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Surgical Site Infection Prevention in Orthopaedic Nursing - A Descriptive Literature Review

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<p>Surgical site infection prevention in orthopaedic surgery is a problematic incidence that requires combination of various strategies preoperatively, intraoperatively, and postoperatively. Hence, the purpose of this literature review was to describe surgical site infection prevention and the barriers to infection prevention in orthopaedic nursing. This study aims to produce new knowledge that could utilise to enhance nursing practices in preventing surgical site infection in orthopaedic surgery.</p> <p>To gather the data, CINAHL, PubMed databases and a manual search was applied. Inclusion and exclusion criteria were generated to narrow down the searches. This process led to the selection of 12 articles that were analysed by utilising inductive content analysis. In line with this, two main categories and six generic categories that answered the research questions was formed. The study questions were “What are the existing nursing practices in surgical site infection prevention in orthopaedic nursing?” and “What are the barriers to surgical site infection prevention in nursing practice in orthopaedics?”.</p> <p>The data collected were analysed showed that a range of practices in surgical site infection prevention are currently being used in orthopaedic nursing. Most of the methods are preventing infection through combination of nursing interventions and managements like for instance, bundles of skin solutions for decontamination. Range of various opinions as well as general lack of consensus in pin site management, unable to relate to the theory related knowledge into practice, negative emotional impact on nurses, non-compliance and psychological burden of patients were identified as the main challenges.</p> <p>The results lead to the conclusions that surgical site infection has detrimental effects to both patients and healthcare providers. Therefore, it is significant to effectively implement the evidenced-based nursing practices to prevent, limit or eradicate the burden produced by SSI. On the other hand, there is a need for improvement in nursing perspective and practices as well as to manage the inconsistency between theory and practice.</p>	
Key Words	Surgical site infection, SSI prevention, orthopaedic, orthopaedic surgery, orthopaedic nursing, nurses

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ABBREVIATIONS

SSI	Surgical Site Infection
WHO	World Health Organization
HAIS	Hospital Acquired Infections
CDC	Centers for Disease Control and Prevention
NICE	National Institute for Health and Care Excellence
ECDC	European Centre for Disease Prevention and Control
OR	Operating Room
CHG	Chlorhexidine Gluconate
EBP	Evidenced Based Practice
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta Analyses
FDA	Food and Drug Authority
PJI	Periprosthetic Joint Infection
AORN	Association of Perioperative Registered Nurses
MRSA	Methicillin-Resistant Staphylococcus Aureus
QI	Quality Improvement
ASEP-SIS	Additional treatment; Serous discharge; Erythema; Purulent exudate; Separation of deep tissues; Isolation of bacteria

1 Introduction

In orthopaedic surgeries, despite the adopted precautions, surgical site infection (SSI) is still a major concern internationally. Infection prevention in perioperative settings is significantly fundamental in every health care system. Since patients who experience surgical site infection have increased mortality and morbidity rates, hospital length of stay, and higher hospital cost thereby the management of perioperative infections carries a heavy psychological and financial burden. As the management of infections is particularly problematic in the presence of biomaterial implant, the prevention of SSI in orthopaedic surgery represents a challenging key issue that requires unification of a range of strategies before, during and after surgery as the treatment of such infections is particularly difficult in the presence of an implanted biomaterial. Over time, several aspects of SSI prevention have been studied to identify the outstanding prevention strategies and methods appropriate in clinical practices. (Tucci et al. 2019: 224-239.)

Prevention of SSI is equivalence between monetary expense, patient attitude, and harm. To implement effective management and to guarantee the prevention of SSIs, patients are dependent on operating room (OR) nurses who supervised their journey in perioperative process. To lessen and avoid spreading the infection, nurses are accountable for the implementation of hygiene and aseptic techniques in the OR. Additionally, together with other specialists in the team, perioperative care is their responsibility (Qvistgaard, Lovebo & Almerud-Österberg 2019: 2.).

The purpose of this study is to describe surgical site infection prevention practices and the barriers to infection prevention in orthopaedic nursing. Hence, with the presentation of data and information on existing SSI prevention practices, we aim to provide information that could enhance nursing practices to alleviate or lessen the incidence of SSI in orthopaedic surgeries. This study could be utilised by healthcare practitioners, healthcare institutions and hospital administrators.

2 Background

2.1 Orthopaedic Surgery

Orthopedic surgery is a procedure performed by a specialized medical practitioner. For instance, orthopedic surgeon or orthopaedist who is competent to evaluate and provide treatment to disorders that develop in areas such as in the bones, joints and ligaments. To address and remedy issues that originate in the human skeleton, its attachments, tendons, and ligaments with the purpose of surgery. The issues of the nervous system such as those resulting from injury in the back may be also included. Other issues may also be due to childbirth, aging or trauma. These issues could be intense as in the case of injury or accident or a continuous concern when the person is aging. (Encyclopedia: Orthopedic Surgery 2018.)

The word orthopedic is derived from the Greek words orthos, which means straight, and pais, which means child. A child's skeletal deformities were originally treated with braces by orthopedic surgeons. Since the development of anesthesia and understanding the importance of aseptic technique, orthopedic surgeons have expanded their role to include surgery involving bones, nerves, and connective tissues. (Encyclopedia: Orthopedic Surgery 2018.)

Orthopaedic surgery is divided into elective and trauma. Elective surgery includes surgery such as joint replacement, spine repair and repair of bones that are malformed and arthroscopies. Trauma orthopaedics deals mainly with broken bones and joints. It also involves repair of tissue as well as vascular surgery in extreme cases, mostly caused by accidents. (Wicker 2015: 117.)

The most common and disabling musculoskeletal conditions according to the World Health Organization are fractures associated with bone weakness, back and neck pain, injuries, osteoarthritis, and systemic inflammatory conditions such as rheumatoid arthritis. Persistent pain and limited movement are the typical characteristics of musculoskeletal conditions. Weight management, exercise, medication treatment, psychological therapies, and physical therapies are combination of core intervention through primary care management. However, specialist care, surgical care, or both is required for some

patients who do not respond to conservative measures. (Blom, Donovan, Beswick, Whitehouse & Kunutsor 2021: 1.)

An elective orthopaedic procedure that is common is lumbar spine decompression, carpal tunnel decompression, arthroscopic meniscal knee repair, anterior cruciate ligament reconstruction by arthroscopic means, rotator cuff repair by arthroscopic means, subacromial decompression by arthroscopic means, partial meniscectomy by arthroscopic means, lumbar spine fusion, total hip replacement, and total knee replacement. (Blom et al 2021: 2.)

2.2 Surgical Site Infection in Orthopaedic Surgery

When an implant is placed in a patient within 30 days or within 1 year after surgery, a surgical site infection may result from microbial contamination of the wound. The SSI occurrence in the United States yearly was approximately 1.07%; with 8000 deaths related directly to SSI and a financial value of up to \$10 billion. While in the United Kingdom, the issue of SSI is extensive with the extended hospital stays between 5 to 8 days lengthening to 17 days more. The added cost for each SSI is estimated to be around \$3,394. The effect of SSIs escalated the number of morbidities in patients, longer hospital stays and causes a financial burden on the economy and hospital resources. There were varied preventable reasons of SSI that were identified and enumerated. The incidence could be reduced if proper measures were implemented. Surgeons, nurses, as well as instrumentation and atmosphere of OR are primary areas of interest. To diminish infections in implant surgery, various methods have been established however, infection does occur. (Al-Mulhim, Baragbah, Sadat-Ali, Alomran & Azam 2014: 265.)

Organisms present on the skin of patient are the major cause of surgical site infections. *Staphylococcus aureus*, a bacterium that lives on the skin and in the nose is the most common pathogen that causes SSI. The natural flora bacterium that may be present in the patient's body is a probably multidrug-resistant organism that can be acquired during the hospital confinement. (Franker et al 2021: 276.)

SSI is the second most common nosocomial infection (HAI) in hospitals, as shown in the 2011-2012 European Point Prevalence Study (HAI) and antimicrobial use. For 2010 and 2011, a recent European Center for Disease Control and Prevention (ECDC) statement

on SSI surveillance provided data. The standardized protocol was used by 20 networks in 15 European Union countries and 1 European Economic Area country. Across all surgeries, hip prostheses accounted for 33% of the most frequently reported surgical procedures. The aggregate proportion of patients with SSI was highest for bowel surgery at 9.5% (number of episodes per 100 surgeries), coronary artery bypass graft surgery at 3.5%, caesarean section at 2.9%, cholecystectomy at 1.4%, and total hip replacement. 1.0% and so on. 0.8% for laminectomy and 0.75% for knee replacement. (WHO 2018.)

2.3 Common Complications Related to Orthopaedic Surgery

The World Health Organization (WHO) documented that the prevalence of SSI was higher for cancer procedures which is 17.2%, orthopedic and general surgery were 15.1% and 14.1%, respectively. It has been revealed that around one in twenty surgical patients in hospitals, SSI incidence develops. (Humaun, Wanchai, Hunsa & Nongkran 2017: 246.) High incidence of SSIs, falling within the fifty to ninety percent for SSIs in orthopedic procedures compared with other surgery types. In orthopedic procedures, it is prone to infection with biofilm when using an artificial implant, a cluster of microbial cells encompassing non-living substances. (Buckner, Lacy, Young & Dishman 2022: e414.) The most common procedures with complications are intertrochanteric hip fractures requiring open reduction and internal fixation (ORIF) with an intramedullary device, total knee arthroplasty (TKA), and total hip arthroplasty. Symptomatic anemia requiring blood transfusion followed by wound infection requiring administration of antibiotics or surgical debridement was the most common complication observed. (Willhuber et al 2018: 4.)

SSIs play an important role in early detection in preventing the spread of infection and reducing the likelihood and incidence of complications and undesirable outcomes. Left untreated, SSI can result in sepsis, abscess formation, deep wound infection, failure and dehiscence of implants and wound healing, and impact on other aspects of patient health and functional recovery. Observation of patients and their wounds by nurses is essential to detect infections as early as possible. (Copanitsanou & Santy-Tomlinson 2021: 1.) Data on complications resulting from orthopaedic surgery is an essential means to evaluate the level of medical assistance to be given by the health care organization. Additionally, studying the prevalence of SSI causes and complications will help surgical

teams generate different interferences to reduce or avoid the incidence of SSIs, improve patient safety, and reduce healthcare costs. (Willhuber et al 2018: 5.)

2.4 Infection Prevention Practices in Orthopaedic Nursing

Surgical procedures infections produce patient discomfort and huge costs for public. Therefore, surgical site infections prevention is a vital factor for all surgical settings. The chances of acquiring SSIs are much higher in developing countries, however, this can still be a typical source of infection in industrialised countries. Undoubtedly, better prohibition of SSIs is essential. Preventing SSI needs various approaches as the booming of antibiotic resistance makes it vital that the operating theatre is properly sanitised. SSIs commonly prominent 30 days of surgery, in contrast it can be manifest following a case, for instance after orthopedic joint procedure. Microorganisms breaching surgical opening is the great opportunity for infection. The progression of SSIs depends on number of bacteria, virulence, and the ability of patient to fight infections. Knowledge inadequacy regarding the risk of resistance has led to the speedy development on resistance in antibiotic. (Qvistgaard et al 2019: 1.)

The World Health Organization broadcast comprehensive guidelines regarding prevention of SSI in 2016. On the other hand, there remains standard insufficiency about the best strategies to combat this matter. Control in blood sugar, administration of antibiotic perioperatively, bathing with chlorhexidine are well-established interventions that lessen surgical site infections. (Buckner et al: e414.)

To decrease SSIs was the aim of infection control regulation. Washing with chlorhexidine preoperatively and administration of antibiotic perioperatively are now acknowledged practices in majority of operation procedures. Nonetheless, decreasing OR foot traffic is defined to reduce bacterial count in the air, continue to mitigate SSI risk intervention that is challenging to assimilate into routine task and culture in OR. Although institutions, such as the Centers for Disease Control and Prevention, enumerates the limiting OR traffic recommendations, some of these have been integrated into guidelines or checklists. One such an example would be the released in 2009 by the World Health Organization, yet not generally considered into safety culture. (Buckner et al 2022: e417.)

Comprehensive vital role and persistent care were given by the nurse to prevent spreading of surgical site infection. Therefore, nurse can modify risk factors in routinely basis such as skin preparation and improper hand hygiene. World Health Organization, CDC and NICE guidelines attribute following six recommended outstanding standards for SSI prevention. These includes preoperative shaving using an electric clipper, if removal of hair is necessary, bathing with soap in the morning of the day of surgery, applying anti-septic solution preoperatively to disinfect the skin, antibiotic prophylaxis should be administered within an hour before the incision, complying to washing hygiene accordingly before and after procedure; and the incision dressing should be done aseptically. (Humaun et al 2017: 245-246.)

3 Purpose, Aim, and Study Questions

The purpose of this study is to describe surgical site infection (SSI) prevention and the barriers to infection prevention in orthopaedic nursing. The aim is to produce new knowledge that could utilise to enhance nursing practices in preventing surgical site infection in orthopaedic surgery. It will mean a faster recovery period for the patients, cost-efficiency for the health care facilities and a better service delivery for the healthcare professionals.

The research questions in this thesis are as follows:

1. What are the existing nursing practices in surgical site infection prevention in orthopaedic nursing?
2. What are the barriers to surgical site infection prevention in nursing practice in orthopaedics?

4 Methodology and Methods

4.1 Data Collection Method

Qualitative research is a pattern of collective inquiry that converges on how people construe and fathom their personal narratives and the environment around them. It is called "the specific activity that places the observer in the world." Qualitative research includes material practices with a specific interpretation, and a naturalistic approach. In effect,

qualitative researchers analyse states from an instinctive perspective and try to understand phenomena in terms of human-provided context. (Jindal, Singh & Pandya 2015: 369.)

Qualitative research methods provide an exclusive contribution to health care management specifically on the exploration of the experiences of both patients and healthcare professionals. Epidemiology basically addresses health and healthcare community as well as scientific study concentrates on medical interventions and chances of recovery. Qualitative research methods point out various experiences, perspectives, and behaviours pattern. Additionally, it encompasses a wide-ranging techniques of data navigation and data analysis, direct investigation facilitates understanding of behaviours in the practice of healthcare and evidence can offer judgements into discourses and presentation of self. (Ullrich, Sturtlinger, Wensing & Krug 2020: 2.)

Literary criticism plays an important role in education as science rests largely as a cumulative endeavor. To keep up with the exponential growth of eHealth information in any academic discipline, and for practitioners, researchers, and students to find, critique, and synthesize a wealth of conceptual and empirical research details to support this, rigorous information integration is becoming essential. A literature review is essential to determine what is documented on the topic. Determine the extent to which a particular field of research exhibits understandable trends and guidance, generate factual results relevant to limited research questions that support evidence-based practice, formulate new foundations and theories, and develop themes or identify a question. (Pare & Kitsiou 2017: 9.)

The purpose of descriptive review is to identify areas where the information content of a particular research topic exhibits an explainable design or trend in relation to previous hypotheses, approaches, methods, or results. In contrast, descriptive review in narrative research follows a methodical and understandable process involving questioning, screening, and categorization of studies. Indeed, organized research techniques are used to build illustrative models of the greater associations of presented works. In addition, descriptive review authors excerpt specific features of interest from each study, including year of publication, study methodology, data collection methods, and direction and vitality of study results. For example, positive, negative or insignificant in the form of prevalence study to obtain measurable results. Each study constituted in the descriptive review was considered an analytical group, and the published literature sought to identify

trends the authors could understand or draw general conclusions about the merits of existing conceptualizations, suggestions, methods, or results. It provides a collection of data to derive from. Thus, a descriptive review may need its findings to represent the state of the art for a particular report. (Pare & Kitsiou 2017: 9.)

4.2 Database Search and Selection

The data for this thesis was gathered through searching, reviewing, and analysing written research studies and articles regarding surgical site infection prevention in orthopaedic nursing. The Metropolia informatician was consulted and provided the search terms that were used to access the data results. Reliable databases from Metropolia University of Applied Sciences such as CIHNAL complete and PubMed were used for data search. In the same way, MetCat Finna Library was used to conduct a manual search for scientific publications.

The authors of this thesis utilised PICO which helps to form search strategy. The population were patients who are undergoing orthopaedic procedures. The interest is infection prevention, level of practices and barriers. The context focuses surgery in orthopaedic nursing. The table of PICO can be found below (Table 1).

Table 1. PICO:

Population	Interest	Context
Patients who are undergoing orthopaedic surgery	Infection prevention practices, level of practices, barriers	Surgery in Orthopaedic nursing

Inclusion and exclusion criteria were formed while searching for articles related to the subject. The following are included in the inclusion criteria applied in the database; the research studies had to be issued from 2012 to 2022, all research studies had to be peer reviewed scientific nursing articles, answers the two research questions of the authors and written in English language. The table of Inclusion and Exclusion List can be found below (Table 2).

Table 2. Inclusion and Exclusion:

INCLUSION CRITERIA ARTICLES	EXCLUSION CRITERIA ARTICLES
Preoperative, intraoperative, postoperative types of patients in orthopaedic surgery.	Preoperative, intraoperative, postoperative types of patients in other surgery.
Studies between 2012–2022	Studies earlier than 2012
Written in English	Written in Finnish or other language other than English
Peer reviewed scientific nursing articles, primary studies and easily accessible.	Articles published in non-academic journals, thesis works, systematic/literature review.

Furthermore, the search sentences were formed using Boolean technique under CINAHL and PubMed. To be precise or expand the search, the use of Boolean operators AND, OR, and NOT with keywords may apply. If the search is retrieving prolific number of articles, it can be narrow by adding or limiting terms to specific fields. (Linns 2017).

Search Terms/Boolean:

surgical site infection or surgical wound infection or postoperative infection or ssi
AND orthopaedic surgery **OR** orthopaedic procedure **AND**
 nurse **OR** nurses **OR** nursing

The Database Search Results (Table 3) is shown below:

Table 3. Database Search Result

Database	Search terms	Limiters	Number of hits	Selected based on title	Selected based on abstract	Selected based on whole text
CIHNAL	Surgical site infection or surgical wound infection or postoperative infection or ssi AND orthopaedic surgery or orthopaedic procedure AND nurse or nurses or nursing	Published Date: 2012-2022 English language Peer reviewed	29	8	3	3
PubMed	Surgical site infection or surgical wound infection or postoperative infection or ssi AND orthopaedic surgery or orthopaedic procedure AND nurse or nurses or nursing	Published Date: 2012-2022 English language Peer reviewed	276	16	4	4
Total number of included studies			305	24	7	7

Twelve articles were selected for the analysis. The organisation of the studies was arranged into the table of reviewed articles (Appendix 1). Articles were evaluated and critiqued assuring that they answer the two research questions provided. The articles were properly scrutinized as the following report were documented onto the table: name of

author(s), publication year, country of research, title of the article, methodology and methods of research, number of participants and main outcomes (Appendix 1).

The combination search terms in the above-mentioned database search, yielded a total number of 305 hits. Eight hits were found through manual search produced a total number of 313 hits. Starting with the total of 313 articles, 281 were eliminated based on the title. Subsequently, 32 articles were left in the abstract, another 17 articles were omitted including the three duplicated articles. Reading the remaining 12 articles in full text, all the articles were selected to be part of this study. Utilising inductive content analysis, the study was further analysed. A PRISMA Flow Diagram below (Figure 1) shows the database research process in more detail.

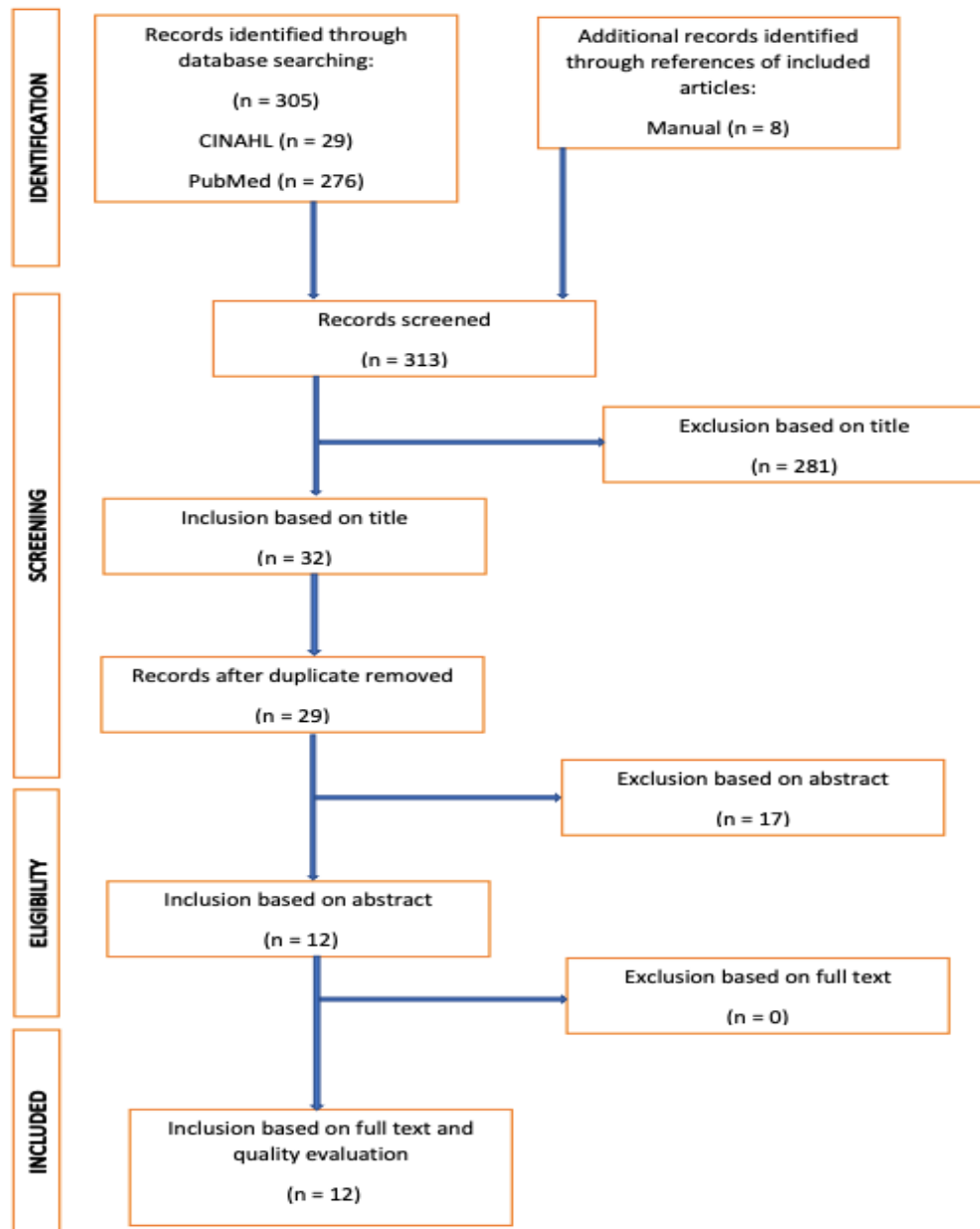


Figure 1. PRISMA Flow Diagram

The authors acknowledge the use of Julkaisufoorumi (JUFO) to ensure the quality of the research journals selected for this study. It is a publication channel that is being implemented by the Finnish scientific community that supports the quality of research. (Julkaisufoorumi 2021). The aim of the Publication Forum is "to support the quality assessment of academic research" (Publication Forum 2021b). Furthermore, this publication channel is divided into four-step classification namely: one is to basic level, two is to the leading level, three is to the highest level, and zero is to channels that do not (yet) meet the

criteria of level one. Eleven of the included studies were classified as level one and one study was classified as level two.

4.3 Data Analysis Method

Content analysis refers to a process frequently applied in qualitative research to analyse words or phrases in text reports. The qualitative description verified and supported by (Sandelowski 2000: 2010) is an outstanding methodological selection for the healthcare environment creator, expert, or researcher of health sciences as it contributes excellent descriptive data from the subjects' point of view. Qualitative description allows the analyst to select from any number of theoretical foundations, sampling techniques, and data collection strategies. (Colorafi & Evans 2016: 19.)

Inductive content analysis is needed when a qualitative study has an inductive beginning specifically when the approach in data collection is accessible and act in accordance to defined themes. The structure of content analysis is acceptable when the phenomenon under investigation is not part of previous research or prior knowledge is fragmented. Basic guided content analysis is performed by following these steps: reduce data, group data, and form ideas that can be utilised to justify research questions. (Kyngäs, Mikkonen & Kääriäinen 2020: 14.)

The data analysis results were generated firstly from obtaining related phrases from each article to solve the two research questions. Phrases were simplified as seen in the reduction and coding. In line with this, existing nursing practices in surgical site prevention in orthopaedic surgeries as well as the barriers in nursing practices to prevent surgical site infection in orthopaedic nursing were grouped as subcategories. Each subcategory was analysed to generate the generic category. Finally, the main category was classified to answer the two research questions of this study.

Table 4. Example of Content Analysis table:

Article	Meaning Unit	Coding	Sub-Category	Generic Category	Main Category
2	"The rate of infection while on QI study reduced, indicating that the measures placed are effective in reducing infection incidence, specifically S aureus infection, in patients undergoing total hip arthroplasty".	Combination of strategies prevents infection in orthopaedic surgery	Nasal and skin decolonisation, 2% mupirocin ointment 0.25g in each nostril 2x daily, alcohol with chlorhexidine or povidone-iodine	Prevention intervention bundle	Existing nursing practices in surgical site infection prevention in orthopaedic nursing

5 Outcomes

In this descriptive literature review, the twelve studies used were diverse, spread over six countries, different orthopaedic surgeries and with the timeline from 2012 to 2022. The studies are shown on the table below (Table 5):

Table 5. Authors, Countries and Participants

North America: USA	
Savage, J.W. et al. (2012)	100 patients in elective spine surgery
McDonald, L.T., Clark, A.M., Landauer, A.K. & Kuxhaus, L. (2015)	305 patients in total joint arthroplasty
Rovaldi, C. J., & King, P. J. (2015)	102 patients in hip and knee procedures,
Goldberg, L (2020)	1000 patients in spine surgery
Franker, L. et al. (2021)	51 preintervention patients and 54 postintervention patients in spine surgery
South America: Brazil	
Torres, L.M., Turrini, R.N.T., & Merighi, M.A.B. (2017)	11 readmitted patients after orthopaedic surgery
Australia	
Campbell, F., & Watt, E. (2020)	200 nurses in the exploration of nursing practices related to the care of orthopaedic external fixators
Pickles, S., McAllister, E., McCullagh, G., & Nieroba, T.-J. (2022)	307 patients in quality improvement evaluation of post-operative wound dressings
Europe	
Copanitsanou, P., Kechagias, V. A., Galanis, P., Grivas, T. B., & Wilson, P. (2019)	111 patients who were included in the validation of ASEPSIS scoring method for orthopaedic wound infections
Beele, H., Van Overschelde, P., Olivecrona, C., & Smet, S. (2020)	113 patients in the investigation of comparing two wound dressings after hip and knee replacements
Markström I, Bjerså K, Bachrach-Lindström M, Falk-Brynhildsen K, Hollman Frisman G. (2020)	19 nurses interviewed for their experiences in skin preparation
Walter, N. et al, (2022)	20 nurses who responded to the investigation of the impact of periprosthetic joint infections on the well-being of nursing staff

Based on the research questions, the data gathered were analysed and classified in two major groupings. The study questions are “What are the existing nursing practices in surgical site infection prevention in orthopaedic nursing?” and “What are the barriers to surgical site infection prevention in nursing practice in orthopaedics?”.

A total twelve research articles selected for the final analysis wherein eight articles discussed the current practices in the prevention of SSI in orthopaedic surgery while four articles showed barriers in nursing practices to aid in the prevention of SSI. The data were further categorised into the types of prevention practices and showed four research articles discussed skin preparation solutions and wound dressing, two articles researched on the prevention intervention bundle, one for wound infection scoring and one research article on foot traffic in the OR. To answer the second research question regarding barriers in nursing practice in the prevention of SSI, one research article studied nursing practice and three articles on nurse’s perspectives and challenges. Figure of data analysis is shown below.

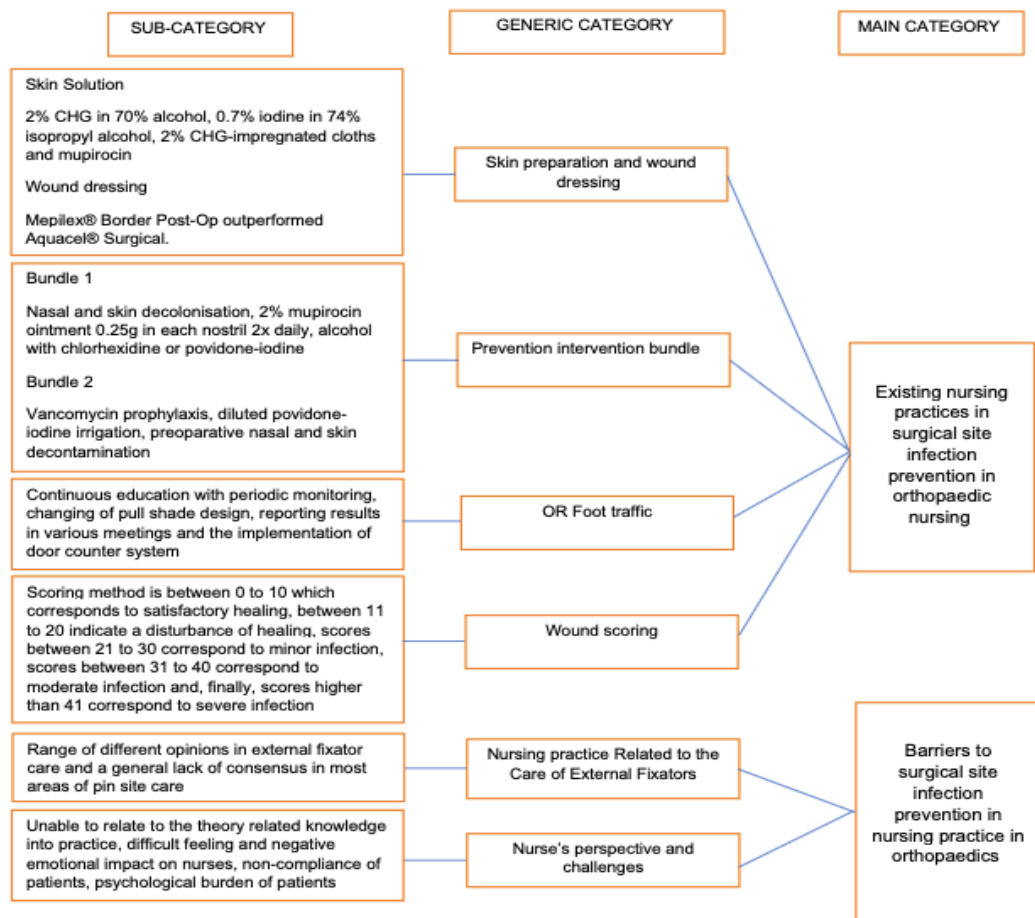


Figure 2: Data Analysis

5.1 Existing Practices in Surgical Site Infection Prevention in Orthopaedic Nursing

5.1.1 Skin Preparation Solutions and Wound Dressing

The food and drug authority (FDA) approved multiple skin solutions that are efficient in reducing bacteria in the skin. The investigation conducted on the efficacy of the two studied skin preparation solutions, 0.7% available iodine in 74% alcohol and 2% chlorhexidine gluconate in 70% isopropyl alcohol, added to the existing figure of study on the effectiveness of skin solutions in reducing skin bacteria. (Savage et al. 2012: 490-4.) The usage of 2% CHG-impregnated cloths together with the implementation of a reinforced preoperative bundle such as preoperative pre-screening plan and the adoption of mupirocin, resulted in the reduction in SSIs from 3.9% to 1.9% in the spine service line. The said approach has been adopted permanently. This was determined using a quasi-experimental design by comparing pre-operative cleaning using towels impregnated with 2% chlorhexidine gluconate and the current bathing regimen using a 4% CHG solution. (Franker et al. 2021: 276-280.) The use of Mepilex® Border Post-Op (Molnlycke) was introduced for patients undergoing orthopaedic surgery as a result of a quality improvement program implemented at a metropolitan teaching hospital. The Mepilex® Border Post-Op (Molnlycke) has proven to be the most acceptable option, especially in hip and knee surgery. Thus, initiation and modification of practice reduced the incidence of SSI. (Pickles, McAllister, McCullagh, & Nieroba 2022: 100922) A randomized controlled clinical study correlating two postoperative dressings, Mepilex® Border Post-Op and Aquacel® Surgical, showed that both postoperative dressings were superior in reducing postoperative wound complications. However, in terms of physician satisfaction, pain minimization and patient comfort, Mepilex® Border Post-Op outperforms Aquacel® Surgical. (Beele, Overschelde, Olivecrona & Smet 2020: 100772.)

5.1.2 Prevention Intervention Bundle

Within the two-year span the outcome of the three-intervention titled Project JOINTS showed that implementing the three-intervention bundle of preoperative procedures has substantially reduced the frequency of infections. As a result, the methods outlined in the JOINTS project are compelling for small community hospitals to lessen the likelihood of staphylococcus aureus SSIs, avoid postoperative complications, and improve patient

well-being. The 2% CHG wipes are antiseptic cloths to wash the skin, it is used at home the night before the surgery after bathing and wait for the skin to dry before applying the three set of CHG cloths. Furthermore, preoperative screening for staphylococcus aureus is done by swabbing patients nose to determine presence of germs. If the patient tested positive the doctor will prescribe the patient with 2% mupirocin 0.25 ointment in each nostril 2 times daily prior surgery to remove MRSA to patient's nose and skin, in addition, the patient will receive additional antibiotics prior surgery. (McDonald, Clark, Landauer & Kuxhaus 2015: 182.)

In addition, for bundle interventions to be successful it requires a collaborative team effort. Comprehensive planning and formation of patient information and resources to support patient lifestyle changes and adherence to orders of physicians. Proposed and implemented methods of changes during team discussions about perioperative nursing care can be provided feedback by perioperative nurses. Perioperative teams can implement numerous evidence-based practices to avoid the progress of SSI postoperatively during routine spine surgery. The prevention of SSIs requires a solution of strategies to minimize exposure to elements that could advance infection. The combination of vancomycin prophylaxis, diluted povidone-iodine irrigation, and lastly the preoperative nasal and skin cleansing for the protection of MRSA. (Goldberg 2020: 158-164.)

5.1.3 Operating Room Foot Traffic

During an investigation, operating room door openings and elevated airborne bacterial poll had demonstrated a positive correlation. The study showed that the implementation of process resulted to less door openings. 50% reduction in phase 2 and 38% reduction in phase 3 after a 6-month follow-up. Improvement efforts in implementing interdisciplinary projects to reduce operating room traffic included communication and lunch or break reliefs, broadening of information and staff training, soliciting recommendations from operating room team members, and regulated practices. Tracking daily door openings can provide prompt feedback to analyse disorganisation. Not only does foot traffic and door openings negatively impact infection risk, tracking door opening patterns can also point out areas of day-to-day operating system inefficiency. Hence, the study recommends continuous education with periodic monitoring, developing of a pull shade design, coverage of outcomes in different meetings and the implementation of door counter system (Rovald & King 2015: 666–678.)

5.1.4 Wound Scoring

The ASEPSIS scoring method is a tool being used by surgeons and nurses, which is being used by the Greek to regularly assess surgical wounds. This scoring method is a simple instrument that is brief, and objective that is used to classify the severity of infection. The scoring method was between 0 and 10 corresponding to adequate healing, 11 to 20 indicating failure to heal, 21 to 30 corresponding to mild infection, and 31 to 40 corresponds to moderate infection and, finally, a value above 41 corresponds to severe infection. The Greek version has proven to be a valid, reliable, and most suitable method for assessing wounds in Greece. (Copanitsanou, Kechagias, Galanis, Grivas & Wilson 2019: 18–26.)

5.2 Barriers to Surgical Site Infection Prevention in Nursing Practice in Orthopaedics

5.2.1 Nursing Practices Related to External Fixator Care (Pin/Wire Sites)

The results of this study identified several different perspectives on the provision of external fixation and the prevailing absence of unity in most areas of pinpoint care in this study of Australian nurses. Guidelines used in the correlation were cleansing solutions, cleaning frequency and dressing changes, dressing type, the presence of clinically serious infection, application of pressure at the pin site, showering, removal of crusts application of compression at the pin site. Furthermore, despite extensive research and multiple Cochrane reviews on the prevention of pin-site infections, there are no other definitive studies to change external fixation care instructions. The UK consensus recommendations are therefore the best advice for building care for people with pin sites. (Campbell & Watt 2020: 100711.)

5.2.2 Nurse's Perspective and Challenges

Operating room nurses have expertise and duty for skin preparation in the operating room department, but factors both within the operating room department and within the organization can control the outcome. The use of traditional nursing practices over evidence-based practice (EBP) may compromise patient safety and increase the possibility

of wound infections. Operating room nurses struggled when faced with a clinical routine in which they were unable to discern and relate the theoretical knowledge gained in training and transform current local learning pattern into one that is EBP-oriented. It is essential to identify the gap between theory and practice. Thus, it is important for operating room nurses to understand how to utilise research as a support for clinical decision-making with the consideration of both academics and clinical practice. (Markström, Bjerså, Bachrach-Lindström, Falk-Brynhildsen & Frisman 2020: 1.)

Even with the given guidelines and agreements in the prevention and regulation of SSI, it will still be up to health professionals to establish skills that consist of openness, listening and awareness of personal accounts past the health–disease process to equip exceptional assistance for those who are readmitted for SSI and to advocate for assistance that exceeds 'knowing how to do' and achieves 'knowing how to do with sensitivity'. The studies conducted establishes us to identify the experiences of individuals who underwent orthopaedic surgery and were readmitted for SSI. Because the background is uncommon and, a sensitive side is required. The patients who are readmitted revealed that there was fear, insecurity of the unknown and frustration. Nurses felt undervalued, and they struggled with their social relationality as defective and sometimes into imminent breakdown. The duty of nurses requires an approach that acknowledges the individuals more than the carrier of disease. Active listening permits the speaker to verbalize more than what is mentioned. Hence, healthcare professionals are urged to extend their understanding of the aspects of care and assistance by improving proficiencies that recognize the distinction of experiences in the process of disease and health. (Torres, Turrini & Merighi 2017: 1011-1020.)

This study addressed the consequences of periprosthetic joint infection (PJI) on the well-being of nurses and identified three major issues. It included emotions connected to the handling of PJI and the importance of emotional assistance, indicating the negative effects on nurses, the burden on patients psychologically showing the lack of time and importance to address the mental issues of patients when the severity of PJI is realized. The result of the study provided a chance for discussion among all team members and to implement strategies that could enhance compliance. Having support from co-workers is deemed as a satisfactory strategy to cope with the negative feelings as an impact of PJI among nurses. Furthermore, the burden on patients psychologically and non-observance because of insufficient realization of the severity of PJI was established as a major factor in PJI management. Hence, the need to involve psychologists in the analysis

and implementation of methods to increase compliance and a chance to conduct professional counselling. Seeing how the nursing staff identifies the PJI management is crucial data for administrators in the health care organization in developing communication among all team members. The increase in awareness and the implementation of treatment can greatly contribute to an optimal working environment, better organizational structures, and enhanced discussions in the prevention of mental health issues within the team of nurses. (Walter et al. 2022: 190.)

6 Discussion

6.1 Discussion of Findings

The purpose of this thesis is to describe existing SSI prevention and the barriers to infection prevention in orthopaedic nursing. The aim is to produce new knowledge that could be utilised to enhance nursing practices in preventing surgical site infection in orthopaedic surgery. The results collected in this study were classified into six generic categories and subcategories.

There were four topics discussed in this research which corresponds to the first study question which is about the existing SSI prevention practices in orthopaedic nursing. These are skin preparation solutions and wound dressing, intervention prevention bundle, reducing foot traffic in the OR and wound scoring to prevent infection. These studies identified the factors in decreasing the incidence SSI due to orthopaedic surgery. Furthermore, this study showed two topics in nursing practices which translates as barriers in the prevention of SSI.

Upon studying the nursing practices relevant to the external fixator care, it identified a lack of consensus by nursing staff in Australia against the UK guidelines which is the recommended consensus in terms of nursing care of external fixators. Another topic discussed on the nursing perspective and challenges including the competencies needed to be developed in relation to caring readmitted patients due to SSI from orthopaedic procedures. A study on nurses' experiences in relation to skin preparation to prevent SSI showed that nurses faced challenges with clinical policies in which the nurses are unable to relate knowledge in theory obtained during their schooling and that there is a need to work out the theory and practice discrepancy. And finally, a study on negative impact on nursing staff in the management of PJI comprises the barriers in the prevention of SSI

resulting from orthopaedic surgeries. These findings are significant in recognizing the current prevention practices and to discover areas in nursing practices which could still be enhanced and develop to aid in the prevention of SSI in orthopaedic surgery.

6.2 Ethics and Validity

Research findings must ensure the process of trustworthiness of each investigation and must demonstrate the value of validity and reliability. If the research is applicable, it is necessary to abstain misleading those who use it. If an institution chooses to change one treatment with more safe and more accurate management, then administrators, healthcare professionals, and clients can justifiably anticipate the verdict to be based on valuable, instead of unsatisfactory, evidence. Trustworthiness of the study depends on various research factors: the initial research question, the process of data collection that includes when and from whom, the method of analysis, and the acquired outcomes. (Roberts, Priest & Traynor 2006.)

Ethics in practice refers to ethical matters which occur in the everyday condition of conducting a research study. This could be viewed as an ethical or professional code of conduct. (Moriña 2021.) Valid research determines whether it legitimately measures what is engaged to be executed or how factual the results of research results. In other statement, does the study tool provide approval you to achieve "the bull's eye" of your research object? In general, to determine the validity, the researchers obtain a tabulation of questions and will frequently review for the response of the others research. (Golafshani 2003.) Validity is generally defined, depending on the degree to which an instrument measures what it aims to measure (Kimberlin & Winterstein 2008: 2278).

In Accordance with the Finnish National Board on Research Integrity, its mandate is to ensure the trustworthiness and the ethical reliability consideration of this study, the Responsible Conduct of Research Guidelines were implemented which is appointed aside with the Ministry of Education and Culture in Finland. (Tenk 2021). The core values were adhered in good ethical research with highlights in honesty, accuracy in every phase of research, and going through different research and taking notes of the results. The research process was meticulously utilised ethically with proven data collection methods. All throughout, the authenticity and reliability of the communication for the entire process were maintained. Ensuring that the authors was acknowledge by citing their names in

the references. As this is considered a literature review purpose, the need for consent is unnecessary.

The search terms used to access the data results were consulted with the Metropolia informatician. The final twelve articles were selected to ensure that the two research questions were answered. The data analysis showed eight articles answered the first research question and four articles discussed the second research question. Three articles were taken from CINAHL and four articles from PubMed. However, three articles out of PubMed can also be found in CINAHL. While eight articles were found through manual search. This literature review has its limitations. Reviewed articles does not include the following criteria; perioperative, intraoperative, postoperative type of other surgeries, studies earlier than 2012 and articles published in non-academic journals, thesis works and systematic reviews. Moreover, the word "prevention" was not counted in the search terms as recommended by Metropolia informatician. In line with this, adequate number of articles was notably found.

6.3 Conclusion and Recommendation

Unprevented surgical site infection resulting from orthopaedic surgery increases morbidity, extended hospital inpatient stays and economic burden in both patient and healthcare organizations. Hence, the need to have prevention measures to lessen the incidence of SSI and the implementation of effective nursing practices to ease the burden caused by SSI. While there were various methods established in the prevention of SSI, it still occurs.

The articles used in this study discussed topics on the established nursing practices to prevent SSI. The implementation of preoperative bundle such as preoperative screening program and use of mupirocin together with 2% CHG-impregnated cloths showed a reduction in SSIs. Effective skin preparation solutions to reduce bacteria on the skin as well as wound management to prevent complications will ultimately avoid SSI. ASEPSIS, an acceptable wound scoring method, is used to assess surgical wounds and is the most reliable assessment method in Greece. The reduction of foot traffic and OR door openings were also discussed as there was a beneficial correlation between door openings in the operating room and elevated number of airborne bacteria. The tracking of door openings and evaluation of foot traffic can provide an environment with a lesser risk of

infection. Additionally, it can also deliver prompt feedback to analyse incompetence in the daily health organizational system.

However, further studies showed that there are still areas of concern and opportunities for improvement in terms of nursing perspective and practices. Nurses who are caring for patients who undergo orthopaedic surgery must develop competencies such as openness, quality listening, comprehension of patient's experiences and promote care that transcends knowing what to do. There is also a need to solve the mismatch between theory and practise as operating nurses have the tendency to use tradition-based practices instead of evidence-based practices which could imperil the safety of patient and upsurge the risk of SSI. Planning, implementation, and monitoring of process changes should be done properly by the hospital administrators to ensure that compliance is observed and there is a consensus in terms of level of practices.

Perioperative nurses should be able to identify barriers and must have active participation in the implementation of process changes in the organization with the aim of reducing or possibly eliminating the incidence of SSI. Each member of the OR team should help ensure compliance of prevention bundle and they must be able to speak up when they observe non-compliance among the team members. OR administrators should be able to provide further training and education to all OR team members on the importance of a well-managed environment in OR and the relation to patient safety and control of infection. Ultimately, SSI prevention involves the participation of all OR team members and is a shared responsibility. It requires extensive planning coupled with monitoring, active collaboration among perioperative team members and implementation of evidence-based practices.

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Appendix

Appendix 1. Table 1. Summary of Reviewed Articles

AUTHOR(S) YEAR, COUNTRY	TOPIC (PURPOSE/AIM) OF THE RESEARCH	METHODOLOGY	PARTICIPANTS	MAIN OUTCOMES
<p>Article 1</p> <p>Savage, JW. et al., 2012 USA</p>	<p>Efficacy of surgical preparation solutions in lumbar spine surgery</p> <p>Evaluation of the two skin preparation solutions in the lumbar area.</p>	<p>Qualitative</p> <p>Quasi-experimental study.</p>	<p>Patients scheduled for elective lumbar surgery</p> <p>N=100</p>	<p>The study shows that both skin preparation solutions were adequate and is believed that the study adds to the existing practices and suggests that there are multiple skin solutions that are effective in reducing bacteria on the skin.</p>
<p>Article 2</p> <p>McDonald, L.T., Clark, A.M., Landauer, A.K. & Kuxhaus, L., 2015, USA</p>	<p>Winning the war on surgical site infection: evidence-based preoperative interventions for total joint arthroplasty.</p> <p>Assisting facilities in reducing S aureus infections after total joint arthroplasty</p>	<p>Quantitative</p> <p>Retrospective chart review</p>	<p>Total joint arthroplasty patients</p> <p>N=305</p>	<p>The study result shows that three bundle intervention decreased the percentage of infection. JOINTS protocol is an effective way for small community hospitals to cut down the risk of SSIs, to avoid postoperative complications, and to improve patient satisfaction.</p>
<p>Article 3</p> <p>Rovaldi, C. J., & King, P. J., 2015, USA</p>	<p>The Effect of an Interdisciplinary QI Project to Reduce OR Foot Traffic.</p> <p>To assess the effect of process interventions on reducing OR door openings and, by extension, surgical site infections.</p>	<p>Quantitative</p> <p>Observational</p>	<p>Patients who undergo Hip and Knee Procedures</p> <p>N=102</p>	<p>The study found positive interaction between OR door openings and elevated airborne bacterial counts. It also showed that the implementation of process change achieved a downgrading in door openings. 50% reduction in phase 2 and 38% reduction in phase 3 after a 6-month follow-up.</p>

<p>Article 4</p> <p>Torres, L.M., Turrini, R.N.T. and Merighi, M.A.B., 2017, Brazil</p>	<p>Patient readmission for orthopaedic surgical site infection: an hermeneutic phenomenological approach</p> <p>To explore the individual experience of being readmitted for surgical site infection resulting from orthopaedic surgery.</p>	<p>Qualitative</p> <p>Face to face non-structured interview</p>	<p>Patients readmitted N=11</p>	<p>The study showed that healthcare professionals are urged to expand their knowledge in the aspect of care by developing expertise that considers the subjectivity of experiences of the health–disease process. Nursing responsibility requires an approach that considers the patient as more than a bearer of disability and should not be limited to what is described and prescribed.</p>
<p>Article 5</p> <p>Copanitsanou, P., Kechagias, V. A., Galanis, P., Grivas, T. B., & Wilson, P. 2019, Greece</p>	<p>Translation and validation of the Greek version of the "ASEPSIS" scoring method for orthopaedic wound infections.</p> <p>To translate and validate the ASEPSIS in Greek.</p>	<p>Quantitative</p> <p>Survey and interview</p>	<p>Orthopaedic patients N=111</p>	<p>The study result of ASEPSIS scoring used by doctors and nurse by the Greek was an effective tool to determine postoperative wound scoring. It is an objective, concise and straightforward instrument. This tool should be used with attention until more studies are aimed with larger cases and in patients with different surgical procedures.</p>
<p>Article 6</p> <p>Beele, H., Van Overschelde, P., Olivecrona, C., & Smet, S. 2020, Sweden</p>	<p>A prospective randomized controlled clinical investigation comparing two post-operative wound dressings used after elective hip and knee replacement; Mepilex® Border Post-Op versus Aquacel® surgical</p> <p>To compare two post-operative wound dressings.</p>	<p>Randomized, controlled, multicenter study</p> <p>Controlled trial</p>	<p>Patients were enrolled into the study N=113</p>	<p>The study resulted that both operative wound dressing achieves well in terms of reducing postoperative problems in hip and knee arthroplasty. The Mepilex border exceeds Aquacel® Surgical.</p>

<p>Article 7 Campbell, F., & Watt, E. 2020, Australia</p>	<p>An exploration of nursing practices related to care of orthopaedic external fixators (pin/wire sites) in the Australian context</p> <p>To investigate the nursing practices related to care of orthopaedic external fixators.</p>	<p>Non-experimental descriptive quantitative design</p> <p>On-line questionnaire</p>	<p>Australian nurses N=200</p>	<p>The study resulted in a different range of opinions on the provision of external fixator care. Thus concludes a general lack of unanimity in most areas of pin site care in this sample of Australian nurses. UK results indicated that the guidelines are not being used to inform clinical practice in most areas of external fixator care.</p>
<p>Article 8 Goldberg, L. 2020, USA</p>	<p>Developing a Surgical Site Infection Prevention Bundle for Patients Undergoing Elective Spine Surgery</p> <p>To promote improved safety for patients undergoing elective spine surgery.</p>	<p>Qualitative</p> <p>Prospective analysis</p>	<p>Patients who underwent spine surgery N=1000</p>	<p>The study concluded that prevention SSIs requires a combination of strategies. Progress of standardized bundles also may include an interdisciplinary literature review, intervention discussion, and bundle design agreement. When participating on interdisciplinary teams for bundle development or performance for patient care.</p>
<p>Article 9 Markström I, Bjerså K, Bachrach-Lindström M, Falk-Brynhildsen K, Hollman Frisman G. 2020, Sweden</p>	<p>Operating room nurses' experiences of skin preparation in connection with orthopaedic surgery: A focus group study.</p> <p>To deepen the understanding of skin preparation within an orthopaedic surgical setting from the operating room nurse.</p>	<p>Qualitative</p> <p>Focus group interviews</p>	<p>Operating room nurses N=19</p>	<p>The study resulted in current information about conditions of the conduct of skin preparation. Theory and practice contradict, and some skin preparation used are based on tradition rather than on evidence or suggestions. Elements both within the team in the operating room and within the organization influence the result.</p>

<p>Article 10 Franker, L. et al, 2021, USA</p>	<p>Preoperative Prevention of Surgical-Site Infection in Spine Surgery</p> <p>The focus of this study is to determine whether cleansing with 2% CHG-impregnated cloths versus current practice of bathing with 4% CHG solution preoperatively would reduce SSIs.</p>	<p>Quantitative</p> <p>Pilot quasi-experimental design</p>	<p>Preintervention patients N=51</p> <p>Postintervention patients N=54</p>	<p>The study showed a reduction in SSIs from 3.9% to 1.9% with use of 2% CHG-impregnated cloths. There was no compelling difference found amid the use of 2% CHG-impregnated cloths and 4% CHG solution. This enhancement change, combined with a strengthened preoperative bundle approach, has permanently been different within the spine service line which resulted to zero SSIs from October 2017 to March 2021.</p>
<p>Article 11 Pickles, S., McAllister, E., McCullagh, G., & Nieroba, T.-J. 2022, Australia</p>	<p>Quality improvement evaluation of postoperative wound dressings in orthopaedic patients.</p> <p>To describe the evaluation of different postoperative dressings in use within the orthopaedic department of a tertiary hospital.</p>	<p>Qualitative</p> <p>Survey forms</p>	<p>Orthopaedic patients. N= 307</p>	<p>The study resulted in a new protocol of care at the major metropolitan teaching hospital has been implemented. For patients undergoing orthopaedic surgery, Mepilex® Border Post-Op (Molnlycke) is routinely applied in theatre and is left intact for 7 days as per the manufacturer's instructions. This change in practice and the introduction of Mepilex® Border Post-Op, the incidence of SSIs at this hospital has reduced.</p>
<p>Article 12 Walter, N. et al, 2022, Germany</p>	<p>Managing periprosthetic joint infection—a qualitative analysis of nursing staffs' experiences</p> <p>The purpose was aimed at investigating the impact of periprosthetic joint infection.</p>	<p>Qualitative</p> <p>Purposive sampling strategy</p>	<p>German university orthopedic trauma nurses N=20</p>	<p>The study concluded three considerable divisions that could be extracted these includes, the need for emotional support, illustrating the negative emotional impact on nurses, receiving collegial support was perceived as an important coping strategy, and lastly highlighting the nurses lack of time to address mental issues adequately and realization of the severity of PJI and compliance problems.</p>