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REVIEW ARTICLE

Surgical site infection in patients undergoing elective orthopedic surgeries: an integrative review

Infección del sitio quirúrgico en pacientes sometidos a cirugías ortopédicas electivas: una revisión integradora

Infecção de sítio cirúrgico em pacientes submetidos a cirurgias ortopédicas eletivas: uma revisão integrativa

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Abstract

The aim was to survey the main risk factors associated with surgical site infection in patients undergoing elective orthopedic surgeries in the literature. This is an integrative review whose bibliographic survey was carried out through the virtual health library portal and PubMed. The inclusion criteria were primary studies in Portuguese, English, and Spanish, published in the last 5 years, and patients aged 18 years old or older. The exclusion criteria were reflection articles, research protocols, editorials, conference abstracts, dissertations, theses, and letters. Only ten studies met the criteria. The risk factors identified: were high body mass index, diabetes mellitus, decreased albumin level, high neutrophil count, smoking, advanced age, male gender, preoperative stay and prolonged surgical time. The pathogens were identified, Methicillin-resistant Staphylococcus aureus, followed by methicillin-sensitive Staphylococcus aureus and Pseudomonas aeruginosa. The studies highlighted the main associated risk factors, related to the patient for the development of the infection. The importance of evidence-based practice and continuing education actions is highlighted, as well as the need for quality protocols for prevention and infection control.

Descriptors: Postoperative Complications; Risk Factors; Surgical Wound Infection; Nosocomial Infection; Orthopedic Procedures.

Resumén

El objetivo fue relevar los principales factores de riesgo asociados con la infección del sitio quirúrgico en pacientes sometidos a cirugías ortopédicas electivas en la literatura. Se trata de una revisión integradora cuyo levantamiento bibliográfico se realizó a través del portal de la biblioteca virtual en salud y PubMed. Los criterios de inclusión fueron: estudios primarios en portugués, inglés y español, publicados en los últimos 5 años y pacientes con edad igual o mayor a 18 años. Los criterios de exclusión fueron: artículos de reflexión, protocolos de investigación, editoriales, resúmenes de congresos, disertaciones, tesis y cartas al lector. Sólo diez estudios cumplieron los criterios. Los factores de riesgo identificados: índice de masa corporal elevado, diabetes mellitus, nivel disminuido de albúmina, recuento elevado de neutrófilos, tabaquismo, edad avanzada, sexo masculino, estancia preoperatoria y tiempo quirúrgico prolongado. Los patógenos identificados fueron Staphylococcus aureus resistente a la meticilina, seguido de Staphylococcus aureus sensible a la meticilina y Pseudomonas aeruginosa. Los estudios resaltaron los principales factores de riesgo asociados, relacionados con el paciente para el desarrollo de la infección. Se destaca la importancia de la práctica basada en evidencia y acciones de educación continua, así como la necesidad de protocolos de calidad para la prevención y control de la infección.

Descriptores: Complicaciones Postoperatorias; Factores de Riesgo; Infección de Heridas Quirúrgicas; Infección Nosocomial; Procedimientos Ortopédicos.

Resumo

Objetivou-se levantar na literatura os principais fatores de risco associados a infecção de sítio cirúrgico em pacientes submetidos a cirurgias ortopédicas eletivas. Trata-se de uma revisão integrativa cujo levantamento bibliográfico realizado pelo portal da biblioteca virtual em saúde e PubMed. Os critérios de inclusão foram: estudos primários nos idiomas português, inglês e espanhol, publicados nos últimos 5 anos e pacientes com idade igual ou maior a 18 anos. Os critérios de exclusão foram: artigos de reflexão, protocolos de pesquisa, editoriais, resumos de congresso, dissertações, teses e cartas ao leitor. Apenas dez estudos atenderam aos critérios. Os fatores de risco identificados: índice de massa corporal elevado, diabetes mellitus, nível de albumina diminuído, contagem elevada de neutrófilos, tabagismo, idade avançada, gênero masculino, permanência pré-operatória e tempo cirúrgico prolongado. Identificados os patógenos, Staphylococcus aureus resistente à meticilina, seguido por Staphylococcus aureus sensível à meticilina e Pseudomonas aeruginosa. Os estudos evidenciaram os principais fatores de risco associados, relacionados ao paciente para o desenvolvimento da infecção. Ressalta-se a importância da prática baseada em evidências e de ações em educação permanente, como também, a necessidade de protocolos de qualidade para a prevenção e controle da infecção.

Descritores: Complicações Pós-Operatórias; Fatores de Risco; Infecção da Ferida Cirúrgica; Infecção Hospitalar; Procedimentos Ortopédicos.

Introduction

In Brazil, every citizen has the right to healthcare offered through the Unified Health System (SUS) and to receive dignified, appropriate, and safe care. However, during the healthcare provided to the patient, adverse events sometimes occur that put the patient and professionals' safety at risk. One of these damages is healthcare-associated infections (HAIs), previously known as hospital infections[1].

The Ministry of Health (MS), through Ordinance No. 2,616/98, defines HAIs as infections acquired 72 hours after the patient's admission to the hospital, if the incubation period of the microorganism is unknown and without evidence clinical or laboratory. That manifests itself during hospitalization or after discharge if it is related to hospitalization or hospital procedures[2].

As a result, for the control and prevention of HAIs, institutions must implement what is determined by Ordinance No. 2,616/98 of the Ministry of Health, which establishes the establishment of a Hospital Infection Control Commission (CCIH), whose responsibilities are: review of care practices, isolation measures and precautions to avoid communicable diseases, standards for health professionals, ongoing education of professionals and educational actions[2].

To form the CCIH, professionals must be from the health sector, have a higher education level, and be formally designated. At CCIH, there are two types of members: consultants and executors. Consultant members are professionals who work in sectors such as medicine, nursing, pharmacy, microbiology laboratory, and administration, being responsible for the development of recommendations and protocols related to the prevention of HAIs[3].

Similarly, the executing members of the CCIH represent the Hospital Infection Control Service (SCIH), with at least 2 higher-level health technicians for every 200 beds or a fraction of that number with a minimum daily workload of 6 hours for the nurse, and 4 hours for other professionals who work in planned actions to train teams, to prevent and avoid the spread of HAIs[3].

Furthermore, still thinking about the containment of IRAS, through RDC No. 36, of July 25, 2013, the Patient Safety Center (NSP) was implemented, to institute actions to promote the safety of the patient and improve the quality of health services, seeking to prevent and reduce incidents/accidents. The NSP is made up of a multidisciplinary team. This entire strategy is aimed at the best possible results for the patient[4].

For surveillance and monitoring purposes, HAIs are classified into four main types: primary bloodstream infection (SCI), ventilation-related infection or pneumonia (VAP), urinary tract infection (UTI), and surgical site infection (SSI)[5].

IPCS are infections with serious systemic consequences, including sepsis, without an identifiable primary focus and associated with the prolonged use of venous or arterial catheters. VAP can appear between 48 and 72 hours after endotracheal intubation or when using a tracheostomy tube. UTI is related to urological procedures and may or may not be associated with the length of stay of the indwelling bladder catheter[6].

SSIs represent complications that persist over the years due to their persistent incidence and can result in physical, social, and psychological damage. Among the most frequent adverse events arising from healthcare, the impact of this complication directly reflects on patient safety and, in turn, on financial costs for the healthcare system in Brazil, which gain prominence given these repercussions[7].

According to data from the World Health Organization (WHO), it is estimated that 234 million patients undergo surgery each year around the world. Of which, approximately one million die because of hospital infections and seven million have postoperative complications, in which SSI are considered the most common complications, and are therefore understood as a serious problem for public health. In Brazil, SSI is the third largest cause of infection in healthcare services and affects approximately 14% to 16% of patients – with 5% to 10% of cases resulting in death[5,6].

Since they result in serious physical, psychological and financial losses to affected patients, they are responsible for an increase in hospital stays of an average of seven to eleven days and, consequently, increase healthcare costs with antimicrobial treatment, exams, and dressings, which can lead to US $1.6 billion annually. Constituting a serious problem for health institutions. Its development occurs in the first 30 days following surgery (the 1st day being the date of the procedure) or up to 90 days post-surgery, whether implants are used[5,8].

The National Health Surveillance Agency (ANVISA), as of 2017, considers SSI as clinical manifestations occurring in the first 30 days of surgery, or up to 90 days (whether implants are used); except in cases of contamination with Fast-Growing Mycobacterium (MCR), when 24 months are considered. Before these changes, clinical manifestations within 30 days of surgery, or up to 12 months, whether implants were used, were considered SSI[9].

According to the Centers for Disease Control and Prevention (2017), SSIs can be classified into three types: superficial incisional infection that only affects the skin and subcutaneous tissue; deep incisional infection, in which soft tissues deep within the incision (fascia and muscles) are affected; and infection of organs or cavities that were opened or manipulated during the surgical procedure[5].

In this context, orthopedic surgeries are understood as procedures aimed at partial or total correction of fractures, deformities in joints, ligaments, muscles, and bones, caused by poor body positioning, trauma, or other diseases. They are defined as clean surgeries, performed on sterile tissues, free from contamination and infection, elective, with the primary intention of healing, without penetration into the digestive, respiratory, or urinary tract[5].

Currently, orthopedic surgeries have increased in the country, causing concern, as implants are generally used in these surgeries to enable realignment, stabilization, bone synthesis, and joint replacement, increasing the risk of SSI. Authors point out in a study that the occurrence of orthopedic SSI varies from 1.4 to 40.3%[10].

In a study, 98 medical records with 107 orthopedic surgeries were evaluated, of which 63.2% used orthopedic implants, which progressed to SSI. Furthermore, in discussing the results with 6,123 patients who underwent orthopedic surgeries, they indicated a 2.0% overall incidence of SSI, on the other hand, studies found an occurrence rate of 1.8%[9,10].

The incidence of orthopedics-related SSI occurs due to several causes and depends on intrinsic and extrinsic factors. The intrinsic factor is related to the patient's clinical conditions, such as extremes of age; surgical risk classification, according to the American Society of Anesthesiologists (ASA), greater than or equal to two; obesity; smoking; diabetes mellitus; presence of another infection at the time of surgery, which increases the chance of infection by six times; immunosuppressive therapy such as chemotherapy and radiotherapy; and even use of steroids that can compromise this immune response, among others[11].

On the other hand, extrinsic factors refer to the external environment – in this case, the procedure – such as the complexity of the surgery; approach technique; surgery time; antibiotic prophylaxis at the right dose and at the right time; control of air temperature and the number of people in the operating room; failures in surgical hand antisepsis and team clothing; inadequate performance of trichotomy and skin preparation at the incision site. These are risk factors that increase the chances of infections[11].

The manifested signs and symptoms generally depend on the infectious agent that colonizes the region. Among the bacteria that cause nosocomial infections, Staphylococcus aureus, Enterococcus, and coagulase-negative Staphylococcus (SCN) stand out in the Gram-positive group, being the main pathogens found in culture media, followed by contamination of Gram-negative bacilli: Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, and Acinetobacter baumanni[12].

Clinically, the main characteristic of an infected surgical wound is the drainage of purulent secretion, and this sign is considered the gold standard for its diagnosis. Normally, it is also accompanied by a foul odor and impairment of the patient's general condition. In addition, classic phlogistic signs appear, such as pain, local heat, hyperemia, flushing, loss of function, and systemic signs such as fever[13].

It is also worth noting that these signs and symptoms are not presented completely, since edema and erythema can be common after the surgical procedure. Other damages to the patient caused by SSI are opening of the surgical wound, violaceous blisters, hypertrophic scars, deformity, necrotizing fasciitis, and loss of a limb, among others[14].

The ANVISA establishes specific diagnostic criteria for the classification of SSIs, based on the following signs or symptoms: purulent drainage from the incision, positive secretion or tissue culture, spontaneous dehiscence, abscess, fever (≥ 38 degrees), localized pain or swelling. This diagnosis is made by the surgeon or other attending physician[5].

In addition to resulting in serious complications, as previously mentioned, SSIs increase financial costs for the health system with treatments, and prolonged hospitalization time of an average of seven to eleven days, causing chances of hospital readmission and additional surgeries. This also has repercussions on physical limitations that affect the patient's quality of life, and withdrawal from social life, work, and family, which are causes of morbidity and mortality. It is estimated that 60% of cases can be avoided through the application of guidance and prevention measures recommended in guidelines and manuals[13].

With the aim of prevention, international and national associations such as the World Health Organization (WHO) and ANVISA, have publicized and reinforced the import of methods of compliance to good practices aimed at patient safety and prevention of SSI, through manuals, guidelines, and updates related to the topic. The objective is to standardize conduct, thus contributing to strengthening the work of the entire multidisciplinary team, benefiting the patient who has undergone surgery[15].

In this sense, with the aim of improving surgical patient care, preventing SSI and ensuring safe assistance when carrying out surgical procedures, the WHO created the Surgical Safety Checklist (LVSC), a known method to systematically minimize the occurrence of harm to the patient. The implementation of the checklist seeks to meet international safety goals and guarantee the quality of care, covering the entire perioperative period[16].

The checklist has important markers that draw the multidisciplinary team's attention to small actions, failures of which can trigger serious complications in patient care. This instrument has information ranging from patient identification, procedure to be performed, place to be operated, identification of allergies, among other measures, to establish safe assistance, free from adverse events or failures, such as changing the patient or of the site to be operated, as well as forgotten surgical instruments or compresses inside the manipulated cavity[15].

Given the above, the role of the nurse is centered on care, being a professional who has technical skills and scientific knowledge to provide dignified, appropriate, and safe assistance to the patient according to their real needs, aiming at the prevention and control of HAIs[17].

Perioperative nursing care prioritizes reducing factors related to the operating room environment, the post-anesthesia recovery room (PAR), the use of materials and equipment necessary to carry out surgical procedures, in a planned and systematized manner. Currently, nursing uses the Systematization of Perioperative Nursing Care (SAEP), to offer the patient specialized, individualized, and humanized care[16].

Furthermore, SAEP enables the identification of diagnoses, nursing interventions and the recognition of basic human needs that affect surgical patients, enabling nurses to offer planned assistance based on practices based on scientific evidence. This instrument is in conjunction with the multidisciplinary team, to promote patient safety, control asepsis and, consequently, reduce infection rates[17].

For the surgical procedure to be carried out with a view to patient safety with a focus on preventing SSI, preventive measures are related to the surgical periods. In the preoperative period, there must be smoking cessation and glycemic control. Related to the procedure are trichotomy, bathing, skin preparation and hand hygiene of the surgical team. Intraoperatively, there is adequate surgical attire and temperature control in the operating room. Post-operative care includes wound dressing and discharge planning[16].

It is worth noting that these hygiene and organization measures in hospitals are emphasized by nursing pioneer Florence Nightingale, who contributed significantly to the drop in infections in her time, which has repercussions today[17].

As already mentioned, according to data from the World Health Organization (WHO), it is estimated that 234 million patients undergo surgery each year around the world. Of which, one million die because of hospital infections and seven million have post-operative complications, in which SSIs are considered the most common complications, representing a serious problem for public health. In Brazil, SSI is the 3rd largest cause of infection in healthcare services and affects approximately 14% to 16% of patients – with 5% to 10% of cases resulting in death[5,6].

This study arose from the need to identify the risk factors associated with the development of SSI in elective orthopedic surgeries, as they result in serious physical, psychological and financial losses for affected patients. In addition to being responsible for an increase in hospital stays of an average of seven to eleven days, they consequently increase healthcare costs with antimicrobial treatment, exams and dressings, potentially reaching US$1.6 billion annually[8].

The identification of risk factors for the occurrence of SSI can help nurses clearly understand the extrinsic and intrinsic factors that predispose to the development of SSI in patients undergoing orthopedic surgery and based on this, study prevention and treatment strategies.

The objective was to collect scientific evidence in the literature on the main risk factors associated with the development of surgical site infections in patients undergoing elective orthopedic surgeries. To guide the integrative review, the following guiding question was formulated: "What are the main risk factors associated with the development of surgical site infections in patients undergoing elective orthopedic surgeries?".

Methodology

The study refers to an integrative review, which is qualified as a search and findings of existing studies, developed using methodologies available in different sources, offering researchers the synthesis and extraction of results without affecting the reference of the studies covered and used[18].

This literature review was developed in accordance with the purposes of Evidence-Based Practice (EBP) and is based on a rigorous process of synthesis of the researched reality[19].

This integrative review was conducted through six stages in agreement with some authors, namely: 1st stage: identification of the theme and selection of the research question; 2nd stage: establishment of inclusion and exclusion criteria; 3rd stage: identification of pre-selected and selected studies; 4th stage: categorization of selected studies; 5th stage: analysis and interpretation of results; 6th stage: presentation of the review/synthesis of knowledge[19].

In the 1st stage, the theme was designated and the research problem was chosen to prepare this integrative review. The topic covered was: "Surgical site infection in patients undergoing elective orthopedic surgeries", related to the need to identify the factors associated with the development of this complication that needed to be known or revealed.

The guiding question was prepared based on the PICo strategy[20], which represents an acronym for Patient, Intervention and Context, where the "P", classified as a problem or clinical situation, in the present study, corresponded to the surgical patient; "I", which classifies the intervention, are the main risk factors associated with surgical site infection; "Co", which corresponds to the context, was related to surgical site infection (Chart 1).

Chart 1. PICo Strategy. Uberaba, MG, Brazil, 2022

Acronym	Definition	Description
P	Patient or problem	Surgical patient
I	Intervention	Associated risk factors
Co	Context	Surgical site infection

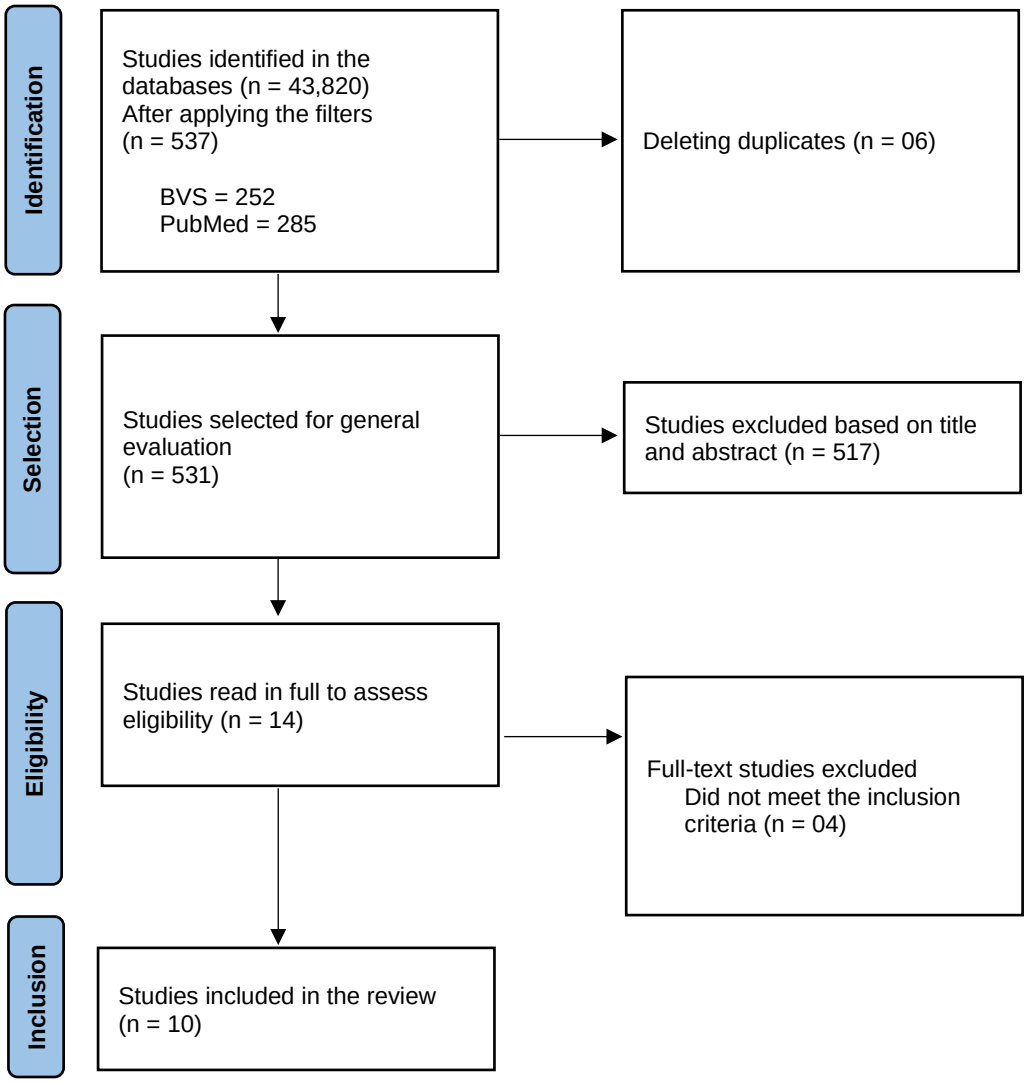
In the 2nd stage, measures were defined for the selection of sampling studies or literature searches. The survey of scientific bibliography took place from August to October 2022, with a search being carried out in the following online databases: Latin American and Caribbean Literature in Health Sciences (LILACS) and Nursing Databases (BDENF), found on the Virtual Health Library (VHL) portal and the PubMed portal.

Among the terms combined and used in the databases to guide the search, according to the Health Sciences Descriptors (DeCS) and the Medical Subject Headings (MeSH), the following controlled descriptors in Portuguese were selected: fatores de risco, infecção da ferida cirúrgica e procedimentos ortopédicos. The descriptors in English were risk factors, surgical wound infection and orthopedic procedures. The descriptors in Spanish were factores de riesgo, infección del patrimonio quirúrgico y procedimientos ortopédicos. The uncontrolled descriptors in Portuguese were fator de risco, infecção de sítio cirúrgico e ligamentoplastia. Os descritores não controlados em inglês foram: risk factors, surgical wound infection e orthopedic procedures. The uncontrolled descriptors in Spanish were: factores de riesgo, infección de herida operatoria e cirugía ortopédica. In addition to the descriptors, delimiters or Boolean Operators were used as a

search filter, represented by the connecting terms "AND" and "OR".

The study inclusion criteria were primary studies in Portuguese, English, and Spanish, published in the last 5 years, which address elective orthopedic surgeries with complications of surgical site infection and their risk factors in patients aged 18 or over years. Reflection articles, research protocols, editorials, conference abstracts, dissertations, theses, and letters to the reader were excluded from the research.

Figure 1. Flowchart of the primary studies selection process. Uberaba, MG, Brazil, 2022



The 3rd stage of the method consists of defining the information that was extracted from the studies selected in the previous stage. The abstracts of the selected articles were read. The information obtained was materialized using a data collection form that ensured that all relevant data was extracted from the selected articles, serving as a record for checking information, as well as reducing transcription errors. To extract information from the selected studies, an adaptation of the form validated in a previous study was used.[21]. This form includes the following items: identification of the original article, year of publication, scientific journal, methodological characteristics of the study and summary of the results found.

The 4th stage consisted of data analysis from the selected studies. This analysis was carried out critically, evaluating the methodological quality, relevance of information and representativeness of these articles[19].

The 5th stage continued with the discussion of the results, making it necessary to compare the data presented in some studies[19]. There was an interpretation and discussion of the main results, highlighting the main risk factors associated with surgical site infection in adults undergoing elective orthopedic surgeries described in the selected scientific studies.

The 6th and final stage consisted of presenting the integrative review with clear, complete, pertinent, and detailed information, without any omission of results, allowing the reader to evaluate the coherence of the study and contributing to future studies[19].

Regarding ethical aspects, it is worth noting that, in all articles used in the study, the authors and their respective years of publication were duly referenced, respecting their key ideas, without necessarily making literal citations.

Results

A total of 43,820 articles were identified in the electronic search through the databases, LILACS (Latin American and Caribbean Literature in Health Sciences) and BDENF (Nursing Database), found on the Virtual Health Library portal (VHL) and the PubMed portal. After applying the filters, 537 articles were found, 252 articles from the VHL and 285 from PubMed. 10 studies were selected that met the inclusion criteria, one published in 2017, four in 2018, two in 2019, two in 2020, and one in 2021.

Below is a summary of each of the selected studies, containing information such as identification of the primary study, objective(s), as well as the main results and conclusions.

Chart 2. Summary of selected studies. Uberaba, MG, Brazil, 2022

Study Number	**1**	**Journal**	**Journal of Orthopaedic Surgery and Research, v. 15, n. 1, pág. 1-8, 2020.**	**Year**	**2020**
Authors	Meng, J.; Zhu, Y.; Li, Y.; Sun, T.; Zhang, F.; Qin, S.; Zhao, H[22].				
Title	Incidence and risk factors for surgical site infection following elective foot and ankle surgery: a retrospective study				
Objective	Investigate the incidence of surgical site infection (SSI) in elective foot and ankle surgeries and identify associated risk factors.				
Main results	The sample consisted of 1,201 patients undergoing 1,259 elective foot/ankle surgeries, of which 26 (2.1%) had SSI, representing an incidence rate of 1.3% for superficial SSI and 0.8% for deep SSI, respectively. Microorganism culture results showed Pseudomonas aeruginosa in seven cases, Methicillin-resistant Staphylococcus aureus in six, methicillin-sensitive Staphylococcus aureus in five, Methicillin-resistant coagulase-negative Staphylococcus in two, Escherichia coli in two, and Proteus mirabilis in one case. Five factors were identified as independently associated with SSI, including prolonged preoperative length of stay, allograft or bone substitute, elevated fasting blood glucose level, low albumin levels, and abnormal neutrophil count.				
Conclusion	SSI after elective foot and ankle surgeries is low, but relatively high in forefoot surgeries, requiring special attention in clinical practice. Although most are not modifiable, these identified factors assist in assessing SSI risk and stratifying patients and therefore should be kept in mind during the perioperative period.				
Study Number	**2**	**Journal**	**Medicine, v. 97, n. 7 de 2018.**	**Year**	**2018**
Authors	Su, Y.; Wang, H.; Tang, Y.; Zhao, H.; Qin, S.; Xu, L.; Xia, Z.; Zhang, F[23].				
Title	Incidence and risk factors for surgical site infection after open reduction and internal fixation of ankle fracture: a retrospective multicenter study				
Objective	Determine the incidence and risk factors for surgical site infection (SSI) after open reduction and internal fixation (ORIF) of ankle fracture.				
Main results	The sample consisted of 1,510 patients (843 men, 667 women). SSI occurred in 34 of 843 men (4.03%) and 32 of 667 women (4.80%). Factors related to the occurrence of SSI were investigated by univariate analysis and then by multivariate analysis. During hospitalization, 4.37% (66/1511) of patients developed SSI, being deep in 1.32% (20/1510) and superficial in 3.05% (46/1510). The most common causative agent was polymicrobial (causing approximately half of all SSIs), followed by Methicillin-resistant Staphylococcus aureus. Multivariate analysis revealed that significant risk factors for the occurrence of SSI were open injury, advanced age, high-impact injury, surgeon experience, higher BMI, chronic heart disease, history of allergy, and preoperative neutrophil count > 75%.				
Conclusion	The identification of these risk factors can be of great importance in the risk-benefit analysis of prophylaxis before surgery and the implementation of appropriate preventive measures. Furthermore, the results could be used when counseling patients and their families.				
Study Number	**3**	**Journal**	**International Wound Journal, v. 16, n. 3, pág. 773-780, 2019.**	**Year**	**2019**
Authors	Liang, Z.; Rong, K.; Gu, W.; Yu, X.; Fang, R.; Deng, Y.; Lu, L[24].				
Title	Surgical site infection following elective orthopaedic surgeries in geriatric patients: Incidence and associated risk factors				

Objective	Investigate the incidence of surgical site infection (SSI) after geriatric elective orthopedic surgeries and identify associated risk factors.				
Main results	The sample consisted of 4,818 patients undergoing elective orthopedic surgeries. One year postoperatively, SSI occurred in 74 patients (n=1.5%). The diagnosis of SSI occurred during hospitalization in 64.9% (48/74) of patients and 35.1% (26/74) upon hospital readmission, 0.4% for deep infection and 1.1% for superficial infection. Staphylococcus aureus (25/47, 53.2%) and coagulase-negative Staphylococci (11/47, 23.4%) were the most common causative pathogens; half of Staphylococcus aureus SSIs were caused by Methicillin-resistant Staphylococcus aureus (12/25, 48.0%). Five risk factors were identified as significant for SSI, including diabetes mellitus, morbid obesity, smoking, prolonged surgical duration exceeding 120 minutes (above the cutoff value, 75th percentile), and albumin < 35.0 g/L.				
Conclusion	These data allow for individualized risk assessment and can improve preoperative counseling. Therefore, optimization of the preoperative strategy of modest weight loss, glycemic control of patients with diabetes, supplemental nutrition, and smoking cessation is recommended to reduce the incidence of SSI.				
Study Number	**4**	**Journal**	**The Journal of arthroplasty, v. 33, n. 6, pág. 1861-1867, 2018.**	**Year**	**2018**
Authors	Almustafa, M. A.; Ewen, A. M.; Deakin, A. H.; Picard, F.; Clarke, J. V.; Mahmood, F. F[25].				
Title	Risk factors for surgical site infection following lower limb arthroplasty: a retrospective cohort analysis of 3932 lower limb arthroplasty procedures in a high volume arthroplasty unit				
Objective	Provide evidence on the presence of existing risk factors and identify potential new risk factors.				
Main results	There were 27 infected cases among 1,832 total hip replacements (1.5%) and 43 infected cases among 2,100 total knee replacements (2%). Of these, 23 total hip arthroplasties (1.3%) and 19 total knee arthroplasties (0.9%) were deep infections. Two risk factors have been identified for SSI after total hip arthroplasty: body mass index ≥30 and perioperative blood transfusion. Eight risk factors have been identified for SSI after total knee arthroplasty: hypertension, perioperative blood transfusion, skin closure with 2-octyl cyanoacrylate skin glue, use of oral steroids, reduced mean serum corpuscular volume, reduced mean cellular hemoglobin, serum count elevated neutrophil count and use of warfarin or rivaroxaban for venous thromboembolism prophylaxis.				
Conclusion	Were identified several risk factors such as transfusion, use of oral steroids, and reduction in mean corpuscular volume were identified as potentially modifiable risks that increase the risk of SSI. The low role of mean corpuscular volume and mean corpuscular hemoglobin is a new finding and deserves further investigation. Furthermore, the results suggest the use of 2-octyl cyanoacrylate skin glue in total knee arthroplasty as a cause for concern, which has not been previously reported.				
Study Number	**5**	**Journal**	**American Journal of Infection Control, v. 47, n. 10, pág. 1270-1272, 2019.**	**Year**	**2019**
Authors	Baier, C.; Adelmund, S.; Schwab F.; Lassahn, C.; Chaberny, I. F.; Gosse, F.; Vonberg, R. P.; Ebadi, E[26].				
Title	Incidence and risk factors of surgical site infection after total knee arthroplasty: results of a retrospective cohort study				
Objective	Determine the incidence and risk factors for such surgical site infections (SSI).				
Main results	The sample consisted of 2,439 patients, 84 of them (3.4%) developed SSI. Multivariate analysis revealed that significant risk factors for the occurrence of SSI were postoperative hemorrhage, Ahlback disease, obesity, smoking and male sex.				
Conclusion	Evidencing the incidence of SSI and associated risk factors is crucial to developing appropriate infection control measures, especially concerning deep SSI after knee arthroplasty, as this is a very common type of surgical procedure, however, subsequent infections can have a major impact on patient morbidity.				
Study Number	**6**	**Journal**	**Journal of Shoulder and Elbow Surgery, v. 26, n. 11, pág. 1922-1930, 2017.**	**Year**	**2017**
Authors	Everhart, J. S.; Bishop, J. Y.; Barlow, J. D[27].				

Title	Medical comorbidities and perioperative allogeneic red blood cell transfusion are risk factors for surgical site infection after shoulder arthroplasty				
Objective	Determine the risk of surgical site infection (SSI) due to comorbidities or blood transfusion after primary or revision shoulder arthroplasty.				
Main results	The sample consisted of 707 patients, 22 of them developed SSI, 16 (72.7%) in patients with no previous history of shoulder infection, and 6 (27.3%) representing recurrent infection in patients who underwent treatment for arthritis. septic, osteomyelitis and periprosthetic infection. The infection rate was 1.9% for primary hemiarthroplasties and 1.3% for primary total shoulder arthroplasties. Risk factors for SSI included male sex, rheumatoid arthritis, and long-term corticosteroid use. Perioperative allogeneic RBC transfusion significantly increased the risk of infection and was dose dependent.				
Conclusion	Revision surgery, particularly in the setting of prior infection, increases the risk of future infection. Finally, halogen RBC transfusion increases the risk of SSI after shoulder arthroplasty in a dose-dependent manner.				
Study Number	**7**	**Journal**	**Medicine, v. 99, n. 8 de 2020.**	**Year**	**2020**
Authors	Yang, G.; Zhu, Y.; Zhang, Y[28].				
Title	Prognostic risk factors of surgical site infection after primary joint arthroplasty: a retrospective cohort study				
Objective	Identify potential risk factors associated with surgical site infection (SSI) after primary joint arthroplasty.				
Main results	The sample consisted of 986 patients. There were 314 men and 672 women in this study with a mean age of 64.6 years, and 20 patients developed SSI. The overall incidence of SSI was 2.03%, with 0.20% for deep infection and 1.83% for superficial SSI. Multivariate analysis revealed that significant risk factors for the occurrence of SSI were albumin < 36.7 g/L, BMI ≥28 and ASA class 3 or higher.				
Conclusion	The incidence of SSI after primary joint arthroplasty was 2.03%. ASA ≥3, BMI ≥28, and ALB < 36.7 were identified as significant risk factors for postoperative wound infection.				
Study Number	**8**	**Journal**	**The American Journal of Sports Medicine, v. 46, n. 4, pág. 809-814, 2018.**	**Year**	**2018**
Authors	Cancienne, J. M.; Brockmeier S. F.; Carson, E. W.; Werner, B. C[29].				
Title	Risk factors for infection after shoulder arthroscopy in a large medicare population				
Objective	Determine Patient-Related Risk Factors for Infection After Shoulder Arthroscopy Using a Large Insurance Database.				
Main results	The sample consisted of 530,754 patients who met all inclusion criteria. There were 1,409 infections within 90 postoperative days (0.26%). Revision shoulder arthroscopy was the most significant risk factor for infection. Intraoperative steroid injection was also an independent risk factor for postoperative infection. There were also several independent patient-related risk factors for infection, the most significant being chronic anemia, malnutrition, male sex, morbid obesity, and depression.				
Conclusion	The present study identified several modifiable risk factors that were significantly associated with increased risk of infection, including obesity, malnutrition, depression, and intraoperative steroid injection. Furthermore, this study was able to identify revision surgery as a substantial risk factor for postoperative infection. By establishing these risk factors, many of which are modifiable, clinicians will be able to better identify and counsel higher-risk patients and employ and improve infection prevention methods targeting these patients.				
Study Number	**9**	**Journal**	**International Wound Journal, v. 15, n. 6, pág. 971-977, 2018.**	**Year**	**2018**
Authors	Meng, J.; Sun, T.; Zhang, F.; Qin, S.; Li, Y.; Zhao, H[30].				

Title	Deep surgical site infection after ankle fractures treated by open reduction and internal fixation in adults: a retrospective case-control study				
Objective	Investigate the incidence and risk factors for deep surgical site infection (SSI) after open reduction and internal fixation (ORIF).				
Main results	Within one year postoperatively, 2.83% (74/2617) of cases developed SSI, with the first occurring on the 4th day and the latest on the 147th day. Pseudomonas aeruginosa, Methicillin-resistant Staphylococcus aureus, and Methicillin-sensitive Staphylococcus aureus were the three main bacteria, causing 73% (37/51) of all cases. Age (45-64 and ≥65 years), current smoking, chronic heart disease, lower preoperative albumin level, open injury, and prolonged surgical duration were identified as independently associated with the development of SSI.				
Conclusion	The incidence of risk for SSI after ORIF of ankle fractures was 2.83% at one year postoperatively. Active preoperative nutritional supplementation, immediate cessation of smoking, and optimization of the operative plan to reduce surgical time were viable measures to prevent SSI after ORIF of ankle fractures.				
Study Number	**10**	**Journal**	**Revista Cuidarte, v. 12, n. 2, 2021.**	**Year**	**2021**
Authors	Silva, E. N.; Silva, R. K. S.; Carvalho, S. B.; Façanha, D. M. A.; Carvalho, R. E. F. L.; Pereira, F. G. F[31].				
Title	Fatores de risco para infecção de sítio cirúrgico em cirurgias traumato-ortopédicas				
Objective	Verify the association between risk factors and the presence of surgical site infection (SSI) in trauma-orthopedic surgeries.				
Main results	The sample consisted of 84 patients; it was found that 52 (61.9%) of the patients developed SSI. The significant risk factors for the occurrence of SSI were smoking, diabetes mellitus and age over 50 years. Age was the main risk factor related to the patient, present in 31 (36.9%) of the cases.				
Conclusion	Signs of infection were only associated with patient-related risk factors, and the main factors were age over 50 years, diabetes, and smoking. The importance of an adequate hospital structure, material, and human resources to guarantee safe surgical care is highlighted, including technique, instruments, and practices throughout the patient's stay. There is a lack of literature on the signs of infection presented by the patients' respective risk factors.				

Discussion

After analyzing the studies, SSI in orthopedic surgeries can occur due to several causes not only related to the extrinsic environment, but also to the patient. Regarding the associated risk factors, the authors mention several conditions that predispose to the development of the infection, which can be modifiable and non-modifiable. The incidence of SSI in orthopedic surgeries was 0.26%, the lowest rate and 4.37% the highest rate among the 10 studies[23,29].

Several risk factors for SSI were highlighted, according to the studies included in this review: body mass index (BMI) was highlighted in six studies[23-26,28,29]. Smoking identified in four studies[24,26,30,31]. Decreased albumin level (<35 g/L) in four studies[24,26,28,30]. Elevated serum neutrophil counts were cited in three studies[22,23,25].

Followed by males in three surveys[26,27,29]; elevated age in three studies[23,30,31]; and the most prevalent microorganisms were: Methicillin-resistant Staphylococcus aureus, followed by methicillin-sensitive Staphylococcus aureus, as well as Pseudomonas aeruginosa in three articles[22,23,30]; diabetes mellitus (DM) in two studies[24,31].

The studies also discussed the associated risk factors, the preoperative stay, and the prolonged surgery time, also mentioned in two studies[22,31,24,30]. In another study, the high level of fasting glycemia and, finally, a study that mentions the reduced mean serum corpuscular volume and reduced mean corpuscular hemoglobin[22,25].

Studies show that high body mass index (BMI) was a significant risk factor and reported a higher probability of SSI for patients with obesity and morbid obesity compared to non-obese groups[23-26,28,29]. A study suggests that adipose tissues actively participate in inflammation and immunity through a variety of inflammatory cytokines and immune mediators, which is the described mechanism of action that predisposes to infection[24].

In addition to BMI as a patient-related risk factor for SSI, diabetes mellitus (DM) has stood out concerning orthopedic surgeries, as it contributes to the inhibition of the healing process and impairs immune function, being related to signs of pain infection, hyperemia, and local edema, in the studies cited the high level of fasting glycemia did not remain significant[24, 31].

In contrast, a higher fasting blood glucose level was identified as an independent risk factor for postoperative SSI and associated with a 17% increased risk[22]. The Brazilian Diabetes Society guideline (2019) recommends, in patients with previous diabetes, optimized glycemic control in the preoperative period, when there is glycated hemoglobin <5% or >9%, it is worth considering postponing the surgery to evaluate the glycemic pattern.

Furthermore, studies address that patients with reduced albumin levels (<35 g/L) present another risk factor for the development of SSI and other complications, concluding that low albumin levels increased the risk of SSI, approximately, 2.39 times, compared to those with albumin > 35 g/L[22,24,28,30].

It is observed that the decreased albumin level is associated with the patient's state of malnutrition, which results in compromising the healing process of the surgical wound, due to the proliferation of fibroblasts and decreased collagen synthesis. This aspect also depresses the immune system, causing lymphocytopenia, and hindering the fight against infection[28].

According to studies, a high serum neutrophil count (>75%) in the preoperative period was revealed in studies to be a significant factor in favoring SSI, in which the incidence rate varies between 6.34% and 9.0%, considerably the results were higher than those with normal neutrophil count range[22,23,25].

Another important fact concerns the reduced mean serum cell volume and reduced mean cellular hemoglobin, which are other independent factors that demonstrate a risk for the development of SSI, as they reflect iron deficiency, thus impairing immune function. Being a modifiable factor through iron supplementation, such evidence is not mentioned in the analysis of other studies[25].

Concomitant to some studies, smoking was another strong risk factor associated with the increased development of SSI after orthopedic surgeries. According to the authors, smokers had an approximately 3.1 times greater risk of developing the complication, compared to non-smokers. The practice of smoking cessation four to eight weeks before the surgical procedure proved to be an important preventive measure to reduce the risk of infection[24,26,30,31].

Still, on the associated risk factors, studies[23,31] demonstrate that being over 50 years old is an important risk factor for the incidence of SSI when compared to adults between 18 and 50 years old. One study suggested that increasing age decreased the immune response, impairing the fight against infection[31]. On the other hand, in another study, it was indicated that age over 45 years corresponds to an independent factor associated with the occurrence of the infection[30].

It was also shown that the incidence of SSI in males is higher than in females[26,27,29]. For some authors, the reason is that there are differences in the microbiology of the skin, in particular, the higher number of positive cultures for Propionibacterium acnes (P. acnes), being higher for men when compared to women, thus causing infectious complications[27,29].

Concerning microorganisms, studies have shown that the prevalent agents in infections in orthopedic surgeries were Methicillin-resistant Staphylococcus aureus (MRSA), followed by Methicillin-sensitive Staphylococcus aureus (MSSA), as well as Pseudomonas aeruginosa, among others, however, mentioning the most predominant[22,23,30].

Regarding factors related to the surgical procedure, studies carried out show that the length of time during surgery was significant in favoring SSI[24,30]. It was observed that surgical time longer than 60 minutes significantly increases the incidence of infection[30]. However, in one result obtained, surgical duration exceeding 120 minutes was considered as an associated risk factor[24]. The authors also showed that the prolonged surgical duration is due to the complexity of the procedure.

Studies cite that a pre-operative hospitalization period of more than four days is another important risk factor for the development of SSI related to the procedure[22,31]. According to the ANVISA manual, prior hospitalization is recommended for elective surgery, less than or equivalent to 24 hours[5]. Hospitalization should be reduced for surgical and clinical patients. It should be noted that a nursing team trained and qualified to prevent infections reduces the mortality rate and promotes shorter hospital stays[32].

Final Considerations

Regarding risk factors, after collecting data and analysis, the studies highlighted the following risk factors: high body mass index, diabetes mellitus, decreased albumin level, high neutrophil count, smoking, advanced age, male gender, preoperative stay, and prolonged surgical time.

The pathogens also identified were Methicillin-resistant Staphylococcus aureus, followed by methicillin-sensitive Staphylococcus aureus and Pseudomonas aeruginosa, significant in the association of SSI in patients undergoing elective orthopedic surgeries, resulting in complications and deleterious effects on quality of life.

Thus, it was observed that risk factors related to the patient were more evident in the results of studies favoring SSI compared to those related to the procedure, being important to be recognized by the nursing team early to prevent the occurrence of infection.

The surgical center nurse, with a critical eye, must also use the systematization of care, which stands out for the scope of investigations and invest in continuing education and actions such as the implementation of bundles, checklists and other protocols that enable prevention and control of SSI, thus ensuring the quality of care provided and patient safety.

It is understood that, given the results evidenced for the development of SSI, the prevention of this complication becomes a challenge for the nursing team, since non-modifiable risk factors can favor infection. Knowing about the associated risk factors and adopting prevention measures is essential to minimize orthopedic SSIs, thereby reducing damage to the patient's health and avoiding highly high hospital costs due to readmissions for treatment.

References

1. Tavares APC, Silva JLLS, Silva JVL, Soares LM, Costa FS, Chrizóstimo MM. Análise da produção científica sobre infecção de sítio cirúrgico: uma revisão integrativa. Enferm. UFPI [internet]. 2019 [acesso em: 11 abr. 2022];8(2):60-5. Disponível em: https://ojs.ufpi.br/index.php/reufpi/article/view/7871/pdf
2. Ministério da Saúde (BR). Portaria n.º 2.616, de 12 de maio de 1998. Dispõe sobre a obrigatoriedade da manutenção pelos hospitais do país, de programa de controle de infecções hospitalares [Internet]. Diário Oficial da União: seção 1, Brasília, DF, 1998 [acesso em 10 abr 2022]. p.33. Disponível em: http://bvsms.saude.gov.br/bvs/saudelegis/gm/1998/prt2616_12_05_1998.html
3. Agência Nacional de Vigilância Sanitária (ANVISA). Implantação do Núcleo de Segurança do Paciente em Serviços de Saúde [Internet]. Brasília, DF: Anvisa, 2016 [acesso em 10 abr 2022]. (Série Segurança do Paciente e Qualidade em Serviços de Saúde). Disponível em: https://www.saude.go.gov.br/images/imagens_migradas/upload/arquivos/2017-09/2016-anvisa---caderno-6---implantacao-nucleo-de-seguranca.pdf
4. Agência Nacional de Vigilância Sanitária (ANVISA). RDC n.° 36, de 25 de julho de 2013. Institui ações para a segurança do paciente em serviços de saúde e dá outras providências [Internet]. Brasília, DF: Anvisa, 2013 [acesso em 10 abr 2022]. Disponível em: https://bvsms.saude.gov.br/bvs/saudelegis/anvisa/2013/rdc0036_25_07_2013.html
5. Agência Nacional de Vigilância Sanitária (ANVISA). Critérios Diagnósticos de Infecções Relacionadas à Assistência à Saúde [Internet]. (2. ed.). Brasília, DF: 2017 [acesso em 10 abr 2022]. Disponível em: http://www.saude.mt.gov.br/upload/controle-infeccoes/pasta5/novo/novos_criterios_diagnosticos_nacionais_iras_2017.pdf
6. Agência Nacional de Vigilância Sanitária (ANVISA). Medidas de prevenção de infecção relacionada à assistência à saúde [Internet]. Brasília, DF: Anvisa, 2017 [acesso em 10 abr 2022]. (Série Segurança do Paciente e Qualidade em Serviços de Saúde). Disponível em: http://www.riocomsaude.rj.gov.br/Publico/MostrarArquivo.aspx?C=pCiWUy84%2BR0%3D
7. Cavalcante EFD, Pereira IRBDO, Leite MJVDF., Santos AMD, Cavalcante CAA. Implementação dos núcleos de segurança do paciente e as infecções relacionadas à assistência à saúde. Rev. Gaúcha Enferm. 2019;40(spe). https://doi.org/10.1590/1983-1447.2019.20180306
8. EC Mendes, MC Carvalho, RB Carvalho, CA Ferraz, DMST Souza, TB Schnaider. Rev. bras. ortop. 2020;55(2). https://doi.org/10.1055/s-0039-3400520
9. Longo LB, Lemos A de S, Vellosa JCR, Montes EG. Análise das infecções de sítio cirúrgico em pacientes ortopédicos de um hospital do Paraná. RSD. 2021.10.17. https://doi.org/10.33448/rsd-v10i17.24868
10. Franco LMC, Ercole FF. Infecção de sítio cirúrgico em pacientes submetidos a cirurgias ortopédicas em um hospital público de Minas Gerais. Rev. Min. Enferm. [Internet]. 2011. [acesso em 16 jun. 2022];15(3):399-405. Disponível em: https://reme.org.br/artigo/detalhes/51
11. Carvalho RLR, Campos CC, Franco LMC, Rocha AM, Ercole FF. Incidence and risk factors for surgical site infection in general surgeries. Rev. Latino-Am. Enfermagem. 2017;25:e2848. http://dx.doi.org/10.1590/1518-8345.1502.2848
12. Dias ATP, Melo SA, Rigo MM, de Souza DG, da Silva Figueiredo D, dos Santos RAA, Naue C. Perfil das infecções hospitalares em um Hospital Universitário do Submédio do Vale do São Francisco–Brasil.Revista de Ensino, Ciência e Inovação em Saúde. 2021;2(1):101-110. https://doi.org/10.51909/recis.v2i1.117
13. Soares RCR. Incidência de infecções de sítio cirúrgico em cirurgias limpas em clínicas cirúrgicas de um hospital oncológico da região norte. RECIMA21 [Internet]. 2021 [acesso em: 10 abr. 2022];2(10):e210798-e210798. Disponível em: https://recima21.com.br/index.php/recima21/article/view/798/674
14. Moreno FTH, Andrade FR, Rezende LGRA, Cagnolati AF, Mandarano Filho LG, Mazzer N. Perfil das infecções nosocomiais de cirurgias ortopédicas do membro superior em hospital terciário no Brasil. Arch Health Invest. 2021; 10(4):564-9. https://doi.org/10.21270/archi.v10i4.5390
15. Agência Nacional de Vigilância Sanitária (ANVISA). Assistência segura: uma reflexão teórica aplicada à prática [Internet]. Brasília, DF: Anvisa, 2017 [acesso em 11 mai 2022]. (Série Segurança do Paciente e Qualidade em Serviços de Saúde). Disponível em: http://www.saude.pi.gov.br/uploads/divisa_document/file/374/Caderno_1_-_Assist%C3%AAncia_Segura_-_Uma_Reflex%C3%A3o_Te%C3%B3rica_Aplicada_%C3%A0_Pr%C3%A1tica.pdf
16. Souza ISB, Santana AC, Júnior GDA. A ocorrência de infecção do sítio cirúrgico: um estudo de revisão. Revista Médica de Minas Gerais [Internet]. 2018. [acesso em 09 mai. 2022];28(5):e-S280521. Disponível em: http://www.rmmg.org/artigo/detalhes/2453
17. Santos PVF, Jesus KB, Santana KISP, Nogueira EC, Cariri LS, Brito FPG. Infecção do sítio cirúrgico em pacientes no pós-operatório de cirurgias ortopédicas eletivas. ICSA. 2017;5(2):71-9. https://doi.org/10.17564/2316-3798.2017v5n2p71-79
18. Soares C B, Hoga LAK, Peduzzi M, Sangaleti C, Yonekura T, Silva DRAD. Revisão integrativa: conceitos e métodos utilizados na enfermagem. Rev Esc Enferm USP. 2014;48(02):335-45. https://doi.org/10.1590/S0080-6234201400002000020
19. Mendes KDS, Silveira RCDCP, Galvão CM. Revisão integrativa: método de pesquisa para a incorporação de evidências na saúde e na enfermagem. Texto & contexto-enfermagem. 2008;17(4). https://doi.org/10.1590/S0104-07072008000400018
20. Santos CMDC, Pimenta CADM, Nobre MRC.A estratégia PICO para a construção da pergunta de pesquisa e busca de provas. Rev Latino-am Enferm. 2007;15(3). https://doi.org/10.1590/S0104-11692007000300023
21. Ursi ES, Gavão C. M.Prevenção de lesões de pele no perioperatório: revisão integrativa da literatura. Rev. Latino-Am. Enferm. 2006;14(1). https://doi.org/10.1590/S0104-11692006000100017
22. Meng J, Zhu Y, Li Y, Sun T, Zhang F, Qin S, et al. Incidência e fatores de risco para infecção de sítio cirúrgico após cirurgia eletiva de pé e tornozelo: um estudo retrospectivo. Journal of Orthopaedic Surgery and Research. 2020;15(1). https://doi: 10.1186/s13018-020-01972-4
23. Su J, Cao X. Fatores de risco de infecção da ferida após redução aberta e fixação interna de fraturas do calcâneo. Remédio. 2017;96(44):e8411. https://doi: 10.1097/md.0000000000008411
24. Liang, Z. et al. Infecção de sítio cirúrgico após cirurgias ortopédicas eletivas em pacientes geriátricos: incidência e fatores de risco associados. International Wound Journal. 2019;16(3):773-80.

25. Almustafa MA et al. Fatores de risco para infecção do sítio cirúrgico após artroplastia de membro inferior: uma análise retrospectiva de coorte de 3.932 procedimentos de artroplastia de membro inferior em uma unidade de artroplastia de alto volume. The Journal of artroplastia. 2018;33(6):1861-67.
26. Baier C, et al. Incidência e fatores de risco de infecção do sítio cirúrgico após artroplastia total do joelho: resultados de um estudo de coorte retrospectivo. Jornal americano de controle de infecção. 2019;47(10):1270-72.
27. Everhart JS, Bishop JY, Barlow JD. Comorbidades médicas e transfusão perioperatória de hemácias alogênicas são fatores de risco para infecção de sítio cirúrgico após artroplastia de ombro. Journal of Shoulder and Elbow Surgery. 2017;26(11):1922-30.
28. Yang G, Zhu Y, Zhang Y. Fatores de risco prognósticos de infecção do sítio cirúrgico após artroplastia articular primária. Medicine. 2020;99(8):e19283. https://doi: 10.1097/md.0000000000019283
29. Cancienne JM, et al. Fatores de risco para infecção após artroscopia de ombro em uma grande população do Medicare. The American Journal of Sports Medicine. 2018;46(4):809-14.
30. Meng J et al. Infecção profunda do sítio cirúrgico após fraturas do tornozelo tratadas por redução aberta e fixação interna em adultos: um estudo retrospectivo caso-controle. International Wound Journal. 2018;15(6):971-77.
31. Silva END, Silva RKDS, Carvalho SBD, Façanha DMDA, Carvalho REFLD, Pereira FGF. Fatores de risco para infecção de sítio cirúrgico em cirurgias traumato-ortopédicas. Revista Cuidarte. 2021;12(2). https://doi.org/10.15649/cuidarte.1292
32. Florentino AO, Duarte AGG, Meira CSM, Júnior IA, Perez FCS, Pereira TACF, Hoelz CMR, Menezes DC, Oliveira EAB, Crivelaro LR. A atuação do enfermeiro na prevenção de microrganismos multirresistentes em unidade de terapia intensiva. Glob Acad Nurs. 2022;3(Sup.1):e238. https://dx.doi.org/10.5935/2675- 5602.20200238