diabetic and non-diabetic adult patients, use protocols for intensive intra-operative blood glucose control
- Use goal-directed fluid therapy intra-operatively
- Irrigate the incisional wound with an aqueous povidone-iodine solution prior to closure, particularly in clean and clean-contaminated wounds
- Avoid antibiotic incisional wound irrigation before closure
- Use wound protector devices in clean-contaminated, contaminated, and dirty abdominal surgical procedures
- In adult patients with primarily closed surgical incisions in high-risk wounds, use prophylactic negative pressure wound therapy.

## INTRA-OPERATIVE PHASE

Immediately before incision and prior to draping, NICE recommends antiseptic preparation of the skin at the surgical site. Two major antiseptics used for skin preparation, available in either an aqueous or alcohol-based form, are chlorhexidine gluconate (CHG) and iodophors (povidone iodine; PI). To disinfect the skin and rapidly

Effective communication between healthcare professionals and patients promotes health literacy, allowing patients to take control of their own health and wellbeing, and improves the provision of patient-centred care.

**Reminder Statement**

kill microorganisms at the incision site, NICE recommends using an alcohol-based solution of CHG unless contraindicated. Additionally, WHO opposes use of antimicrobial sealants following skin preparation of the surgical site for the purpose of reducing SSI.

If incise drapes are used as part of creating a sterile field for surgery, they should be applied following skin disinfection and prior to incision. NICE recommends that incise drapes should be iodophor-impregnated incision drapes, unless the patient has an iodine allergy.

Other intra-operative measures to reduce SSI risk include:

- Maintain asepsis by checking surgical instruments for evidence of sterilisation, setting up surgical tools in a clean area and as close to the procedure time as possible, and ensuring staff who undertake surgical procedures are trained in skills such as aseptic technique
- Staff should wear sterile gowns throughout the operation and could consider double-gloving or changing gloves during the operation.

## POST-OPERATIVE PHASE

Monitoring SSI risk and infection rates using standardised surveillance methodology will provide feedback to the surgical team about the quality of infection prevention in the operating theatre and enable patients to receive accurate and up-to-date information about SSI risk associated with their operation. WHO and NICE recommend not to prolong antibiotic prophylaxis after completion of the operation. Alongside an effective SSI surveillance programme, other recommendations include:

- Use sterile saline for wound cleansing up to 48 hours after surgery
- Advise patients that they can shower safely 48 hours after surgery
- Antimicrobial triclosan-coated sutures should be used for all surgery types
- Consider using sutures rather than staples to close the skin after a caesarean section to reduce the risk of SWD
- Cover surgical incisions with an appropriate interactive dressing at the end of the operation
- Consider removing the wound drain when clinically indicated.

## PATIENT COMMUNICATION

Pre-operatively, clinicians must ensure patients are fully informed of the risks associated with their surgery. This should include their risk of developing an SSI, how to limit their risk, and what the consequences of an SSI are.

Post-operatively, there is an ethical responsibility and duty for all healthcare professionals (HCPs) to inform patients or their families of when mistakes have been made, and harm or even death has occurred. Patient communication involves being honest, apologising, acknowledging, and explaining what has happened to patients and offering support. SSIs can cause moderate or severe harm, and in these cases, it should be communicated to the patient. Examples of moderate or severe harm include: shortened life expectancy; increased need for treatment; changes to the structure of the patient's body; impairment of sensory, motor, or intellectual functions of the patient, which has lasted (or is likely to last) for at least 28 days continuously, or pain or psychological harm that has lasted (or is likely to last) at least 28 days continuously (Inkster and Cuddihy, 2022).

# The patient's surgical journey

Non-healing or infected wounds are not only painful but can have a significant impact on a patient's quality of life.

**Reminder Statement**

Patients should be treated with empathy, dignity and respect at all times and clinicians should remember that there is no single care or treatment plan that is suitable for all patients and their wounds.

**Reminder Statement**

Value-based care and effective communication is relevant throughout a patient's surgical journey from hospital to the community. Poor communication by healthcare providers, inadequate health literacy, and insufficient knowledge have been identified as major obstacles to patient engagement, causing individuals to seek advice from untrusted online sources instead (Coulter and Ellins, 2006; Katz et al, 2007; Rawson et al, 2016).

## PATIENT ENGAGEMENT

Some individuals may wish to be involved in their own care and be included in decision-making processes. Patient respect and empowerment are of utmost importance and, in some cases, the individual is best placed to monitor and document their own wound and report back to their clinician throughout their post-surgical healing journey. For example, using a photo at discharge (PaD) scheme can aid communication between the patient and clinician and has been shown to be supported by the public and patients (Rochon and Morais, 2019). By improving patient communication, individuals can be equipped with the knowledge, skills, attitudes, and self-awareness to actively engage in self-care and monitor their own surgical wounds (WUWHS, 2020).

Clinicians need to be mindful that health literacy skills vary between patients and that they need to adapt their communication to meet individual needs. Patients have the right to be involved and informed about their own treatment and should be encouraged to ask questions and make comments throughout their care journey (WUWHS, 2020). A 'one size fits all' approach fails to accommodate for diversity in post-operative care needs. By tailoring evidence-based care to individuals, their overall health status, and their needs and preferences, clinicians can achieve a high degree of patient satisfaction and improved patient quality of life. Moreover, to encourage an educational environment that inspires patients to participate, information communicated to patients should be multifaceted and applicable to a variety of health literacy needs to promote active patient engagement (WUWHS, 2020). The National Wound Care Strategy Programme (NWCSP) seeks to address variations in wound care services to improve healing rates, reduce patient suffering, prevent wound recurrence and SSIs, and limit the use of costly and ineffective treatments (NWCSP, 2021).

The NWCSP (2021) has identified that too few patients are receiving evidence-based care, too many wound care pathways are poorly organised, and a lack of data collection is preventing improvements from being made. Therefore, implementing new clinical pathways (CPWs) of care and using clinical time and other health and care resources in the most effective way is paramount. CPWs are tools to ensure consistent delivery of evidence-based practice for improved patient outcomes and cost-effective care (Rotter et al, 2019). As a structured multidisciplinary care plan, implementing CPWs could help standardise wound care and enhance care for people with wounds.

In addition, interprofessional collaboration, increased autonomy of non-specialist staff, and embraced digitisation of clinical record-keeping and information-sharing will support wound care solutions to become more seamless between acute, primary, and community healthcare settings. Wound care should no longer be viewed as a separate clinical issue. Underlying co-morbidities, which cause or contribute to delayed wound healing and SSI, should be considered. Working within a multidisciplinary team to ensure that patients get the right care and support, at the right time from the right service, should improve wound assessment, care, and management.

# SSI surveillance

Comprehensive, standardised SSI surveillance programmes should be encouraged and supported by the multidisciplinary team. If resources for surveillance are limited, then a planned, rolling programme of surveillance activity, targeted at categories of surgical specialties that present the greatest risk of SSI, should be employed.

**Best Practice Statement**

The purpose of SSI surveillance should be clear to everyone involved in the care of the patient and their surgical wound.

**Reminder Statement**

SSI surveillance is best completed by trained and specialist staff; however, frontline clinicians and surgical staff should be aware of infection control methods to prevent SSI.

**Best Practice Statement**

SSI surveillance allows healthcare organisations to monitor the occurrence of infection after surgery, provide patients with accurate information about the risk of SSI, track rates of SSI over time, review or change practice to prevent SSI, and improve and assure patient safety. Conducting high-quality SSI surveillance is crucial to achieve these aims. It needs to be designed to collect accurate data on the number of patients who undergo surgery in the target category of procedure, and include an active system for following up all these patients after surgery to consistently identify all those that develop an infection meeting the definition of SSI.

Most SSI surveillance systems report rates of SSI for specific categories of procedure – e.g. hip replacement, vaginal hysterectomy and caesarean section. Grouping procedures in this way aims to ensure that procedures with similar risk of SSI and sufficient data can be collected to generate accurate rates over a relatively short period of time – e.g. 1 to 3 months. This also makes it possible to compare rates within the same category of procedure reported by other hospitals or national surveillance systems (UKHSA, 2022).

The aim of SSI surveillance is to measure SSI rates and feedback the data to clinicians so that they can use it to understand where improvement of clinical practice is required. SSI surveillance supports early detection of changes occurring in an organisation, with the aim of identifying problems and thus improving patient quality of life.

## WHO IS RESPONSIBLE FOR SSI SURVEILLANCE?

Anecdotal evidence shows that if everyone is made responsible for surveillance, it fails to be completed and the data collected is too inaccurate to be of any value. The best system of surveillance relies on trained personnel to collect data consistently.

Based on the published literature, there is an understanding of SSI in some hospital settings; however, SSI surveillance is less of a priority in outpatient and community settings, as the risk of SSI is low. One of the main reasons for this is that hospital outpatient services usually manage SSI-related care and costs (Guest et al, 2020).

Community or district nursing services often provide surgical wound management outside of the acute care context (CASSIS Project Group, 2022). In some cases, information may not be provided to the operating hospital unless a readmission is needed. Furthermore, if acute readmission to a hospital other than the operating institution occurs, the latter may remain unaware of the readmission.

Arguably, the period after hospital discharge provides the greatest opportunity to improve patient outcomes and reduce variation in practice in relation to SSI surveillance (CASSIS Project Group, 2022). Some workers describe tangible benefits for patients and HCPs in the community, with reports that there are better patient outcomes and greater job satisfaction when working as part of a team (Rochon et al, 2017).

The impact of an incisional site failing to heal in a timely manner – leading to wound chronicity and related complications – should be clear to everyone. SSI surveillance needs to be easy to do in practice, with standardised and locally recognised definitions, measurements, and outcomes.

# Ideal surveillance method

An individual with an SSI should be identified at the time of infection rather than retrospectively.

**Best Practice Statement**

Significant planning and preparation is needed before surveillance can be carried out. Designated and trained personnel should be identified and categories for surveillance and the surveillance period need defining.

**Best Practice Statement**

The ideal surveillance method is prospective, active surveillance, which ensures that each patient who has undergone a relevant operation is followed up prospectively to determine their risk of developing an SSI (Wilson, 2013). To achieve prospective, active surveillance in the community setting, a joined-up approach across healthcare could be utilised to provide more accurate SSI surveillance data.

Active and systematic SSI surveillance involves designated and trained personnel utilising surveillance methodology to identify cases of SSI. In contrast, passive methods, which are associated with reduced case-finding sensitivity, rely on staff reporting cases who have little to no responsibility for the surveillance programme. Active surveillance is a resource- and time-consuming activity; however, SSI surveillance enables hospitals to record infections post-operation, actively follow-up patients at risk of SSI, and improve and change clinical and community practices to avoid further infections. The ideal surveillance method is patient-based, with data collected at an individual level on all patients undergoing a surgical procedure in pre-determined categories, and at risk of SSI. Patients should be included in the surveillance even if the operation is performed as an emergency; however, procedures that do not involve an incision in the skin (e.g. endoscopy) or are minimally invasive procedures (e.g. laparoscopy) should be excluded.

## DEFINING CATEGORIES FOR SURVEILLANCE AND THE SURVEILLANCE PERIOD

To complete datasheets for each patient eligible for SSI surveillance, categories for surveillance need to be determined, as incidence and rates of SSI will be reported by these categories. Usually, surgical procedures are assigned to a category as listed in the SSI Protocol Office of Population Census and Surveys (OPCS) Codes Supplement with their corresponding OPCS surgical procedure codes (UK Health Security Agency, 2019). Before conducting surveillance, the surveillance period also needs determining. Notably, the period of surveillance depends on whether the procedure involves the insertion of an implant, whereby surveillance does not continue beyond the 30th day post-operation (where the day of surgery is day 0) if no implant is inserted. If an implant is inserted and left in the incision site, an infection may meet the definition of SSI for up to a year following the surgery. Surveillance for SSI should continue during the patient's post-operative stay and post-discharge patient questionnaires can be used to find SSI that occur up to 30 days post-operation.

The UKSHA SSI surveillance system uses 3-month periods to capture data for SSI reports:

- 1 January to 31 March
- 1 April to 30 June
- 1 July to 30 September
- 1 October to 31 December.

Before surveillance can be carried out, hospitals also need to perform the following measures:

- Identify designated person/s to collect the data and ensure that training is provided
- Raise awareness and promote surveillance among staff
- Pilot data collection methodology if required.

## DATA COLLECTION ON ALL ELIGIBLE PATIENTS

Once intended participation in the surveillance programme is confirmed, datasheets must be completed for all eligible patients and their procedures, including both demographic (see page 6) and surgical data, including date of onset of signs and symptoms of SSI, type of SSI (superficial incisional, deep incisional or organ/space), type of closure, causative microorganisms, and microbiological criteria used to identify the SSI. Importantly, data relating to the infection is only necessary for patients who develop an infection that meets the case definitions of SSI, obtained from the patient administration system (PAS), patients' clinical records or theatre records. SSI can be detected during surgical admission, readmission to hospital, or follow up – e.g.

outpatient clinic, specialist nurse visit, review on ward, or post-discharge patient questionnaire. Therefore, trained personnel should actively monitor wounds for SSI while the patient is in hospital, is readmitted, or completing the questionnaire at 30 days post-operation.

## CALCULATING RATES OF SSI AND RISK ADJUSTMENT

SSI incidence rates are calculated by identifying how many patients have had an operation eligible for surveillance and, of these, how many develop an SSI. Separate rates for SSI detected post-discharge should be reported, as these are more likely to vary with the intensity of case finding. If conducting patient-based surveillance and looking to adjust for patient- and procedure-related risk factors, risk index data needs to be collected, including ASA score, wound classification, and duration of operation. Calculation of SSI rates based on surgical procedure stratification is only possible where risk factor data is collected on all patients included in the SSI surveillance protocol.

## POST-DISCHARGE SURVEILLANCE

Following discharge, implementation of a robust protocol is needed to follow up all patients to determine if they develop an SSI. Hospitals need to decide which methodology to use (see page 17) to actively follow up patients post-discharge – e.g. case finding, involving selection of a study population and identifying patients with an SSI within this group. After the date of surgery, remaining inpatients should be monitored until discharge, by designated staff trained in surveillance, to determine cases of SSI, and up to 30 days post-operation if no implant, during readmission to hospital, patient questionnaires, or any other return visit to the hospital. The following measures have also been described to help promote awareness of SSI among staff involved in surveillance:

- Encourage all clinical staff to clearly document the clinical signs and symptoms of SSI
- Encourage staff to write diagnoses of SSI in patients' case notes
- Educate staff on when a wound swab should be taken and what test should be requested. Usual practice is to avoid swabbing unless signs of infection are present – e.g. discharging pus, heat, pain, redness, swelling
- Remind staff to avoid ritualistic sampling. Guidance should recommend a tissue sample where deeper infection is suspected
- Remind staff to record antibiotic therapy as part of request
- Remind staff to only interpret microbiology results relating to SSI in conjunction with clinical data.

# Post-discharge SSI surveillance

Post-discharge SSI surveillance should be undertaken to allow organisations to record incidents of infection following surgery, track patient results and review or change practice to avoid further infections.

**Best Practice Statement**

Consider the role of the patient and/or informal carers (e.g. relatives and friends) in identifying SSIs that occur after discharge from hospital.

**Reminder Statement**

The main outcome measures for national surveillance purposes are identification of SSI, in inpatients and readmitted patients; however there are various follow-up methods for post-discharge surveillance.

## CASE-FINDING METHODS

The need for post-discharge surveillance depends on the average length of hospital stay, where a shorter stay requires more focus on post-discharge surveillance than a longer stay. Additionally, post-operative inpatient stay is likely to be very short for some types of surgery, including spinal, breast and long bone fracture reduction surgeries. Therefore, finding robust methods of identifying infections after the patient has been discharged from hospital is critical to measuring the risk of SSI (Wilson, 2017). Briefly, case-finding methods to identify SSI in patients that have already been discharged include:

- Identification of patients readmitted to hospital with SSI
- Detection of SSI at outpatient clinic, review by specialist staff, or other return visit to hospital
- Patient questionnaire completed at 30 days post-operation and returned promptly, either as a postal return or follow-up telephone call.

In the 30 days post-surveillance period, records of patients included in the surveillance protocol should be completed and processed electronically. Where post-discharge questionnaires have been used, patients should be reminded to return their questionnaires promptly and staff trained in surveillance should follow up any patients who report wound problems. Patient-reported SSI, via the patient post-discharge questionnaire, can only be confirmed through discussion of clinical signs and symptoms and treatment with the patient. Trained personnel will need to interpret answers given by patients to assess whether their symptoms are indicative of an SSI (Table 6).

Post-discharge surveillance can have significant cost implications for organisations, so it is important to establish a robust method to obtain this data. Post-discharge SSI surveillance can be problematic, as there is often disagreement about who is responsible for conducting surveillance and the patient often doesn't see a professional when discharged into the community. It is important to understand that surveillance is about quality improvement rather than attribution of blame or performance management.

For post-discharge SSI surveillance to be successful, the criteria for SSI data collection must be met, regardless of where the SSI is detected. Finding robust methods of identifying infections after the patient has been discharged from hospital is critical to measure the risk of SSI (Wilson, 2017). Reviewing only hospital records to find cases will vastly underestimate the true size of the problem, since most infections take at least 5 days to become apparent and the average length of hospital stay is now less than this for many categories of surgical procedure (UK Health Security Agency, 2022). The signs and symptoms of infection associated with foreign bodies (e.g. joint replacement and sternal wires) can take a longer time to develop beyond the normal 30-day cut-off. Therefore, it is up to primary care teams to classify and record infections correctly, where they are the first point of presentation for the patient.

**Table 6. Criteria for patient-reported SSI (UK Health Security Agency, 2013)**

| Criterion | Description |
|---|---|
| 1 | Discharge pus AND antibiotics prescribed |
| 2 | Clinical signs* AND dehiscence |
| 3 | Clinical signs* AND antibiotics prescribed |

* Clinical signs – at least 2 of the following must be present: pain, heat, swelling or redness.

Post-discharge SSI surveillance should be digitalised, with practical and economically viable solutions, such as telemedicine, to improve patient follow-up after surgery.

**Best Practice Statement**

Clinicians should take a patient-centred approach and bear in mind patients' preferences regarding telehealth or in-person care to optimise healthcare quality and patient outcomes.

**Best Practice Statement**

Methods for detecting SSIs that occur after the patient has been discharged include monitoring patients on readmission, or any other return visit to the hospital (e.g. outpatient clinic), and post-discharge questionnaires completed at 30 days post-operation. These methods are detailed in Box 2.

## DIGITALLY-ENABLED POST-DISCHARGE SURVEILLANCE

The only consistent individual in the journey from surgery to community is the patient (and their informal carers), so solutions that involve the patient have a place in making surveillance more consistent (Macefield et al, 2017; CASSIS Project Group, 2022). Patient-initiated contact is one potential approach to improve SSI surveillance and deliver patient data directly to inpatient surgical teams, enabling prompt referrals at the right time to the right place.

A randomised controlled trial examining patients taking and transmitting wound images on their own device, following emergency general surgery, had favourable results in terms of early diagnosis of SSI, reducing attendances in primary care without increasing hospital attendance (McLean et al, 2021).

A project compared five different patient-involved SSI surveillance approaches to determine response rates (CASSIS Project Group, 2022). The five different responses were: telephone follow-up; postal questionnaires; postal questionnaires and contacting non-responders by telephone; a post-operative app downloaded on their personal smartphone; or an SSI surveillance text link that did not need to be installed and could receive photographs sent by the patients. Telephone follow-up had the highest response rate (90%; *n*=83/92) and the SSI surveillance text link had a return rate of 84.5% (*n*=49/58).

Although telephone follow-up had the highest return rate, it is a more labour-intensive approach than the SSI surveillance text link. Nevertheless, any patient-initiated SSI surveillance approach should be quick to complete and have the capability to send a photo to clinicians for review. Subjective questions such as 'is the wound healing as expected?' should be avoided, as the patient may not understand what this means. Frequency of review and patient contact can be based on the initial patient risk assessment.

Having been rapidly deployed due to the COVID-19 pandemic, telemedicine and telehealth services present an innovative solution for monitoring patients and their wound care post-operatively. The accuracy of telemedicine for the diagnosis of SSI was assessed in a recent systematic review and meta-analysis (Lathan et al, 2022).

**Box 2. Post-discharge SSI surveillance methods (UK Health Security Agency, 2013)**

**Method A: Patient reviewed at outpatient clinic**

- All patients included in the surveillance attend an outpatient clinic after their operation and this provides an opportunity to review their wound for SSI. Clinicians should be provided with standard definitions, and they should clearly indicate symptoms on a standard report form.

**Method B: Systematic review by community-based trained healthcare professional**

- Where a Bridging Team or Homecare Team visit all post-operative patients in their own home, they should be trained to apply the standard definitions and clearly indicate symptoms on a standard report form. The form should be completed whether or not an SSI is detected and indicate that the patient was part of a systematic post-discharge surveillance programme.

**Method C: Patient returns to hospital if they have a problem with their wound**

- Patient-reported questionnaire at 30 days post-operation.
- All patients discharged before 30 days should be given details of a key person to contact if they have concerns about their wound. If the patient makes contact, arrangements should be made for the wound to be reviewed by the hospital. A drop-in clinic could be established to facilitate this.

# Post-discharge SSI surveillance

There is a greater priority for SSI surveillance among inpatients and patients readmitted to hospital where SSI incidence is higher; however, post-discharge methods of surveillance are critical for patients with shorter post-operative hospital stays and to determine the overall risk of SSI.

**Reminder Statement**

Conducted in nine countries across five continents worldwide, the study aimed to establish diagnostic accuracy of several telemedicine methods for SSI. The Quality Assessment of Diagnostic Accuracy Studies 2 (QUADAS-2) was used to assess methodological quality of 1400 titles and abstracts, in which telemedicine for SSI diagnosis was found to be both highly specific (97%) and sensitive (88%). These findings were irrespective of the patient's geographical location and socioeconomic status. However, further studies are needed to investigate the feasibility of telemedicine in patient groups such as elderly people, as well as the impact of machine learning and artificial intelligence on the future of telehealth, and the diagnostic accuracy of telemedicine techniques.

Since telephone-based telemedicine appears to be more accurate in SSI diagnosis, photograph-based telemedicine should avoid using standalone photos and instead ensure that data forms accompany the visual record. Regardless, telephone-based telemedicine, with or without photo- or video-based components, has potential to be utilised as a remote screening tool for real-time, wound-related data collection from patients during post-operative follow-up. Telemedicine is both readily deployable and economically viable, reducing wound care-related travel, costs, and waiting times, limiting the need for carers, and preventing nosocomial infection.

SSI reporting should include a core outcome set of standardised risk factors so that data is comparable across centres. Risk factors vary according to surgery type.

**Best Practice Statement**

Clinicians should use wording that is accepted in their national coding system for accurate SSI reporting.

**Reminder Statement**

The numerator and denominator of SSI incidence should be clearly defined and maintained at a local or national level.

**Best Practice Statement**

## SSI data collection

There are two components to SSI surveillance data: the procedures included in the surveillance (denominator) and the number of patients in the denominator who develop an SSI (numerator). In the UK, surgical procedures are defined by OPCS codes, while in other countries, ICD10 codes are used. It is possible to identify patients who have undergone procedures included in the surveillance by identifying the relevant OPCS codes from the electronic records. The number of patients in the denominator who develop an SSI (numerator) should be identified by regular review of patients and their wounds while they are in hospital, and by reviewing patients readmitted to hospital to see if they develop an SSI, through contact with the patient following discharge. Patients should ideally be followed up for 30 days post-operation.

This active system can be supplemented with systems to identify potential SSI from electronic records; however, these may not be reliable as they depend on the SSI being clearly documented in the case record so it is available for coding, and unless the primary and secondary care electronic records are integrated, the system will only detect SSI that occur during a hospital stay.

SSI data collection via prospective active surveillance by trained personnel is the gold standard, and is associated with reduced SSI rates. In an ideal world, all data would be captured, so that outcomes from similar surgeries or types of surgeries can be compared. Where it isn't possible to conduct active surveillance by trained personnel, for accurate reporting, clinical language should mirror the nationally recognised codes that 'coders' (Box 3) are familiar with.

Where paper notes are involved, clinicians should use correct terminology to ensure that coders are able to identify an infection; however, where electronic records are used, digital healthcare systems must have the capacity to automatically flag the relevant data point.

### Box 3. Role of a clinical coder

The job of a clinical coder is to review the medical records made by clinical staff and to record information about every patient who attends hospital, from admission to discharge. They will not make assumptions about the presence or absence of a disease state. If a clinician reports a possible SSI, a coder would not code it. Coders work in absolute terms, so clinical terminology needs to be precise and accurate.

An alphanumeric code is used to record everything on the computer system. These records can be analysed by organisations to identify trends and potential issues, and to plan for the future.

SSI is predominantly defined by clinical signs and symptoms; however, higher-quality microbiology laboratory support could improve the characterisation of SSIs (WHO, 2018a). Microbiological testing methods and results can be useful for SSI data collection and analysis but should not be used in isolation to define SSI. SSI culture results of microbiological tests include the type of specimen collected, the date it was taken, the microorganism identified, and antibiotics that the patient is resistant or sensitive to. CDC recommendations describe indirect methods of surveillance, including regular reviewing of microbiology reports and patient medical records, to identify positive surgical site cultures and any clinical signs of infection (WHO, 2018b). Moreover, according to WHO, a key principle for effective HAI surveillance is educating staff on surveillance methods and basic concepts in epidemiology, microbiology, and communicable diseases (WHO, 2018a).

$$\text{Incidence (\%)} = \frac{\text{numerator}}{\text{denominator}} = \frac{\text{\# of SSI cases detected during the surveillance period}}{\text{\# of total surgical patients during the surveillance period}} \times 100$$

# Implementing SSI surveillance in practice

Headline SSI rates and significant patient cases should be discussed at surgical mortality and morbidity meetings.

**Best Practice Statement**

Interprofessional collaboration is paramount to SSI surveillance and ensures a seamless patient journey from surgery to community.

**Best Practice Statement**

The patient, family, carers and wider clinical team(s) all need to be educated on SSI prevention.

**Reminder Statement**

Once an effective, efficient SSI surveillance programme is set up, there may be an initial increase in rate of SSI, which can be disheartening, but that is because the accuracy and quality of data has improved.

## SETTING UP A SURVEILLANCE TEAM

Assembling a team of individuals who are motivated to conduct SSI surveillance and disseminate the findings within a health facility (e.g. under the Infection Prevention and Control [IPC] directorate dedicated to collecting SSI data) is key to success (Box 4). The size and composition of this team will depend on the interest and availability of local clinical staff, but important disciplines that should be represented in the 'core' team include:

- Surgical staff, ideally including a surgeon with local seniority
- Theatre staff, possibly anaesthetists and/or theatre nurses
- Infection Prevention Control staff
- Community/district HCPs.

In particular, a representative from primary care can help facilitate communication between acute and primary care settings (Tanner et al, 2011). An ideal long-term method to capture data on SSI may involve notification by GPs or district nursing teams who could inform the surveillance team when they encounter and treat a patient with an SSI. However, this requires significant training, enhanced communication between staff groups and more collaborative practice.

Many other disciplines may also be useful additions to the surveillance team, including pharmacists, ward-based nursing staff, staff routinely in charge of wound dressings, staff with experience of data management, and staff involved in procurement and sustainability. Involvement of senior executive staff is important to support SSI surveillance in a wider context, as SSI occurrence rates are often considered an important indicator of institutional care quality.

**Box 4. Tips for setting up a surveillance system**

- There is no need to reinvent the wheel – SSI surveillance is an established epidemiological method
- Surveillance data need to be accessible relatively quickly and easily at close to the point of care throughout the patient's journey
- Find a method of data presentation that helps clinicians understand the results and feedback in way that is relevant to them
- Mortality and morbidity should be discussed by every surgical department. Discussing instances of significant, catastrophic infection in terms of the impact on individual patients - rather than abstract percentages, facts and figures - can be more impactful to the team.

Data collection needs to be properly resourced, with specific staff allocated to collect, assimilate and report the data. The surveillance system will be passive and unreliable without staff who have received appropriate training to apply the case definitions.

## IMPLEMENTING A MULTIDISCIPLINARY APPROACH

There is widespread agreement that taking a multidisciplinary approach is the most effective method of reducing SSI risk (Ballard et al, 2012; Borden et al, 2016; Mackenzie et al, 2018). Evidence shows that, through a multidisciplinary approach, comprehensive, evidence-based infection control practices can be implemented successfully, which may help to reduce overall SSI and cost burden (Chiwera et al, 2018).

A hospital unit in London found that a multidisciplinary-led, structured protocol significantly and consistently reduced SSIs in paediatric scoliosis surgery (Tipper et al, 2020). The protocol involved a diverse team (consisting of spinal surgeons, infectious disease consultants, physiotherapists, specialist nurses and theatre managers) and standardisation of infection control measures to reduce the overall risk of SSI. These

measures commenced with the admission of the patient and continued throughout the postoperative stage, including pre-theatre skin decontamination, operative site preparation, betadine-soaked swabs sutured to wound edges, blood loss minimisation, and a defined protocol of glove changes, including double-gloving. The findings demonstrate a robust and reproducible protocol for the reduction of SSI, which could be replicated both locally and globally as part of a wider surveillance system.

## EDUCATION

Educating all members of the clinical team about SSIs is needed to ensure consistent care. Education should include:

- Understanding risk factors for SSI (see WUWHS, 2016; WUWHS, 2018)
- Understanding clinical signs of SSI (see WUWHS, 2016; WUWHS, 2018; Sandy-Hodgetts et al, 2020)
- Awareness and use of appropriate testing methods (wound swab; serology) for diagnosing an infection
- The significant impact SSI can have on the patient
- The importance of recording either an SSI or SWD and knowing the differences between the two
- How to record an SSI and SWD using language that coders can understand as per local protocol.

# Conclusion

Patients with surgical wounds that become infected upon discharge, from surgical services to primary care or community services, can be lost to follow-up if not referred to the surgical team. SSI prevention requires a multi-disciplinary and holistic approach, involving patients, families/carers and healthcare organisations, to provide quality care for patients. Effective patient–clinician communication, interprofessional collaboration, and embracing digitalisation of clinical record-keeping will improve wound assessment, care, and management, creating a more seamless patient journey from surgery to community.

While SSI surveillance is best conducted by trained personnel, all clinicians should understand the importance of SSI surveillance and that improving patient care requires tenacity and ongoing momentum.

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