Perioperative Nursing Interventions for the Prevention of Surgical Site Infections

A Literature Review

Ermek Mamsydykov

Bachelor’s thesis
December 2023
Degree Programme in Nursing
Abstract

SSIs continue to pose a great strain on healthcare systems worldwide, with high morbidity and mortality and considerable additional healthcare costs. The perioperative nursing staff helps prevent SSI and achieve the desired outcomes of the surgical process through sustained adherence to aseptic measures and the application of evidence-based interventions throughout the patient’s surgical journey.

The aim of this literature review was to evaluate different perioperative approaches for preventing surgical site infections and their impact on improved patient outcomes and reduced healthcare costs. The purpose of the literature review is to classify how to improve perioperative knowledge on reducing the risks of surgical site infections among nurses working in the operation theatre.

A thorough literature review was carried out to identify and appraise current evidence of perioperative nursing interventions for preventing SSI. The relevant studies were identified through a search of databases from both CINAHL and PubMed. The articles were analyzed utilizing the conventional content analysis method. The data was extracted and then methodically arranged to determine and distinguish themes and sub-themes.

The literature review established that preoperative, intraoperative, postoperative and entire perioperative nursing interventions should be implemented to minimize the occurrence of SSI. This research highlighted the importance of perioperative nursing strategies to prevent surgical site infections by incorporating evidence-based practices such as preoperative hygiene, appropriate antimicrobial prophylaxis, aseptic techniques, maintaining normothermia, and proper postoperative wound care.

Surgical site infections remain the most common perioperative complications and that it is important to ensure patient safety during the surgical procedure to improve postoperative surgical outcomes. It is crucial for perioperative nurses to minimize the risks of getting SSI through various evidence-based guidelines. The research results show that healthcare institutions should develop and implement standardized, evidence-based protocols and keep them up to date. Perioperative nurses should be educated and continuously trained and work in a multidisciplinary approach.

Keywords/tags (subjects)

Perioperative, Nursing, Interventions, Prevention, Surgical Site Infection

Miscellaneous (Confidential information)

None
## Contents

1. **Introduction** ..................................................................................................................... 5
2. **Background** ...................................................................................................................... 6
   2.1 Perioperative nursing ................................................................................................... 6
   2.2 Surgical site infection .................................................................................................... 7
   2.3 Perioperative management of surgical site infection .................................................... 8
3. **Aim, Purpose, and Research Question** ........................................................................... 10
4. **Methodology** ................................................................................................................. 10
   4.1 Literature review ........................................................................................................ 10
   4.2 Literature search ........................................................................................................ 11
   4.3 Data analysis............................................................................................................... 13
5. **Results** ........................................................................................................................... 14
   5.1 Interventions in the preoperative phase ..................................................................... 15
      5.1.1 Bathing .............................................................................................................. 15
      5.1.2 Nutrition ............................................................................................................ 16
      5.1.3 Hair removal ...................................................................................................... 16
      5.1.4 Antibiotic prophylaxis ........................................................................................ 17
   5.2 Interventions in the intraoperative phase ................................................................... 18
      5.2.1 Surgical drapes .................................................................................................. 18
      5.2.2 Skin disinfection ................................................................................................ 18
      5.2.3 Hand antisepsis ................................................................................................ . 19
      5.2.4 Irrigation of the surgical wound ......................................................................... 19
   5.3 Interventions in the postoperative phase ................................................................... 20
      5.3.1 Wound care ....................................................................................................... 20
      5.3.2 Negative pressure wound therapy ...................................................................... 20
   5.4 Interventions in the entire perioperative phase .......................................................... 21
      5.4.1 Normothermia................................................................................................... 21
      5.4.2 Glycemic control............................................................................................... 21
      5.4.3 Perioperative oxygenation ................................................................................. 22
6. **Discussion** ...................................................................................................................... 22
   6.1 Discussion of results .................................................................................................... 22
   6.2 Critical appraisal, ethical considerations, validity, and reliability ......................... 24
Conclusion and recommendations ................................................................. 25
References ............................................................................................................. 26
Appendices ............................................................................................................. 30
  Appendix 1. Critical appraisal of included studies (Hawker et al., 2002) .......... 30
  Appendix 2. Summary of included studies .......................................................... 31

Table 1. Wound classification .............................................................................. 8
Table 2. PICOs Criteria .......................................................................................... 11
Table 3. Themes and subthemes .......................................................................... 15

Figure 1. Studies selection process ................................................................. 12
Figure 2. Example of data analysis process ...................................................... 14
1 Introduction

All patients undergoing surgery are at risk of getting surgical site infection (SSI). These infections occur on the skin's surface and within deep layers of subcutaneous tissue, e.g., muscles and fascia in the operative field and in the organ. Surgical site infections are among the most prevalent and expensive infections linked with health care. Although the number of cases of SSI has significantly decreased in recent decades, patient safety remains an issue that needs to be considered. Perioperative nurses use various evidence-based practices to minimize SSIs and ensure a safe surgical experience for the patient. Some interventions include preoperative hair removal, hand cleanliness, preoperative patient skin antisepsis, and antimicrobial irrigation. (Bashaw, M. 2018)

Recent studies by the World Health Organization (WHO) reveal that SSIs are the most frequently reported and examined healthcare-associated infections (HAIs) in low- and middle-income countries, impacting up to 33% of patients who have undergone surgery. Despite having a lower incidence in high-income countries, SSI continues to be the second most prevalent HAI in Europe and the USA. Moreover, SSIs represent a major concern for healthcare systems, as they can lead to longer hospital stays, increased healthcare costs, and a higher risk of complications for patients undergoing surgery. (WHO, 2016)

Surgical site infections are the most expensive issues linked with health care (Zimlichman, E. 2013). SSI is extremely costly to the healthcare system. Hospital stays are frequently extended by 7-10 days. For example, charges for SSI in the USA range from $3,000 to $29,000, depending on the operation and pathogen. This amounts to a ten-billion-dollar annual expense in the United States. Most estimates exclude the additional expenditures of rehospitalization, outpatient care after discharge, and long-term disability. SSI is the most common reason for unplanned postoperative readmission. (Waltz & Zuckerbraun, 2017)

The author chose this topic because surgical site infections remain the most common complication after surgery, while this can be controlled and avoided. The aim of this literature review is to explore perioperative nursing interventions for the prevention of surgical site infections and to classify how to improve perioperative knowledge on reducing the risks of surgical site infections among nurses working in the operating theatre.
2 Background

2.1 Perioperative nursing

The perioperative nurse is an important team member in the surgical setting. Scrub nurses, operating theater nurses, circulating nurses, surgical technicians, theatre nurses or assistants, and operating theater technicians are all names for these nurses. Prior to surgery, the perioperative nurse may be in charge of overseeing patient transportation to and from the operating theater and wards. In addition, the nurse prepares the patient for surgery by reviewing medical records, checking vital signs, and performing tasks such as washing, shaving, and disinfecting the surgical site. (Mathenge, 2020)

The perioperative nurse is responsible for ensuring the availability of all required gloves and gowns in appropriate sizes. They are also in charge of the initial scrubbing for a procedure and help the rest of the team put on gowns and gloves. The perioperative nurse supplies the surgeon with the necessary instruments, sponges, retraction assistance, suction, and other tools throughout the procedure. The circulating nurse, on the other hand, works outside of the operating theater’s sterile area. They provide additional sterile tools and materials as needed throughout the procedure and assist fellow team members in monitoring the patient’s condition or assisting in patient repositioning. (Mathenge, 2020)

Nurses may be in charge of monitoring the patient’s status and monitoring for any indicators showing a positive or negative outcome. The nurse is frequently in charge of giving patients the necessary postoperative instructions before they leave home, which can significantly impact on the outcomes. (Mathenge, 2020)

Collaboration among the multidisciplinary team is fundamental to effective SSI reduction, compelling all staff to take ownership and responsibility. It was discovered that cohesive cooperation boosted communication among healthcare personnel and reduced the number of unfavorable events. Most SSIs are preventable, and steps can be taken to limit the risk of infection during the perioperative care. (Burden & Thornton, 2018)
As integral healthcare team members, nurses play an important role in attending to patients in a surgical health condition. Patients require special attention, care, and guidance during this time due to a combination of emotions such as fear, anxiety, and uncertainty. Nurses are responsible for admitting and caring for patients throughout the perioperative period by implementing nursing interventions. Implementing these nursing interventions, with a focus on preventive measures, significantly contributes to the reduction and spread of SSI. (Martins et al., 2020)

### 2.2 Surgical site infection

According to the Centers for Disease Control and Prevention (CDC) National Healthcare Surveillance Network, SSI is defined as an infection that occurs within 30 days of surgery or within 90 days if an implant is left in place after the procedure (Yuki & Shibamura-Fujigoi, 2021). Even though the accurate diagnosis of SSI is difficult to achieve since it can take several weeks to develop purulent discharge, discomfort or tenderness, localized swelling, redness, or heat are all clinical indications and symptoms of SSI at the site of an incision. Still, many infections may not become obvious until the patient has been discharged from the hospital. (WHO, 2016)

Various factors can affect surgical wound healing and infection risk. Patient-related (endogenous) factors and process or procedure-related (exogenous) variables play a role in a patient's likelihood of acquiring an SSI (WHO, 2016). Nonmodifiable patient factors include sex, age, and history of skin or soft tissue infection, while modifiable factors encompass overall health, lifestyle habits, blood sugar control, diabetes, shortness of breath, alcohol and smoking habits, obesity, and immunosuppression (Bashaw & Keister, 2019).

As defined by the CDC, SSIs can be classified into three categories: 1. Superficial – manifests within 30 days post-surgery, affecting the skin and subcutaneous tissue; 2. Deep – occurs after 30 days or within a year if a foreign object is implanted, impacting fascia and muscles; 3. Organ or body cavity infection near the surgical site – develops within 30 days or a year if a foreign body was implanted (Onyekwelu et al., 2017).

According to the CDC classification, surgical wounds are generally categorized into four types based on how clean or polluted they are (Table 1) (Onyekwelu et al., 2017).
Table 1. Wound classification

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>Clean wound Infection risk &lt;2%, e.g., laparotomy, breast resection, vascular interventions;</td>
</tr>
<tr>
<td>Class II</td>
<td>Clean/contaminated Infection risk &lt;10%, e.g., elective cholecystectomy, small bowel resection, laryngectomy;</td>
</tr>
<tr>
<td>Class III</td>
<td>Contaminated wound Risk infection of about 20%, e.g., appendiceal phlegmon, gangrenous cholecystitis;</td>
</tr>
<tr>
<td>Class IV</td>
<td>Dirty/infected wound Risk infection &gt;40%, e.g., infected traumatic wounds or pus collections such as testicular abscess. The appropriate evaluation for surgical site infection risk is not based solely on wound classification.</td>
</tr>
</tbody>
</table>

2.3 Perioperative management of surgical site infection

Perioperative nurses must care for their patients in a way that minimizes the risks because SSIs are not only a worry for patient safety but also unfavorable conditions for the financial well-being of healthcare organizations. Different ways exist to prevent the patient from getting an infection after a surgical procedure. (Bashaw & Keister, 2019)

For a long time, the importance of environmental pollution in contributing to HAI was overlooked compared to other causes. Nonetheless, new research indicates that a dirty hospital environment strongly contributes to the spread of bacteria. It is critical to ensure that the operating theater is thoroughly cleaned regularly. Cleaning entails removing dust, dirt, and impurities from surfaces in the environment, thereby promoting a sanitary and healthful environment for both patients and staff. Furthermore, good mechanical ventilation is required to protect surgical wounds from contamination caused by unfiltered air entering the operating theater and to distribute and eradicate bacteria generated by skin scales. (WHO, 2016)
During the preoperative phase, it is critical to educate patients and their families about the risks of SSIs and prevention strategies. Nurses should emphasize the importance of proper hand hygiene and provide preoperative bathing instructions and postoperative care instructions, such as wound care and dressing changes. Assessing patients for factors that increase the risk of SSIs, such as obesity, malnutrition, or diabetes, allows nurses to work with the surgical team to develop a plan to address or mitigate these risk factors. In addition, working with the surgical and pharmacy teams, nurses should ensure that the appropriate preoperative antibiotic is administered on time, considering factors such as the type of surgery, patient allergies, and local antimicrobial resistance patterns, ideally within 60 minutes of the surgical incision. (WHO, 2016)

Various precautions must be taken during the intraoperative period to reduce the risk of SSIs. Before putting on sterile gloves, the surgical team must perform surgical hand and forearm antisepsis using antimicrobial soap or an alcohol-based hand rub with sustained activity. To minimize the release of skin and hair particles into the surgical field and reduce respiratory droplet transmission, surgical team members should wear a sterile gown, gloves, a cap, and a mask. Using sterile, disposable, nonwoven drapes to cover the patient's skin is also advised. Creating and maintaining an aseptic surgical environment is critical for minimizing contamination risk. This includes adhering to aseptic techniques, controlling operating theater traffic, and ensuring uninterrupted sterile barriers. Finally, using optimal surgical techniques such as gentle tissue handling, careful hemostasis, adequate irrigation, and proper wound closure reduces the risk of infection even further. (WHO, 2016)

During the postoperative period, the main points are wound care, patient education, and surveillance. Initially, the incision site is protected from external microbial contamination by using sterile occlusive dressings, which vary depending on the type of wound and the amount of drainage. If surgical drains are required, they should be placed away from the main incision and removed when no longer required. Patients must be educated on proper surgical incision care, such as hand hygiene, changing dressings, recognizing signs of infection, and seeking prompt medical attention. (WHO, 2016)
3  Aim, Purpose, and Research Question

The aim of this literature review is to explore perioperative nursing interventions for the prevention of surgical site infections. The purpose of the literature review is to classify how to improve perioperative knowledge on reducing the risks of surgical site infections among nurses working in the operation theatre. Research Question: What are perioperative nursing interventions for the prevention of surgical site infections?

4  Methodology

4.1  Literature review

Literature reviews and evidence syntheses are crucial research contributions that help further scientific progress by building upon previous discoveries. Unlike conventional literature overviews that heavily rely on the authors’ expertise, systematic literature reviews approach the literature review process as a scientific procedure, employing empirical research concepts to increase transparency and reproducibility while minimizing potential bias. Systematic reviews have emerged as a vital methodology in health sciences, leading to the development of a specialized infrastructure for conducting these reviews and continuously refining the approach in response to emerging research concerns. (Lamé, 2019)

A literature review serves as an effective means of consolidating research findings, showcasing evidence at a meta-level, and pinpointing areas needing further investigation, which are essential aspects of constructing theoretical frameworks and conceptual models. (Snyder, 2019).

In this study, a literature review was used to analyze perioperative nursing intervention to prevent surgical site infection. SSI can cause serious postoperative consequences, and perioperative nursing plays a critical role in avoiding such infections. The study looks into the body of available research, examining various nursing treatments, best practices, and protocols to lower the prevalence of SSIs. It investigates the efficacy of preoperative strict aseptic practices, antibiotic prophylaxis, and wound care protocols in reducing infection risk. This study aims to shed light on
evidence-based techniques that can improve surgical outcomes, increase patient safety, and influence perioperative nursing practices to reduce the incidence of surgical site infections by a comprehensive assessment of the literature.

4.2 Literature search

This study’s literature search was conducted using two databases: CINAHL (EBSCO) and PubMed. These databases were chosen because they include various health-related research, including medical and nursing literature. The research question was framed using PICOs format, the keywords “perioperative nursing” AND “surgical site infection” AND “prevention”, OR “management”. Boolean operators “AND” and “OR” were applied to keywords. Inclusion criteria were defined as follows: articles were published between 2013 and 2023, peer-reviewed, the primary language was limited to English, and full text available. Exclusion criteria were articles published before 2013, were not peer-reviewed, or were in other languages except English.

Table 2. PICOs Criteria

<table>
<thead>
<tr>
<th>PICOS</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Populations</strong></td>
<td>Perioperative nurses OR perioperative nursing care OR preoperative OR intraoperative OR postoperative nursing care</td>
</tr>
<tr>
<td><strong>Interest</strong></td>
<td>AND surgical site infections OR surgical wounds OR postoperative infection</td>
</tr>
<tr>
<td><strong>Context</strong></td>
<td>AND prevention OR intervention OR reduction OR minimize.</td>
</tr>
<tr>
<td><strong>Study design</strong></td>
<td>Full text, peer-reviewed articles between 2013 and 2023, in English</td>
</tr>
</tbody>
</table>
The initial results of the PubMed database search were 80 articles. Simultaneously, the CINAHL database search yielded 746 papers. Further filters and limits were used, yielding a total of 91 distinct articles for further assessment. After reading 91 articles, the final 12 articles answered the research question (Figure 1).

**Identification of studies via databases and registers**

Records identified from*:
- Databases (n = 746 CINAHL)
- (n = 80 PubMed)
- Registers (n = 0)

Records removed before screening:
- Duplicate records removed (n = 8)
- Records marked as ineligible by automation tools (n = 0)
- Records removed for other reasons (n = 0)

Records screened (n = 818)

Records excluded** (n = 727)

Reports sought for retrieval (n = 91)

Reports not retrieved (n = 0)

Reports assessed for eligibility (n = 91)

Reports excluded:
- Abstract not available (n = 30)
- Content (n = 35)
- Full text (n = 14)

Studies included in review (n = 12)
Reports of included studies (n = 0)

Figure 1. Studies selection process
The evaluation process described by Hawker et al. (2002) was used to determine the quality of the selected articles for the review. Each article was evaluated in nine categories, with a maximum score of 4 possible in each category. Consequently, the highest overall score was 36 for each article. All the assessed articles received scores between 28 and 36 points. For a detailed analysis of the critical appraisal, refer to Appendix 1.

4.3 Data analysis

Content analysis is a well-established research method in nursing with a lengthy history. This systematic and objective approach allows for the description and characterization of events and is sometimes referred to as document analysis. Researchers can employ content analysis to explore theoretical issues and enhance their understanding of the data. This process enables the condensing of words into fewer content-related categories. (Elo & Kyngäs, 2008).

Content analysis aims to transform a significant amount of text into a highly structured and short summary of major findings (Erlingsson & Brysiewicz, 2017). Qualitative content analysis can be classified into three methods: conventional (inductive), directed (deductive), and summative (Assarroudi et al., 2018). Conventional content analysis was used in this study. Conventional content analysis is the most popular method in data analysis, as it helps develop theories, schematic models, or conceptual frameworks that should be enhanced, evaluated, or developed further via directed content analysis (Elo & Kyngäs, 2008). Directed content analysis is a common data analysis tool in healthcare research, but there is limited knowledge regarding how this method is used. (Elo & Kyngäs, 2008)

Elo and Kyngäs (2008) introduced "structured" and "unconstrained" approaches or pathways for guided content analysis. In this process, the entire content is reviewed and coded based on an identified "categorization matrix" which serves as the foundation for data collection and analysis throughout the study. The unconstrained matrix approach allows for the creation of categories inductively through the processes of "grouping," "categorization," and "abstraction." On the other hand, the structured approach requires using a pre-determined matrix with meticulously coded data. (Assarroudi et al., 2018). Figure 2 below is an example of a data analysis process.
5 Results

The studies in this literature review were published in Switzerland (2), Spain (1), UK (1), USA (4), Poland (1), Singapore (1), Canada (1), Netherlands (1). The research methods of the reviewed articles were qualitative research method, literature review, and systematic review. The summaries of these reviewed articles can be seen in Appendix 2.

After the analysis, articles were conducted and grouped together. Four main themes emerged: interventions in the preoperative phase, interventions in the intraoperative phase, interventions in the postoperative phase, and interventions in the entire perioperative phase. The themes and sub-themes can be seen in Table 3.
Table 3. Themes and subthemes

<table>
<thead>
<tr>
<th>Main themes</th>
<th>Sub-themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interventions in the preoperative phase</td>
<td>Bathing</td>
</tr>
<tr>
<td></td>
<td>Nutrition</td>
</tr>
<tr>
<td></td>
<td>Hair removal</td>
</tr>
<tr>
<td></td>
<td>Antibiotic prophylaxis</td>
</tr>
<tr>
<td>Interventions in the intraoperative phase</td>
<td>Perioperative oxygenation</td>
</tr>
<tr>
<td></td>
<td>Surgical drapes</td>
</tr>
<tr>
<td></td>
<td>Skin disinfection</td>
</tr>
<tr>
<td></td>
<td>Hand antisepsis</td>
</tr>
<tr>
<td></td>
<td>Irrigation of the surgical wound</td>
</tr>
<tr>
<td>Interventions in the postoperative phase</td>
<td>Wound care</td>
</tr>
<tr>
<td></td>
<td>Negative pressure wound therapy</td>
</tr>
<tr>
<td>Interventions in the entire perioperative phase</td>
<td>Perioperative normothermia</td>
</tr>
<tr>
<td></td>
<td>Glycemic control</td>
</tr>
<tr>
<td></td>
<td>Perioperative oxygenation</td>
</tr>
</tbody>
</table>

5.1 Interventions in the preoperative phase

5.1.1 Bathing

Badia (2020) states that a preoperative shower with chlorhexidine soap is more effective than povidone-iodine or non-pharmacological soaps in reducing bacterial inoculum. However, it does not correlate with a lower incidence of SSI (Badia et al., 2020). Yet, according to Benedetta (2016), preoperative bathing is a good clinical practice to ensure the skin is clean before surgery to decrease the bacteria, especially at the incision site. The analysis also found that using soap containing chlorhexidine gluconate (CHG) did not significantly reduce the incidence of surgical site infection as compared to plain soap. Hence, plain and antiseptic soap can be used for preoperative bathing (Allegranzi et al., 2016).
Ling (2019) states that preoperative bathing with either antimicrobial or non-antimicrobial soap is generally acknowledged as beneficial prior to surgery. Although the ideal timing and protocol remain unresolved, it is advised to take at least two preoperative baths. When considering the solution for preoperative bathing, it is advised to use antiseptic rather than plain soap in areas where multidrug-resistant organisms are highly prevalent. Alternative antiseptic agents, such as octenidine, may be used in some Asian countries where allergies to CHG are common or where it is unavailable.

5.1.2 Nutrition

Malnutrition can impact the healing process, delayed recovery, morbidity, prolonged stay in hospital, increased health care costs, readmission, and how the body responds to postoperative infections. According to the European Society for Clinical Nutrition and Metabolism, malnutrition defines as a state caused by inadequate nutrient absorption or improper nutrient intake, resulting in alterations in body composition and compromised physical and mental function, this condition negatively impacts the treatment outcomes for the underlying health issues (Kolasiński, 2018). Patients must be well-nourished before undergoing any elective procedure. Perioperative nutrition is recommended for malnourished patients to support their general health during the surgical process (Badia et al., 2020; Ling et al., 2019).

According to Kolasiński (2018), to determine a patient's nutritional status, two questionnaires are available: the Nutritional Risk Screening (NRS-2002) and the Nutritional Risk Index (NRI). The NRS involves calculating four variables, including the percentage of weight loss, body mass index (BMI), the general condition (indicating the severity of the underlying disease), and food intake in the week leading up to the surgery. Conversely, the NRI is based on serum albumin levels and a ratio between actual and expected body weight (Kolasiński, 2018).

5.1.3 Hair removal

Historically, hair removal was a common practice based on the belief that hair presence could interfere with incision exposure, suturing, and wound dressing administration (Tartari et al., 2017). While hair removal may be required for proper exposure and preoperative skin marking, the tech-
nique employed can result in microscopic skin trauma, elevating the risk of SSIs (Allegranzi, Bischoff, et al., 2016; Bath et al., 2022). However, there is no need for preoperative hair removal unless the hair in or around the incision region interferes with the surgery (Tartari et al., 2017).

Numerous studies show that the use of a razor can cause skin irritation and result in micro lesions (Allegranzi, Bischoff, et al., 2016; Badia et al., 2020; Ling et al., 2019; Seidelman et al., 2023; Tartari et al., 2017). As a result, germs can gradually colonize the damaged skin, significantly increasing (doubling) the risk of postoperative infections (Tartari et al., 2017). The safest approach, if necessary, is to use a clipper for hair removal shortly before surgery (Allegranzi, Bischoff, et al., 2016; Ling et al., 2019; Logan et al., 2016; Tartari et al., 2017).

5.1.4 Antibiotic prophylaxis

Antibiotic prophylaxis is advised for clean or contaminated wounds with implanted foreign objects such as vascular or joint prosthesis. In case of contaminated and filthy wounds, an entire course of antibiotics should be given to the patient instead of a preventive dose. The National Nosocomial Infections Surveillance scale is a commonly used instrument for determining the need for perioperative antibiotics. Antibiotic prophylaxis is advised if the patient's total score is one or more points (Kolasiński, 2018).

Guidelines recommend delivering antibiotics within 60 minutes of incision to maximize antibiotic concentration in the tissue (Calderwood et al., 2023; Seidelman et al., 2023). Other recommendations include adjusting antibiotic doses based on the patient's weight to guarantee adequate tissue concentrations and administering additional doses during prolonged procedures in case of significant bleeding (Calderwood et al., 2023; Kolasiński, 2018; Seidelman et al., 2023). Antimicrobial prophylaxis is increasingly being linked to harm in patients, including complications such as acute kidney injury. Antibiotics administered after closure, on the other hand, lead to heightened antimicrobial resistance and an elevated risk of Clostridioides difficile infection (Calderwood et al., 2023; Seidelman et al., 2023).
5.2 Interventions in the intraoperative phase

5.2.1 Surgical drapes

Surgical drapes create a sterile barrier between the operative field and adjacent non-sterile surfaces. This, in turn, reduces the risk of bacterial contamination, which could lead to SSIs. These drapes are available in various materials, such as cloth, disposable paper, or plastic, and designs, such as flat sheets, fenestrated options, or those with adhesive edges, to accommodate various types of surgical procedures (Goldberg et al., 2021).

After preparing the surgical site, nurses apply adhesive plastic incise drapes to the patient's skin, and the incision is made through both the drape and the skin simultaneously, with or without antimicrobial impregnation. Existing researches, however, provides conflicting recommendations regarding the use of these plastic adhesive drapes, often discouraging their use for SSI prevention (Allegranzi, Zayed, et al., 2016; Goldberg et al., 2021). Based on the evidence, Benedetta’s research recommends that adhesive incise drapes should not be used to prevent SSIs, whether or not they have antimicrobial properties. Hence, sterile disposable non-woven or sterile reusable woven drapes should be used (Allegranzi, Zayed, et al., 2016). Ling (2019), on the other hand, says that non-iodophor-impregnated drapes may increase the risk of SSI. Hence, in some surgeries, such as orthopedic or cardiac, iodine-impregnated drapes may be beneficial since they control skin recolonization and the potential link between bacterial wound contamination (Ling et al., 2019).

5.2.2 Skin disinfection

Antisepsis in the operating theater reduces the occurrence of SSI (Badia et al., 2020). The aim of preparing the surgical site skin is to minimize the microbial presence on the patient's skin before making an incision in the skin barrier. CHG and povidone-iodine in alcohol-based solutions are common agents for this purpose. However, in low- and middle-income countries, aqueous solutions are also widely employed, especially those containing iodophors (Allegranzi, Zayed, et al., 2016; Bath et al., 2022; Kolasiński, 2018). According to Badia (2020), in surgeries categorized as clean or clean-contaminated, chlorhexidine solutions appear to be more efficient than povidone-iodine solutions. While alcohol-based preparations are not suitable for use on mucous membranes, nerve tissue, impaired skin, or in newborns. In such cases, aqueous solutions of chlorhexidine or povidone are recommended (Badia et al., 2020; Calderwood et al., 2023).
5.2.3 Hand antisepsis

The hands of medical personnel can serve as a potential origin of infections acquired in hospitals, with Staphylococcus aureus and Gram-negative bacilli being the main components of the superficial bacterial flora on the skin (Kolasiński, 2018). The presence of bacteria on the skin of the surgical team poses a risk of SSI (Badia et al., 2020). Ensuring thorough surgical hand preparation is crucial to minimize contamination of the surgical field as much as possible (Allegranzi, Zayed, et al., 2016).

According to Badia’s (2020) research, chlorhexidine or povidone soap solutions have been the most commonly utilized antiseptics for hand hygiene. Alongside handwashing, further precautions should include avoiding artificial nails, maintaining short nails, cleansing the subungual area, and refraining from wearing rings, watches, and bracelets (Badia et al., 2020). Ling (2019) shared the same idea that surgical hand preparation should involve either scrubbing with an appropriate antiseptic soap and water or using an appropriate alcohol-based hand rub before putting on a sterile gown and gloves. The procedure for surgical hand preparation involves either scrubbing with an appropriate antiseptic soap and water or using a suitable alcohol-based hand rub before putting on a sterile gown and gloves. If the water quality is impaired, especially when tap aerators are susceptible to colonization by non-fermentative Gram-negative bacteria such as Pseudomonas aeruginosa and Acinetobacter baumannii, hand rubbing with an alcohol-based hand rub agent serves as a viable alternative after hand scrubbing (Ling et al., 2019).

5.2.4 Irrigation of the surgical wound

Intraoperative wound irrigation involves the application of a solution over the exposed area of a surgical wound. This common procedure is employed to reduce the risk of surgical site infections. Its primary objectives include physically removing cellular debris, surface bacteria, and bodily fluids. Additionally, wound irrigation diminishes potential contamination by dilution and acts locally as an antibacterial agent, particularly when incorporating antiseptic or antibiotic agents (Allegranzi, Zayed, et al., 2016).

As per Bath (2022), general surgeons commonly prefer using a povidone-iodine solution. This solution is acknowledged for its efficacy against a wide range of pathogens at varied concentrations,
demonstrating superiority over saline irrigation in abdominal surgery. Despite its effectiveness, it is important to note that povidone-iodine carries theoretical risks, including local toxicity and potential delays in wound healing (Bath et al., 2022).

Benedetta (2016) and Badia (2020) suggest that irrigating incisional wounds with an aqueous povidone-iodine solution could be beneficial, especially in clean and clean-contaminated wounds. However, antibiotic incisional wound irrigation before closure is not recommended for preventing SSIs (Allegranzi, Zayed, et al., 2016; Badia et al., 2020).

5.3 Interventions in the postoperative phase

5.3.1 Wound care

After surgery, maintaining wound hygiene is paramount. The recommended practice is to employ 'non-touch' techniques, refraining from direct contact with wounds and dressings using bare hands. Healthcare staff should rigorously wash hands before and after any interaction with surgical wounds or during dressing changes. Using glue on wounds post-surgery is discouraged, and sterile saline is the preferred solution for wound rinsing. Surgical wounds should be safeguarded with a sterile dressing for the initial 24–48 hours. Following this period, patients are advised to shower and cleanse their body with soap. The application of local antimicrobial products to reduce infection risk is not recommended (Badia et al., 2020; Kolasiński, 2018; Tartari et al., 2017).

Changing the surgical wound dressing is a crucial procedure that demands certain precautions to prevent the spread of microorganisms. This involves preparing a surface area that minimizes the equipment's touch contamination risk. During this process, healthcare workers must wear sterile gloves and an apron (Tartari et al., 2017).

5.3.2 Negative pressure wound therapy

According to Bath (2022) a promising method for reducing SSI and improving patient outcomes is negative pressure wound therapy (NPWT) (Bath et al., 2022). The vacuum pump creates a controlled negative pressure environment that makes it easier to remove excess wound fluid and infectious agents, which lowers the risk of infection and promotes a more favorable healing environment. Furthermore, NPWT is beneficial in lowering localized edema and enhancing blood flow in
the area surrounding the wound and encouraging granulation tissue formation. This increased blood flow strengthens the body’s natural defenses against infection by accelerating the delivery of essential nutrients, oxygen, and immune cells to the wound site. NPWT was initially used for open wounds, but it has since been extended to closed surgical incisions. There is a wealth of evidence supporting its ability to reduce the rates of SSIs in orthopedic, cardiothoracic, and general surgical procedures. (Allegranzi et al., 2016; Bath et al., 2022; Calderwood et al., 2023; Kolasiński, 2018)

5.4 Interventions in the entire perioperative phase

5.4.1 Normothermia

The cold environment in the operating theater often causes hypothermia. A core temperature of less than 36°C is defined as hypothermia (Allegranzi, Bischoff, et al., 2016). Perioperative hypothermia is linked to an elevated rate of SSI and increased blood loss (Badia et al., 2020). The presence of mild perioperative hypothermia may increase a patient’s vulnerability to SSI due to vasoconstriction and impaired immunity (Tartari et al., 2017). To prevent a drop in core body temperature during surgery, normothermia is sustained through a combination of methods such as forced warm air, skin warming, and the use of warmed intravenous fluids (Ling et al., 2019; Seidelman et al., 2023). Maintaining the patient’s core temperature above 36°C throughout the entire perioperative period for procedures lasting more than 30 minutes is advised. Achieving perioperative normothermia is especially advantageous, with patients who undergo 30 minutes of preoperative warming experiencing lower rates of intraoperative hypothermia (Badia et al., 2020; Calderwood et al., 2023; Tartari et al., 2017).

5.4.2 Glycemic control

Elevated blood sugar levels during the perioperative period are linked to a higher incidence of SSI (Badia et al., 2020; Kolasiński, 2018; Ling et al., 2019; Tartari et al., 2017). Increased blood glucose levels are frequently noticed during the operative and postoperative phases, attributed to the surgical stress response. This response is characterized by increased secretion of catabolic hormones such as catecholamines or cortisol, suppression of insulin secretion, and the development of insulin resistance. Research studies based on observations have found a link between hyperglycemia and an elevated susceptibility to SSIs in both diabetic and non-diabetic patients (Allegranzi, Zayed,
et al., 2016). As per Sandra (2017), apply perioperative glycemic control and aim for blood glucose target levels below 200 mg/dL in both diabetic and non-diabetic patients (Berríos-Torres et al., 2017).

5.4.3 Perioperative oxygenation

According to Benedetta (2016), perioperative oxygenation is the process of providing patients with adequate amounts of oxygen throughout the surgical period, which includes the preoperative, intraoperative, and postoperative phases. A sufficient supply of oxygen is required for various physiological processes, including wound healing and infection prevention. Inadequate oxygenation can cause tissue hypoxia, impairing cellular immunity and increasing the risk of SSIs. Benedetta’s research shows that patients under general anesthesia with an endotracheal tube should receive 80% FiO2 during the surgical procedure and 2-6 hours in the postoperative period (Allegranzi, Zayed, et al., 2016).

6 Discussion

6.1 Discussion of results

The literature review established that preoperative, intraoperative, postoperative and entire perioperative nursing interventions should be implemented to minimize the occurrence of SSI. This research highlighted the importance of perioperative nursing strategies to prevent surgical site infections by incorporating evidence-based practices such as preoperative hygiene, nutrition, appropriate antimicrobial prophylaxis, aseptic techniques, maintaining normothermia, and proper postoperative wound care.

Numerous studies have emphasized the significance of thorough preoperative measures, such as using antiseptic, plain soap, or CHG cloth during preoperative bathing, as an effective strategy for reducing bacterial colonization on the skin (Bashaw & Keister, 2019; Martins et al., 2020; Rabea et al., 2022). Plain and antiseptic soap help to reduce bacteria colonization on the skin surface during preoperative bathing (Rosa et al., 2023).
Another important factor in SSI prevention is preoperative nutritional status, particularly in patients with malnutrition or diabetes (Cederholm et al., 2017). Adequate protein, amino acids, carbohydrates, vitamins and mineral supplements intake can help with immune function, inflammation, and wound healing (Rabea et al., 2022). To optimize nutrition before surgery, perioperative nurses should assess patients' nutritional status, provide necessary dietary counseling, and collaborate with dietitians to develop individualized care plans (Cederholm et al., 2017; Rabea et al., 2022).

Furthermore, perioperative antimicrobial prophylaxis has been identified as an important strategy for reducing the risk of SSIs (Bashaw & Keister, 2019). Administering appropriate antimicrobial agents on time, specifically within 60 minutes, has been shown to reduce the incidence of SSIs significantly (Kolasiński, 2018). In this context, the perioperative nurse's role is critical, as they are responsible for ensuring that the patient receives the appropriate antimicrobial agent at the appropriate time. Additionally, perioperative nurses must be knowledgeable about specific protocols and antibiotic stewardship principles in order to prevent the overuse or improper use of antibiotics, thereby aiding in the fight against the development of antimicrobial resistance (Rosa et al., 2023).

As highlighted in the literature review, another critical component of preventing surgical site infections is the need for meticulous aseptic techniques during the intraoperative phase (Bashaw & Keister, 2019). Following strict aseptic practices throughout the perioperative period has been highlighted as a critical component in reducing the occurrence of SSIs (Rabea et al., 2022; Rosa et al., 2023). Perioperative nurses are responsible for implementing various aseptic measures such as appropriate skin preparation, correct sterile draping, maintaining the sterility of the operative field, and minimizing traffic in the operating theater. Furthermore, perioperative nurses' responsibilities extend beyond direct patient care to ensure that all surgical team members adhere to the same aseptic standards. (Martins et al., 2020)

According to Rosa (2023), sustaining normothermia throughout the perioperative period has been linked to a reduction in SSI. Prolonged hypothermia has been shown to impair immune function, increase blood loss, and increase the risk of postoperative infections. Monitoring patient tempera-
tare, providing heated blankets and intravenous fluids, and regulating the operating theater temperature are all perioperative nursing measures aimed at preserving normothermia (Rabea et al., 2022).

Intraoperative glycemic control is critical in lowering the risk of SSIs, especially in diabetic patients. Hyperglycemia can weaken the immune system and increase the risk of. Perioperative nurses should closely monitor blood glucose levels and work with the anesthesia and surgical teams to maintain glycemic control during surgery by using appropriate insulin therapies. (Martins et al., 2020)

Effective postoperative wound care is also critical in preventing SSI. Using appropriate wound care methods, dressing changes, and educating patients about infection symptoms can all significantly impact the likelihood of SSIs. Perioperative nurses are frequently the first point of contact for patients who have concerns about their surgical wounds. Therefore, establishing uniform wound care procedures and instructing patients on home wound care and when to seek help in the event of infection symptoms is critical. (Szewczyk et al., 2015)

6.2 Critical appraisal, ethical considerations, validity, and reliability

This study used Hawker's (2001) appraisal tool to evaluate the quality of the article. This aided in the identification of abstract and title, introduction and aims, method and data, sampling, ethics, potential biases, results, transferability or generalizability, and usefulness, using the scale from 1-4, where 4=good, 3=fair, 2=poor, 1=very poor. The maximum score for the articles is 36, and the minimum is 9. In the review, the lowest-graded article was 28, and the highest was 36; therefore, the average score was 33.4.

In terms of ethical considerations, the data source for this review from selected articles has been considered in this review. The reliability and validity of this study is evident in the careful detail of the literature review process, which is designed to be replicated. Careful attention was dedicated to the analysis of the articles to avoid any possible biases. All the information included in this review has been properly referenced and cited using the most recent version of the American Psychological Association (APA, 7th edition) criteria giving full credit to each of the writers to avoid
plagiarism. The limitation of this study primarily draws on existing literature, and further prospective studies may be needed to confirm the effectiveness of these preventive measures in different clinical settings.

7 Conclusion and recommendations

In conclusion, this literature review shows that surgical site infections remain the most common perioperative complications and that it is important to ensure patient safety during the surgical procedure to improve postoperative surgical outcomes. It is crucial for perioperative nurses to minimize the risks of getting SSI through various evidence-based guidelines.

The research results show that healthcare institutions should develop and implement standardized, evidence-based protocols and keep them up to date. Perioperative nurses should be educated and continuously trained and work in a multidisciplinary approach.
References


# Appendices

## Appendix 1. Critical appraisal of included studies (Hawker et al., 2002)

<table>
<thead>
<tr>
<th>Author</th>
<th>Abstract/Title</th>
<th>Introduction and aims</th>
<th>Method and data</th>
<th>Sampling</th>
<th>Data analysis</th>
<th>Ethics and bias</th>
<th>Results</th>
<th>Transferability</th>
<th>Implications and usefulness</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badia et al., (2020)</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>32</td>
</tr>
<tr>
<td>Bath et al., (2022)</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>29</td>
</tr>
<tr>
<td>Berrios-Torres et al., (2017)</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>34</td>
</tr>
<tr>
<td>Author, Year, &amp; Country</td>
<td>Aim and Purpose</td>
<td>Methodology and Analysis</td>
<td>Main findings</td>
<td>Critical appraisal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------</td>
<td>-------------------------</td>
<td>---------------</td>
<td>-------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calderwood et al., (2023)</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>36</td>
</tr>
<tr>
<td>Goldberg et al., (2021)</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>31</td>
</tr>
<tr>
<td>Kolasiński, (2018)</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>28</td>
</tr>
<tr>
<td>Ling et al., (2019)</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>34</td>
</tr>
<tr>
<td>Logan et al., (2016)</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>36</td>
</tr>
<tr>
<td>Seidelman et al., (2023)</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>33</td>
</tr>
</tbody>
</table>

**Appendix 2. Summary of included studies**
<table>
<thead>
<tr>
<th>Study</th>
<th>Objective</th>
<th>Study Type</th>
<th>Recommendations</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allegranzi, Bischoff, et al., (2016), Switzerland</td>
<td>To prioritize the development of evidence-based recommendations for the prevention of SSIs</td>
<td>Qualitative study developed by WHO guidelines</td>
<td>13 recommendations were represented focusing on preoperative measures: discontinuation of immunosuppressive agents, nutritional support, bathing, decolonization with mupirocin ointment with or without CHG, bowel preparation and the use of oral antibiotics, hair removal, surgical antibiotic prophylaxis, surgical hand preparation, surgical site skin preparation, antimicrobial skin sealants.</td>
<td></td>
</tr>
<tr>
<td>Allegranzi, Zayed, et al., (2016), Switzerland</td>
<td>To consider the prevention of SSIs as a priority for patient safety</td>
<td>Qualitative study developed by WHO guidelines</td>
<td>The review presents 16 recommendations focusing on intraoperative and postoperative phase: oxygenation, normothermia, glycemic control, normovolaemia, drapes and gowns, wound-protection devices, wound irrigation, NPWT, antimicrobe-coated sutures, operating room</td>
<td></td>
</tr>
<tr>
<td>Study (Year, Country)</td>
<td>Objective</td>
<td>Methodology</td>
<td>Outcomes</td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------</td>
<td>-------------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>Badia et al., (2020), Spain</td>
<td>To select measures with the highest degree of evidence to be applied in Spanish surgical services</td>
<td>A literature review was conducted through PubMed, Tripdatabase, National Guideline Clearinghouse and The Cochrane Library</td>
<td>The best measures according to article: hair removal, skin decontamination, antibiotic prophylaxis, normothermia, glycemic control.</td>
<td></td>
</tr>
<tr>
<td>Bath et al., (2022), UK</td>
<td>To explore available nonantibiotic intraoperative interventions to reduce the risk of SSI</td>
<td>A scoping review which was undertaken using Medline, Web of Science, Embase, and Cochrane Library databases, with grey literature search results subsequently added using the Open Grey database</td>
<td>Surgical site skin preparation, wound irrigation, closure techniques and devices, NPWT.</td>
<td></td>
</tr>
<tr>
<td>Author(s)</td>
<td>Objective</td>
<td>Methodology</td>
<td>Preventive Measures</td>
<td>Page</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Berrios-Torres et al., (2017), USA</td>
<td>To provide new and updated evidence-based recommendations for the prevention of SSI</td>
<td>Systematic literature review was conducted in MEDLINE, EMBASE, CINAHL, and the Cochrane Library from 1998 through April 2014.</td>
<td>Preoperative shower, antimicrobial prophylaxis, skin preparation, glycemic control, oxygenation.</td>
<td>34</td>
</tr>
<tr>
<td>Calderwood et al., (2023), USA</td>
<td>To assist acute-care hospitals in implementing and prioritizing their surgical site infection prevention efforts.</td>
<td>Systematic review of the available literature on SSI prevention.</td>
<td>Hair removal, decolonization with intranasal antistaphylococcal agents and antistaphylococcal skin antiseptics for high-risk procedures; antibiotic prophylaxis; normothermia; glycemic control; NPTW.</td>
<td>36</td>
</tr>
<tr>
<td>Goldberg et al., (2021), USA</td>
<td>Systematic literature review that used PubMed, MEDLINE and the Cochrane databases.</td>
<td>Preoperative skin antisepsis with an alcohol-based agent, closing surgical wounds with triclosan-coated suture, and applying a NPWT device to open and closed wounds.</td>
<td></td>
<td>31</td>
</tr>
<tr>
<td>Authors</td>
<td>Country</td>
<td>Objective</td>
<td>Methodology</td>
<td>Prevention Measures</td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------------</td>
<td>---------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Kolasiński, (2018), Poland</td>
<td></td>
<td>To present current views on the etiology and methods of prevention of surgical site infection</td>
<td>Narrative review of the available literature on SSI.</td>
<td>Antibiotic therapy, skin antisepsis, surgical site shaving, immunosuppressive therapy, nutrition, surgical field antisepsis, hand disinfection, maintaining patient’s homeostasis, wound hygiene, blood transfusion.</td>
</tr>
<tr>
<td>Ling et al., (2019), Singapore</td>
<td></td>
<td>To highlight practical recommendations in a concise format designed to assist healthcare facilities at Asia Pacific region in achieving high standards in preoperative, perioperative and postoperative practices</td>
<td>The guidelines were developed by previously reviewed guidelines (WHO, CDC, Cochrance) and recommendations relevant to each section and performed computerized literature searches using PubMed</td>
<td>Preoperative bathing, mechanical bowel preparation and oral antibiotics, hair removal, surgical hand preparation, skin antisepsis, glycemic control, antibiotic prophylaxis, normothermia, nutrition, normovolaemia, wound irrigation, surgical drapes, NPWT.</td>
</tr>
<tr>
<td>Logan et al., (2016), Canada</td>
<td></td>
<td>To examine current risk factors and best practice perioperative care for prevention of SSI following cardiac surgery through the lens of</td>
<td>A literature review was examined through a retrospective chart review of the population of patients</td>
<td>The study population was characterized by a high prevalence of risk factors including age, diabetes, obesity, operative time, blood glucose control, surgical</td>
</tr>
<tr>
<td>Seidelman et al., (2023), USA</td>
<td>A literature review that used PubMed, Google Scholar, and the Cochrane database from January 1st 2016 as well as WHO guidelines.</td>
<td>Avoiding razors for hair removal, maintaining normothermia, use of CHG plus alcohol–based skin preparation agents, decolonization with intranasal antistaphylococcal agents and antistaphylococcal skin antiseptics for high-risk procedures, controlling for perioperative glucose concentrations, and using NPWT can reduce the rate of surgical site infections.</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Tartari et al., (2017), Netherlands</td>
<td>To provide pragmatic recommendations for pre-, intra- and postoperative activities for the prevention of SSIs</td>
<td>A literature review that used international published guidelines on pre-, intra-, and postoperative measures for SSI prevention, mainly from WHO, CDC and their reference lists were searched to identify relevant studies.</td>
<td>9 recommendations for the surgical patient are presented: Staphylococcus aureus screening and decolonization, smoking cessation, hair removal, hand hygiene, normothermia, preoperative showering, glycemic control for diabetic patients, wound care after surgery, multidrug-resistant organism risk</td>
<td>36</td>
</tr>
</tbody>
</table>