Review Article

Open Access Journal of
Biomedical Science
ISSN: 2690-487X

# Prevention of Surgical Site Infections and Its Risk Factors: What Should Be Taken into Account?

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## ABSTRACT

Surgical site infection is one of the main complications derived from health care whose occurrence is related to high rates of morbidity and mortality, as well as increased health care costs. The pathogenesis develops from a complex process that involves various risk factors of the host and the environment, therefore, the establishment of preventive measures in clinical practice has represented the focus of attention in research. The methods with the most scientific evidence are related to the non-removal of hair in the surgical field, sterilization of the skin with alcoholic solutions, the correct application of perioperative antibiotic prophylaxis, maintenance of normothermia, glycemic control and the technique correct surgery, however, In this document you will find a systematic review of general data related to the main risk factors of the subject in question, which will allow expanding the associated knowledge and will promote the implementation of care practices directed towards the prevention of the occurrence of the pathology, as well as improved health outcomes.

**KEYWORDS:** Infection; Operative site; Complications; Risk; Preventive

## INTRODUCTION

Surgical site infection (SSI) is a type of health care-associated complication and is defined by the Centers for Disease Control (CDC) as one that occurs at or near the surgical incision during the first 30 days or until one year after the procedure in those cases in which a medical implant has been placed [1]. It is the second most frequently reported cause of nosocomial infection with a variable incidence estimated approximately between 1.2 and 23.6 per 100 surgeries [2]. However, it is important to mention that there is a general consensus that close to 60% of all cases have been preventable [3]. Most of the conditions are developed from pathogens of the patient's skin, mucous membranes or viscera, with *staphylococcus aureus*, coagulase-negative *staphylococcus, enterococci* spp and *E. Coli* as the main isolated pathogens. [4]. The determinants of SSI are the surgeon, the pathogen and the patient [1]. Regarding the pathogen, it is important to mention that the pathology develops when the amount of bacterial inoculum exceeds the response capacity of the patient's immune system [1-

**Quick Response Code:**

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**Received:** August 25, 2022 **Published:** November 22, 2022

**How to cite this article:** Juan AGA, Carlos FDM, María DPE, Valentina GAL, Yureidy TAJ, et al. Prevention of Surgical Site Infections and Its Risk Factors: What Should Be Taken into Account?. 2022- 4(6) OAJBS.ID.000519. **DOI:** 10.38125/OAJBS.000519

4], so the first determination that must be made is the classification of the wound. surgery (Figure 1). At this point, it is important to mention that it has also been possible to show that SSI is a situation in which bacteria activate their virulence in response to a particular environment that allows them to overcome the defense mechanisms of the carrier secondary to the physiological response. against trauma and tissue ischemia [5].

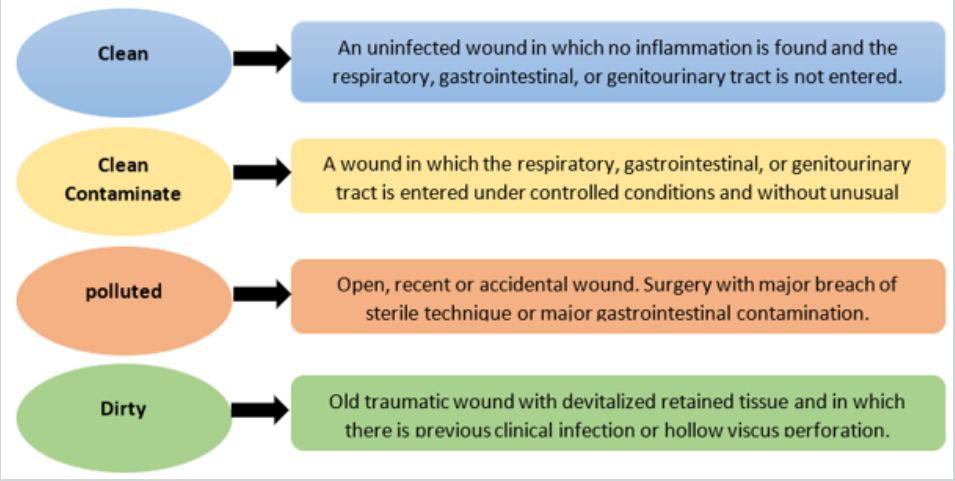


**Figure 1:** Wound classification [4.6].

**Table 1:** Preoperative risk according to the ASA [4].

| Criteria to Assess | Points |
|---|---|
| Abdominal surgery | 1 |
| Surgery > 2 hours | 1 |
| Dirty or contaminated surgery | 1 |
| More than 3 post-exit diagnoses | 1 |
| **Number of Positive Criteria** | **Risk of Infection** |
| 0 | 1% |
| 1 | 3.60% |
| 2 | 9% |
| 3 | 17% |
| 4 | 27% |
| **ASA Score** | **Physical Condition of the Patient** |
| 1 | Normally healthy |
| 2 | Mild systemic disease |
| 3 | Severe systemic disease that limits activity, but is not disabling |
| 4 | Disabling systemic disease that constantly puts your life in danger |
| 5 | Dying person not expected to survive 24 hours with or without surgery |

Taking into account the above, the surgeon, being considered the main modulator of the condition, should focus his surgical technique on performing acts that reduce the inoculum to controllable dimensions such as careful handling of the tissues, good hemostasis, no unnecessary prolongation of the intervention and the reduction of the extravasation of the intraluminal content [1]. To determine patient-dependent risk factors, the parameters established for preoperative risk by the American Society of Anesthesiology (ASA); (Table 1) must be taken into account, as well as the criteria of the National Surveillance System for Nosocomial Infections (NNISS). (Table 2) and the Study on the Efficacy of Control of Nosocomial Infections (SENIC); (Table 3) through which a statistically significant predictive value has been demonstrated, having as commonly associated factors obesity, smoking and pre-existing comorbidity [4]. Preventive measures are divided into preoperative, intraoperative, and postoperative, which must be developed in the company of multidisciplinary teams in order to guarantee continuous evaluation of the results and feedback from all the professionals involved. In general, the techniques that have an important level of evidence are the non-removal of hair in the surgical field, adequate hand hygiene, decontamination of the skin with an alcohol-based antiseptic solution, the use of laparoscopic techniques and the normothermia [6,7].

**Table 2:** National surveillance system for nosocomial infections (NNISS).

| Criteria to Assess | Points |
|---|---|
| ASA Rating 3,4,5 | 1 |
| Contaminated or dirty wound | 1 |
| Duration of surgery >75$^{th}$ percentile | 1 |

**Table 3:** Study on the efficacy of control of nosocomial infections (SENIC) system.

| Number of Positive Criteria | Risk of Infection |
|---|---|
| 0 | 1% |
| 1 | 3% |
| 2 | 7% |
| 3 | 15% |

## METHODOLOGY

A systematic search of original articles, case reports and bibliographical reviews is carried out in databases specialized in the exposed topic such as ScienceDirect, PubMed, Elsevier, Scielo and Medline. Search keywords such as: “infection”, “surgical site”, “postoperative”, “prevention” and “risk factors” are used, carefully

selecting a total of 19 bibliographical references in Spanish and English that were relevant to the development of this review article.

## RESULTS AND DISCUSSION

All surgery carries a risk due to the physiological process that the human body goes through secondary to the stress that tissue damage represents, however, it is necessary to identify the risk factors for preventable complications such as SSI, taking into account that each patient has individual attributes that can be non-modifiable, also known as endogenous factors, as well as characteristics that can be influenced by the external environment or exogenous factors. Among the former, we find chronic diseases that weaken the immune system of patients, age or aging that make it difficult to recover from the wound, smoking associated with adverse effects such as pulmonary complications, as well as slow healing due to mechanisms of vasoconstriction and relative ischemia [8]. Among the exogenous factors is the use of prosthetic materials that can facilitate infection either by direct contamination of the device or by hematogenous dissemination of microorganisms, the duration of surgery greater than 120 minutes due to the increased exposure of the tissues to the operating room environment, pre- and post-hospital stay due to the risk of colonization by resistant intrahospital agents, and the degree of contamination of the wound, which proportionally increases the risk of infection.The prevention of SSI must be carried out after the identification of the possible risk factors mentioned above. For practical purposes, three moments have been defined for the intervention of healthcare personnel known as the preoperative, intraoperative and postoperative phase.

## PREOPERATIVE PHASE

### Detection and Treatment of the Patient's Intrinsic Risk Factors

This section discusses the importance of detecting and treating the main preoperative changes in the patient that can reduce the incidence of SSI [1]. In a special way, mention is made of the effective control of chronic diseases because it has been shown that those patients with better control have lower rates of infection, however, Badía [8] comment that despite the fact that Numerous factors have been evaluated, the reality is that when these are measured, the results comment that these are only indirect markers of risk.

### Hand Hygiene

Hand washing, or disinfection is considered the most effective preventive measure because the contaminated hands of health care personnel act as a vector of transmission and contribute to the colonization of the patient, so during health care hands must be sanitized without excuse during the five moments established by the World Health Organization (WHO) (Figure 2). The process must be carried out with a neutral soap and drying with single-use towels.

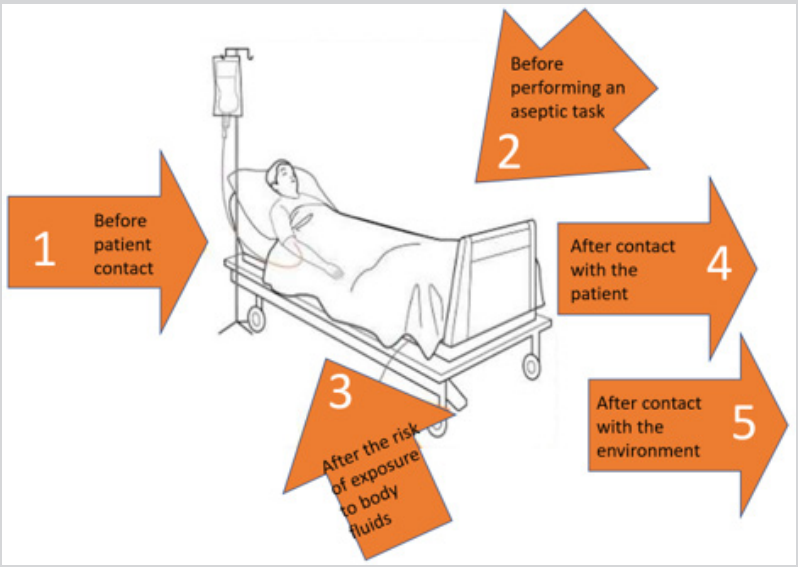


**Figure 2:** The five moments of hand hygiene according to the WHO.

### Pre-Surgical Bathroom

The objective of the pre-surgical shower is to reduce the bacterial load of the patient's habitual and transient flora, which is why numerous studies have been published comparing strategies for skin decontamination [7.8] however, although it is a widespread practice, its effectiveness in reducing SSI rates is not clear. In general, the WHO concludes that it is considered good practice to shower before surgery with both antimicrobial soap and toilet soap in order to reduce risk [6]. In fact, although the antiseptic recommended by the WHO is soapy chlorhexidine, however, Ramírez and Viera [7] comment that when this is compared with the use of soap for personal hygiene, no evidence is reported that demonstrates greater effectiveness of the first.

### Hair Removal

Hair removal in the area of surgery has traditionally been part of the routine preparation of the patient before surgery, however, it has been shown that shaving is associated with microtrauma, the presence of which is related to a higher incidence of SSI [7]. Previously it was stated that the presence of hair made disinfection difficult, however, Tanner et al. [9] comment that it has not been possible to show significant differences when comparing interventions in which the hair was removed versus others in which it was not. It is currently recommended that in those cases in which this practice is considered convenient due to difficulty in delimiting the surgical area or performing the suture, cutting with an electric machine with a replaceable head or the use of depilatory

creams is chosen, since they produce a lower rate of infection than shaving [8].

### Nasal Decontamination in Patients with Methicillin-Resistant Staphylococcus Aureus (Mrsa)

It has been established that MRSA carriers have a higher rate of SSI. In a Cochrane systematic review [10] the use of nasal mupirocin in patients carrying S. aureus significantly reduced the rate of nosocomial infection, but the effect disappeared when only SSIs produced by this bacterium were analyzed, so there is no clear evidence on the effectiveness of decontamination. Currently, the recommendation is based on the fact that before operations in patients with a high risk of colonization by MRSA (chronic renal failure treated with dialysis, recent hospitalizations, coming from a nursing home, recent treatment with beta-lactams or fluoroquinolones, previous history of colonization by MRSA) [10] rule out nasal carrier status and, if positive, perform decontamination with 2% mupirocin every 12 hours for 5-7 days in addition to daily bathing with chlorhexidine [8].

### Mechanical Color Preparation in Colorectal Surgery

This practice aims to reduce infectious complications and postoperative anastomotic dehiscence from preparation with evacuating solutions, however, the meta-analysis of the National Institute of Health and Clinical Excellence [NICE0] [11] conclude that there are no differences in the rate of infection when comparing patients with mechanical preparation and those not prepared. Additionally, Badía and Guirao [8] comment on the presence of complications associated with this practice such as electrolyte disorders, seizures, or spontaneous rupture of the esophagus, therefore, its routine use cannot currently be recommended.

### Antibiotic Prophylaxis

This has been a point widely debated by healthcare personnel, however, in general it has been established that clean surgery is not a candidate for prophylaxis due to an SSI risk of less than 2% (with some exceptions such as the use of prosthetic material) [1]. To define less clear indications, risk assessment using the NNISS index, as well as the general recommendations of national guidelines and bacterial resistance rates, may be useful.

The germ involved in the contamination of the wound depends on the place where it is located. [6] states that the common microorganisms are generally aerobic gram-positive cocci such as S. Aureus, but that contamination from fecal flora such as anaerobic or gram-negative aerobic bacteria can be found when the incision is located near the perineum. In choosing the appropriate antibiotic, it is necessary to assess pharmacodynamic and pharmacokinetic parameters, since it must be taken into account that the levels of the antibiotic must exceed the minimum inhibitory capacity (MIC) of the organisms potentially involved in the development of the infection. The drug dose should be the highest with the shortest duration possible, in this way the time above the MIC will be greater than the surgical time [8].

Prophylaxis should be administered within 30 minutes prior to the start of the intervention since Ruiz and Badía [1] comment that a single dose of prophylactic antibiotic is as effective as multiple doses and that the prolonged use of antibiotic therapy not only does not provide benefit, but rather increases the risk of bacterial resistance. First- or second-generation cephalosporins are determined as first-line drugs. Third- and fourth generation cephalosporins are also effective but are not recommended due to their relationship with the appearance of MRSA and Enterobacteriaceae with a pattern of extended-spectrum beta-lactamase (ESBL) resistance. In patients allergic to beta-lactams, the combination of vancomycin or clindamycin with an aminoglycoside is a good option [6]. Finally, it is important to highlight that in the case of surgeries with contaminated or dirty wounds, antibiotic prophylaxis does not take place since significant bacterial colonization is expected and antibiotic treatment must be therapeutic with broad-spectrum drugs while the microorganism involved is determined [12]. Intraoperative phase.

## INTRAOPERATIVE PHASE

### Environment and Circuits of The Operating Room

**Table 4:** Circuits in the surgical block [8].

| Circuits in the Surgical Block | | |
|---|---|---|
| Restricted area (Clean) | semi restricted area (half clean) | unrestricted zone (dirty) |
| operating theaters | Peripheral support area | changing rooms |
| ante-surgery | Work area with instruments and clean material | Reception of material |
| Surgical hand washing area | Corridors and passageways around the restricted area | Patient information room |
| | Rest zone | Waste room and dirty clothes (better outside the surgical structure) |
| | Resuscitation room (according to the physical structure) | |
| | Secretariat and meeting room | |

Adequate circulation within the operating room is essential for the proper functioning of the area, which is why it is essential to clearly differentiate between clean, semi-clean and dirty spaces (Table 4); [8]. The operating room must have restricted circulation with continuous operation of the ventilation system and keep the doors always closed. Additionally, depending on the type of surgery, operating theaters will be classified into three classes called A (heart, lung and liver transplants, extracorporeal and aortic heart surgery, orthopedic surgery with prostheses), B (conventional and emergency surgery) and C (ambulatory interventions and deliveries) which have special requirements [13].

### Use of Jewelry, Artificial Nails and Nail Polish

Most hospitals prohibit the use of this type of element by the surgical team. However, it is a controversial issue because there is no evidence for or against it. Currently, the British NICE guideline recommends abstaining from these elements before surgical scrubbing [8].

### Surgical Handwash

Decontamination of the hands of surgical personnel is essential for the prevention of SSI. Washing should include the hands, forearms and elbows, rubbing with the palm of the hand or with a single-use soapy sponge, since the skin brush is not recommended due to the skin lesions it produces [7]. As for the duration, the WHO recommends that it be between 3 and 5 minutes (5 minutes for the first washing of the day and 3 minutes for washing between surgeries). The product of choice for the first wash of the day can be 4% povidone soap solution or 4% chlorhexidine, while for subsequent washes 70% alcoholic solution could be used, allowing it to evaporate from the skin [13].

### Skin Preparation of The Surgical Field

This section refers to the treatment of intact skin prior to surgical incision, which must be performed in the operating room and is intended to reduce the microbial load of the patient's skin before breaking the skin barrier. The most widely used antiseptic agents are alcohol- or aqueous-based solutions of chlorhexidine and povidone-iodine, since they do not irritate the skin, cover a wide spectrum of microorganisms, are fast-acting, and are cost-effective [7]. Sánchez [6] comments that in general it can be stated that alcohol-based solutions are superior to water-based solutions and that chlorhexidine may be more effective in reducing the incidence of infection than povidone, since it has a high antibacterial activity with prolonged residual effect, however, the quality of the available evidence is low and does not allow further conclusions to be drawn [7]. It should be remembered that alcoholic solutions cannot be used in locations such as mucous membranes, ears, eyes, mouth, neural tissue, open wounds, non-intact skin, and must be allowed to evaporate to reduce the risk of burns with the use of the electric scalpel [1].

### Use of Double Surgical Gloves

There is a high rate of glove perforation during prolonged surgical interventions, which is why the possibility of using double gloves to avoid contamination has been raised [8]. In a meta-analysis of 9,000 gloves in low-risk surgery for perforation, donning a second glove significantly decreased the rate of innermost perforation; however, there is currently no evidence correlating glove perforation rate and incidence. of SSI, so this practice is not routinely recommended [8].

### Laparoscopy

Laparoscopic interventions generate a lower degree of aggression and better preserve immune function, which is why it is accompanied by a significant decrease in SSI rates, mainly superficial, since it has been shown that it does not modify the organ/space rate [9].

### Skin Incision and Wound Margin Protection

Some authors state that the use of diathermy to make the skin incision could reduce tissue damage, postoperative hematoma and SSI, however, others comment that it worsens the cosmetic effect, SSI and postoperative pain. Aird and Brown [12] Through a meta-analysis carried out in 2012, no statistical differences were found in the SSI rate between the use of an electric scalpel or a scalpel, with little relevant clinical differences in favor of diathermy in terms of blood loss and surgical time. Currently, British and American health institutions recommend the use of a cold scalpel with selective application of electrocautery on bleeding points [14].

### Fascial Sutures with Antimicrobials and Drains

There are suture materials impregnated with antibacterial substances, generally triclosan, that have been designed in order to reduce the concentration of bacteria adhered to the wound. Daout et al. [13] In a recent meta-analysis, they found a 33% reduction in SSI with the use of triclosan-impregnated sutures. However, the beneficial effect is less evident in clean, contaminated, and dirty surgery, which is why it remains a controversial issue and in most the guidelines do not recommend its routine use, advising the performance of more studies in this regard. Regarding the use of drains, Badía and Guirao [8] comment that systematic reviews show that they are unnecessary and do not improve postoperative results, so they are not recommended Rondelli et al. [14] comment that despite the fact that in rectal surgery several meta-analyses deny its efficacy, this has shown a decrease in the rates of suture dehiscence and reintervention without effect on the SSI rate.

### Normothermia

Surgical patients frequently exhibit hypothermic states (core temperature <36°C) due to scantily clad exposure to the ambient temperature of the operating room and anesthetic-induced altered thermoregulation [8]. This process has been shown to leads to an increase in the rate of SSI due to altered immunity and peripheral vasoconstriction that decreases the partial pressure of oxygen in the tissues, so it is recommended to maintain a temperature between 36 and 38 °C in the preoperative and postoperative periods. intraoperative [15].

### Oxygen Therapy

It has been proposed that a greater administration of oxygen would increase the partial pressure of oxygen in the surgical wound and would increase the oxidative destruction of bacteria by neutrophils. However, there is no clear evidence in favor of this practice since studies have been designed comparing the administration perioperative evaluation of 80% FiO2 versus 30% FiO2 with contradictory results [8]. The current recommendation is to maintain optimal oxygenation during surgery (<95%) [2-8].

### Wound and Peritoneum Lavage

The irrigation of the surgical wound at the end of the intervention has been studied as a possible effective practice for the reduction of the bacterial load in the margins of the incision, finding that there is a high level of bacterial clearance, especially when the lavage is performed under pressure, correlating with a better SSI rate [15]. Peritoneal lavage, despite having the same objective as wound irrigation, has shown controversial results regarding its effectiveness, since Badía and Guirao [8] comment that this practice could interfere with the defense mechanisms of the patient in particular. with the response effected by macrophages and proinflammatory cytokines resident in the peritoneum. They also comment that a meta-analysis based on experimental studies showed a decrease in SSI and mortality in up to 65% of cases when irrigation was performed with saline solution or antibiotic solution, while washing with antiseptic solutions obtained the same rate

of SSI as not. Wash. Taking the above into account, it has been established that peritoneal lavage could be performed at the end of the surgical intervention with warm saline and that the use of antiseptics or hypertonic serums is not recommended [7].

### Blood Transfusions

blood transfusions in the perioperative period have been determined as an independent predictor of SSI since they alter the patient's immune response through various immunological mechanisms [8].

### Surgery Time

The duration of the surgery is directly linked to the occurrence of SSI, so it has been established that a time greater than 120 minutes is a risk factor for the occurrence of the complication due to the exposure of the tissues to the environment and the fatigue of the patient. assistance team that could be related to failures in aseptic techniques [6].

### Pre- and Post-Hospital Stay

Hospitalization for more than 24 hours has been established as a risk factor for the occurrence of SSI due to the possibility of colonization by microorganisms from the hospital itself with higher rates of antibiotic resistance [16].

## POSTOPERATIVE PHASE

### Wound Care

As a general rule, wounds that are closed in the operating room can be uncovered 24/48 hours after the intervention, emphasizing the importance of hand washing prior to performing the healing [8].

### Postoperative glycemic control

Patients with a history of diabetes mellitus (DM) more frequently present postoperative complications, including SSI, because hyperglycemia causes increased levels of catecholamines, corticosteroids, and growth hormone, which in turn inhibit the release of oxygen in the blood. the wound [16]. Sánchez [6] comments that maintaining blood glucose levels between 120 and 160 mg/dl in diabetic and non-diabetic patients during the first 2-3 postoperative days reduces the risk of SSI and that each increase of 40 mg/dl dl of blood glucose above 110 mg/dl in turn represents a 30% increase in the risk of suffering from it, which is why the use of insulin is recommended for effective control of the situation, however, [8] manifest the above, it has not shown clear benefits, but it has shown a high risk of hypoglycemia, which can generate higher rates of morbidity and mortality [17,18].

### Removal of dressings and postoperative shower

Surgical wound care differs significantly between health institutions. However, it has been suggested that the lack of postoperative hygiene could increase the SSI rate, which is why Toon et al. [19] states that early removal of the dressing, leaving the wound in the air, is associated with a shorter hospital stay and a decrease in costs. As has been evidenced throughout the document, there are various risk factors and clinical practices related to the prevention of the occurrence of SSIs, however, not all of them are accepted or classified as accurate, so in (Figure 3) they can be found clearly. summarized the recommendations with the highest degree of evidence.

## CONCLUSION

Surgical site infections represent a public health problem since they are widely related to prolonged hospital stay, decreased quality of life and increased morbidity and mortality in addition to the annual health cost, so it is essential to establishment of intra-hospital processes that allow the timely identification of the various risk factors, as well as possible care interventions aimed at prevention and timely management of the situation. Finally, it is important to mention that.


**Figure 3:** Recommendations with high or moderate scientific evidence for the prevention of SSI.

## REFERENCES


1. Ruiz Tovar J, Badia JM (2014) Medidas de prevención de la infección del sitio quirúrgico en cirugía abdominal. Critical Review of the Evidence 92(4): 223-231
2. Hilda Guadalupe HO, José Luis CN (2017) Preventing infections by taking a look at the new Global guidelines for the prevention of surgical site infection. Acta Pediatr Mex 38(1): 1-9.
3. Gómez-Romero FJ, Fernández-Prada M, Navarro-Gracia JF (2017) Prevention of surgical site infection: analysis and narrative review of clinical practice guidelines. Cir Esp 95(9): 490-502.
4. Jiménez M, Moore JH, Quintero G, Lerma C, Nieto JA, et al. Guide for the prevention of the infection of place operative (ISO).
5. Alverdy JC (2018) Microbial virulence and postoperative infection Practical lessons for the surgeon. Cirugia Espanola. Elsevier Doyma 96(10): 612-619
6. Rodríguez Nájera GF, Camacho Barquero FA, Umaña Bermúdez CA (2020) Risk factors and prevention of surgical site infections following spinal procedures. Revista Medica Sinergia 5(4): 44s-48s
7. Ramirez Galleymore P, Viera V (2019) Preoperative skin antisepsis. Intensive Care 1(43): 18-22
8. Badía J, Guirao X (2016) Surgical infections (clinical guidelines of the spanish association of surgeons). Publisher ARAN Spain, 758 p.
9. Tanner J, Norrie P, Melen K (2011) Preoperative hair removal to reduce surgical site infection. Cochrane Database Syst Rev 9(11): CD004122.
10. De Carvalho RLR, Campos CC, Franco LMC, Rocha AM, Ercole FF (2017) Incidence and risk factors for surgical site infection in general surgeries. Rev Lat Am Enfermagem 4(25): e2848.
11. National collaborating center for women's and children's health (UK) (2008) Surgical site infection prevention and treatment of surgical site infection.
12. Aird LN, Brown CJ (2012) Systematic review and meta-analysis of electrocautery versus scalpel for surgical skin incisions. American Journal of Surgery 204(2): 216-221
13. Daoud FC, Edmiston CE, Leaper D (2014) Meta-analysis of prevention of surgical site infections following incision closure with triclosan-coated sutures: robustness to new evidence Surgical Infections 15(3): 165-218
14. Rondelli F, Bugiantella W, Vedovati MC, Balzarotti R, Avenia N, et al. (2014) To drain or not to drain extraperitoneal colorectal anastomosis A systematic review and meta-analysis Colorectal Dis 16(2): O35-042
15. O'Neal PB, Itani KMF (2016) Antimicrobial formulation and delivery in the prevention of surgical site infection. Surg Infect 17(3): 275-285.
16. Berriós-Torres SI, Umscheid CA, Bratzler DW, Leas B, Stone EC, et al. (2017) Centers for disease control and prevention guideline for the prevention of surgical site infection, 2017. JAMA Surg 152(8): 784-791.
17. Bravo Coello J, Pacheco Moreira V, Valverde F, Cango L (2021) Risk factors contributing to surgical site infection. Scientific Journal Consensus of Sciences 7(4): 48-64.
18. Ángeles-Garay U, Morales-Márquez LI, Sandoval MA, Velásquez-García JA, Maldonado-Torres L, et al. (2014) Risk factors related to surgical site infection in orthopedic prosthesis surgery. Cir Cir 82(1): 48-62.
19. Toon CD, Ramamoorthy R, Davidson BR, Gurusamy KS (2013) Early versus delayed dressing removal after primary closure of clean and clean-contaminated surgical wounds. Cochrane Database of Systematic Reviews 2015(9): CD010259.