# Frequency of Surgical Site Infection in Patients Operated on by The General Surgery Department in a Tertiary Care Pediatric Hospital, From September 1, 2014 To August 31, 2015

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**KEYWORDS**

Surgical site infection, General surgery, Hospitalization

**ABSTRACT**

This observational, descriptive, and ambispective study aims to determine the frequency of surgical site infections (SSIs) among patients treated in the general surgery department of the National Institute of Pediatrics between September 1, 2014, and August 31, 2015. Currently, surgical site infection (SSI) represents a significant cause of morbidity and mortality on a global scale. The objective of this study is to ascertain the percentage of patients who present with SSIs in accordance with the CDC specifications, thereby establishing a basis and reference for subsequent studies.

## 1. Introduction

Surgical site infection (SSI) represents one of the most common postoperative complications, posing a significant challenge to healthcare systems worldwide. These infections can result in considerable morbidity, prolong hospital stays, increase healthcare costs, and in some cases, result in fatal outcomes, particularly in vulnerable populations such as pediatric patients. In tertiary hospitals, where complex and highly specialized surgical procedures are performed, surveillance and prevention of SSIs is crucial to ensure patient safety and improve surgical outcomes.

SSIs can have several important implications for patients, affecting both their health and overall well-being. The main implications include:

1. Increased morbidity: SSI can cause pain, swelling, redness, fever, and discharge at the wound site, which can lead to prolonged recovery and additional complications, such as abscesses or deeper infections.
2. Prolonged hospital stay: Patients with SSIs often require additional hospitalization time to receive antibiotic treatment, drainage procedures, or surgical reinterventions. This not only affects the patient's quality of life, but also increases the risk of acquiring additional nosocomial infections.
3. Increased health care costs: SSIs generate significant additional costs due to the need for additional treatments, additional surgical procedures, prolonged antibiotic use, and intensive nursing care. This represents an economic burden for both patients and their families and for the health system.
4. Risk of serious complications: In some cases, SSIs can lead to serious complications such as sepsis, deep tissue infection, or involvement of internal organs, which can be life-threatening, especially in vulnerable populations such as children, the elderly, or the immunocompromised.
5. Psychological and emotional impact: The presence of SSIs can cause anxiety, stress, and emotional distress in patients, especially those who require additional procedures or a prolonged hospital stay. This can affect your quality of life and overall well-being.
6. Delayed recovery: SSIs can delay a patient's full recovery, limiting their ability to return to normal daily activities, and in the case of pediatric patients, can affect their development and participation in school and social activities.

The current global consensus is that the occurrence of surgical site infection (SSI) serves as an indicator of the quality of healthcare provided. According to the literature reviewed, SSI represents the third most prevalent nosocomial infection, with a prevalence rate of 16 to 20%. The presence of surgical site infection is directly associated with an increase in hospital stay duration, which consequently results in a higher economic cost. Similarly, numerous studies have evaluated the impact of surgical site infections on hospital stay and economic cost. In a 2009 study, Sparling and colleagues reported that surgical site infections (SSIs) resulted in an additional 10.6 days of hospital stay and $25,000 in costs compared to surgical interventions that did not develop SSIs. Both the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) recognize SSIs as a significant public health concern. A surveillance program for the detection of surgical site infections (SSIs) has been in place in the United States since 1970. At the National Institute of Pediatrics (INP), the frequency of surgical site infection (SSI) remains unknown. The last study was conducted in 1971, and Dr. González Saldaña reports an incidence of SSI of 3%, according to the Center for Research and Scientific Documentation.

**Objectives**

**General objective**

- To determine the current frequency of surgical site infection in patients operated on by the Department of General Surgery of the National Institute of Pediatrics.

**Specific objectives**

- To identify possible causes of SSI, analyzing variables such as age, underlying condition, nutritional status (weight-for-age), immunosuppression, concomitant infection at the time of SSI, surgical time, presence of previous surgery and temporality, classification of the surgical wound (National Research Council 1964) and nature of the surgery (urgent, scheduled, outpatient or hospital).
- Identify the causative bacteria.
- To determine the sensitivity of the antibiogram of the cultures obtained from the surgical wound.

## 2. Methodology

Type of design. Observational, cross-sectional, ambispective study of patients who underwent surgery in the INP and followed up in the outpatient clinic.

Population.

- **Objective**. Patients who were operated on by the general surgery service at the National Institute of Pediatrics in the period September 1, 2014 to August 31, 2015.
- **Eligible.** Those patients who meet the inclusion criteria.
- **Sample.** All patients who were operated on by the general surgery service at the National Institute of Pediatrics in the period September 1, 2014 to August 31, 2015 were included.

**Inclusion criteria**

Those patients operated on by the pediatric surgery department of the INP in the period September 1, 2014 – August 31, 2015, with a minimum post-surgical surveillance of 30 days, and in case of the use of prostheses of up to 12 months.

**Exclusion Criteria**

Deaths are excluded from the protocol, except for those who die secondary to SSI (or related to SSI), patients with incomplete records, and also patients over 18 years of age.

**Elimination criteria**

Those patients who are lost in post-surgical follow-up or those without supervision for at least 30 days in case of not having prostheses or up to 12 months in case of placing some type of prosthesis are eliminated from the protocol.

**Sample size**

Knowing the prevalence of surgical wound infection, which is 3% according to Dr. Gómez Saldaña's statistics, in 1971 we decided to calculate the sample size with a formula for descriptive studies.

$$N = \frac{pq * Z_{1-\alpha/2colas2}}{\text{Allowed Error2}}$$

Replacing

$$N = \frac{(0.03*0.97)*(1.96^2)}{(0.052)} = 44.7162 \text{ patients with infected surgical wound}$$

## 3. Result and Discussion

A total of 1289 surgical procedures were performed in 365 days, 19 were excluded (6 due to adult patients and 13 due to death) with a total sample of 1270, during that year 3,482 procedures were performed per day, and the percentages contemplated in the protocol were as follows:

Table 1. Variable nutritional status, frequency and percentage of the 1270 patients who were included in the protocol.

| Nutritional status | Number | Percentage |
|---|---|---|
| Eutrophic | 727 | 57.2 |
| Undernourished | 468 | 36.9 |
| Obese | 75 | 5.9 |
| Total | 1270 | 100.0 |

Table 2. Variable previous surgery, frequency and percentage of the 1270 patients who were included in the protocol.

| Previous surgery | Number | Percentage |
|---|---|---|
| No prior surgery | 1194 | 94.0 |
| With previous surgery | 76 | 6.0 |
| Total | 1270 | 100.0 |

Table 3. Variable sex, frequency and percentage of the 1270 patients who were included in the protocol.

| Sex. | | Number | Percentage |
|---|---|---|---|
| | | | |
| | male | 792 | 62.4 |
| | female | 478 | 37.6 |
| | Total | 1270 | 100.0 |

Table 4. Immunocompromise variable, frequency and percentage of the 1270 patients who were included in the protocol.

| Immunosuppression | | Number | Percentage |
|---|---|---|---|
| | Immunocompetent | 930 | 73.2 |
| | Immunocompromised | 340 | 26.8 |

| | | | |
|---|---|---|---|
| | Total | 1270 | 100.0 |

Table 6. Percentage and frequency of different types of wounds in the population

| Age group | | Number | Percentage |
|---|---|---|---|
| | Baby | 58 | 4.6 |
| | Infant | 172 | 13.5 |
| | Older infant | 101 | 8.0 |
| | Preschool | 366 | 28.8 |
| | Pupil | 445 | 35.03 |
| | Adolescent | 128 | 10.1 |
| | Total | 1270 | 100.0 |

Table 7. Percentage and frequency according to the nature of the surgery.

| Nature of the surgery | | Number | Percentage |
|---|---|---|---|
| | Scheduled | 762 | 60 |
| | Urgency | 508 | 40 |
| | Total | 1270 | 100.0 |

Table 8. Percentage and frequency according to the need for hospitalization.

| | Frequency | Percentage |
|---|---|---|
| Hospital | 1053 | 82.90 |
| Ambulatory | 217 | 17.10 |
| Total | 1270 | 100 |

Table 9. Frequency and percentage of immunocompromised patients who presented SSI.

| Number | | Percentage |
|---|---|---|
| Immunocompetent | 35 | 61.4 |
| Immunocompromised | 22 | 38.6 |
| Total | 57 | 100.0 |

Of the total cases, 57 developed surgical site infection, corresponding to 4.48%. The percentages of the variables analyzed were as follows:

Table 10. Frequency and percentage of patients who presented SSIs based on sex.

| Number | | Percentage |
|---|---|---|
| Male | 34 | 59.6 |
| Female | 23 | 40.4 |
| Total | 57 | 100.0 |

Table 11. Percentage and frequency of patients who presented SSI according to the definition of 'previous surgery'.

| Number | | Percentage |
|---|---|---|
| With previous surgery | 14 | 24.5 |
| Total con ISQ | 57 | 100.0 |

Table 12. Frequency and percentage of surgeries with SSIs according to the type of surgery.

| Number | | | Percentage |
|---|---|---|---|
| | Cleaning | 5 | 8.8 |

| | | | |
|---|---|---|---|
| | Contaminated cleaning | 31 | 54.4 |
| | Contaminated | 13 | 22.8 |
| | Dirty | 8 | 14.0 |
| | Total | 57 | 100.0 |

Table 13. Percentage and frequency of patients with SSI according to nutritional status.

| | | Number | Percentage |
|---|---|---|---|
| | Eutrophic | 30 | 52.6 |
| | Undernourished | 22 | 38.6 |
| | Obese | 5 | 8.8 |
| | Total | 57 | 100.0 |

Table 14. Percentage and frequency of patients with SSIs who were cultured.

| Number | | Percentage |
|---|---|---|
| No culture | 20 | 35.1 |
| With cultivation | 37 | 64.9 |
| Total | 57 | 100.0 |

Table 14. Percentage and frequency of patients with SSIs according to age group.

| Number | | | Percentage |
|---|---|---|---|
| | Baby | 8 | 14.0 |
| | Infant | 7 | 12.3 |
| | Older infant | 10 | 17.5 |
| | Preschool | 15 | 26.3 |
| | Pupil | 15 | 26.3 |
| | Adolescent | 2 | 3.5 |
| | Total | 57 | 100.0 |

Table 15. Percentage and frequency of patients with the need for post-surgical hospital stay and presence of SSI.

| | Number | Percentage | With ISQ (%) |
|---|---|---|---|
| Ambulatory | 217 | 17.08 | 2 (0.92) |
| Hospitalization | 1053 | 82.91 | 55 (5.22) |

Table 15 details 57 pathologies that presented SSIs and the surgical procedure.

| **Pathology** | **Procedure** | **Number of cases** |
|---|---|---|
| Appendicitis | Appendectomy | 20 |
| Intestinal perforation | Bowel resection | 7 |
| Gastroesophageal reflux | Gastrostomy / Fundoplication | 3 |
| Hernia inguinal | Inguinal hernioplasty | 2 |
| Anorectal malformation | Colostomy | 2 |
| Frantz's tumor | Whipple Procedure | 2 |
| Intestinal Occlusion | Adherensiolysis | 2 |

| | | |
|---|---|---|
| Portal hypertension | Distal renal splenum shunt | 1 |
| Gastric peroration | Primary closure | 1 |
| Colonic stenosis | Resection and anastomosis | 1 |
| Tricobeoazer | Gastrotomy, trichobezoar removal and primary closure | 1 |
| Mesenteric clamp | Duodenoplasty | 1 |
| Cholestatic syndrome | Liver biopsy | 1 |
| Esophageal atresia | Esophagoplasty | 1 |
| Diaphragmatic hernia | Diaphragmatic plasty | 1 |
| Gastrosquisis | Primary closure | 1 |
| Sewer | Urogenital sinus descent | 1 |
| intestinal perforation | Ileostomy | 1 |
| Intussusception | Devagination by taxis | 1 |
| Apendicitis and ileostomía | Ileostomy closure | 1 |
| Anorectal malformation | Colostomy closure | 1 |
| Hirschsprung | Duhamel descent | 1 |
| Anorectal malformation | Posterior sagittal anorectoplasty | 1 |
| Brachial arch remnant | Fistula resection | 1 |
| Esophageal atresia | Gastric tube | 1 |

Table 16. Pathologies that presented SSIs and the surgical procedure.

| **Microorganismo** | **Absolute number (%)** |
|---|---|
| *Escherichia coli* | 12 (33.8) |
| *Enterococcus faecalis* | 6 (16.6) |
| *Staphylococcus aureus* | 4 (11.1) |
| *Pseudomona aeroginosa* | 4 (11.1) |
| *Klebsiella pneumoniae* | 3 (8.3) |
| *Enterobacteria aerogenes* | 2 (5.5) |
| *Staphylococcus epidermidis* | 2 (5.5) |
| *Acinetobacter baumannii* | 1 (2.7) |
| *Morganella morganii* | 1 (2.7) |
| *Enterobacter cloacaeblee* | 1 (2.7) |

Of the 57 patients who developed SSI, 38 were cultured, 36 developed microorganisms, and 6 did not. Table 16 shows the characteristics of the microorganisms isolated. Tables 17 to 20 show the percentages of each variable with SSI related to 100% of them

Table 17. Characteristics of isolated microorganisms

| Variable | With ISQ | Total | Percentage |
|---|---|---|---|
| Immunocompromised | 22 | 340 | 6.47 |
| Immunocompetent | 35 | 930 | 3.76 |
| Total | 57 | 1270 | |

100% of the crops with development were antibiogram, the results are discussed below

*Acinetobacter baumannii* (1 cultivo), resistente ceftriaxona. amikacina, ceftazidima, piperacilina/ tazobactam. Sensible a tetraciclina, meropenem y ciprofloxacino.

*Morganella morganii* (1culture), resistant ampicillin and cefuroxime. Sensitive amikacin, ceftazidime,

ciprofloxacin, meropenem, and ampicillin.

*Enterobacter cloacaeblee* (1 culture), resistant meropenem, ceftriaxone, ampicillin, sensitive amikacin and ciprofloxacin.

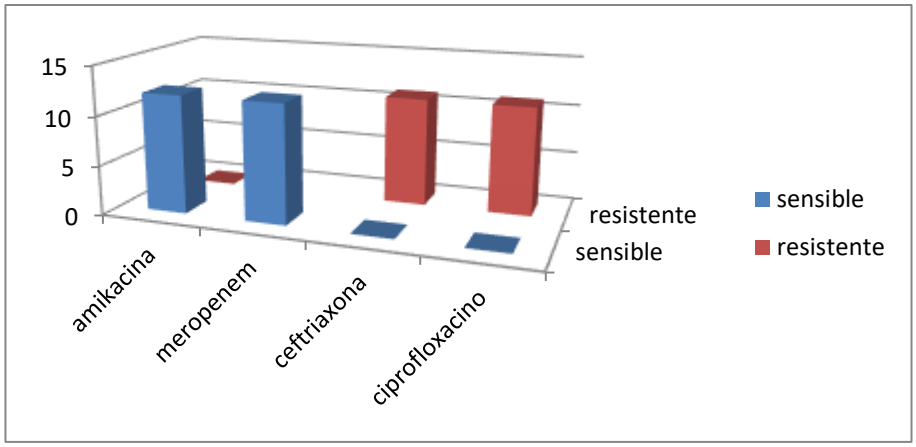
Table 18. Immunocompromise variable, total number of patients in relation to those who developed SSI.

| Age group | With ISQ | Total | Percentage |
|---|---|---|---|
| Baby | 8 | 58 | 13.79 |
| Infant | 7 | 172 | 4.06 |
| Older infant | 10 | 101 | 9.90 |
| Preschool | 15 | 366 | 4.09 |
| Pupil | 15 | 445 | 3.37 |
| Adolescent | 2 | 128 | 1.56 |
| Total | 57 | 1270 | 100 |

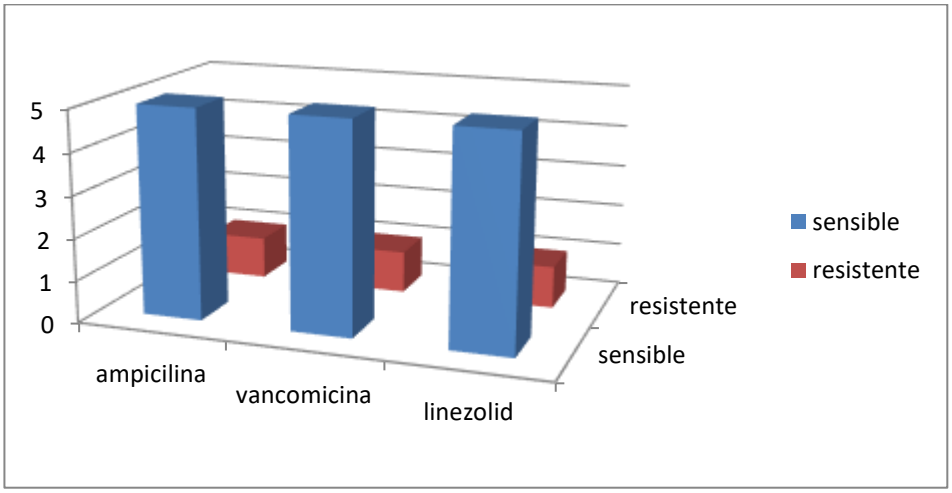
Table 19. Age group variable, we present the total number of patients and their relationship with the percentage who presented SSI

| Need for hospitalization | ISQ | Total | Percentage |
|---|---|---|---|
| Ambulatory | 2 | 217 | 0.91 |
| Hospital | 55 | 1053 | 5.22 |
| Total | 57 | 1270 | |

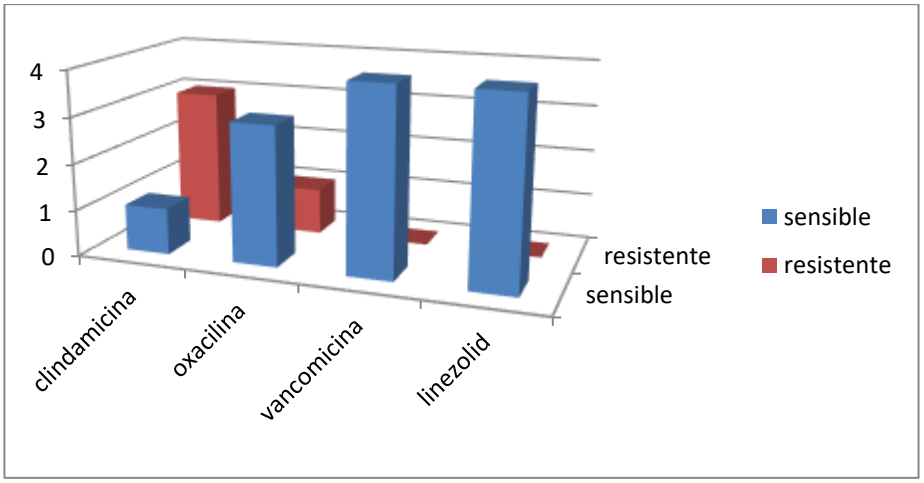
Table 20. Variable need for hospitalization, we present the total number of patients and their relationship with the percentage of patients with SSIs.



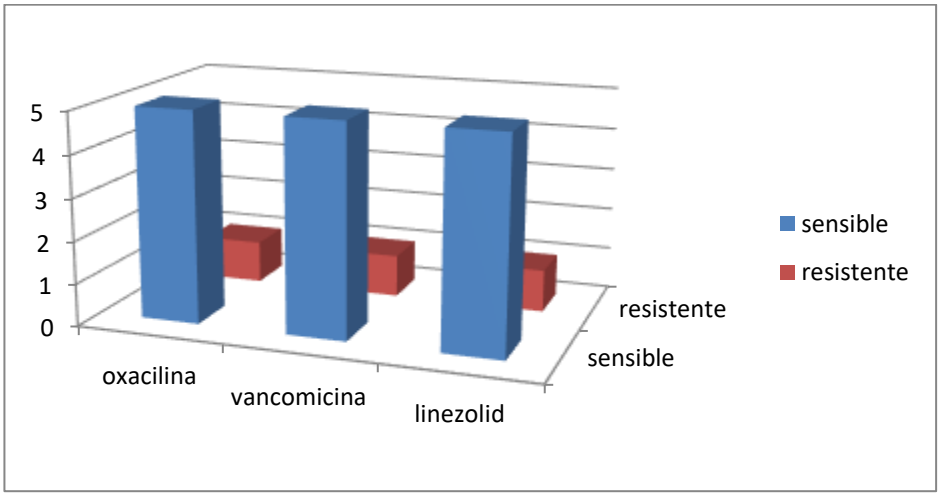

*Escherichia coli* (12 cultures), without resistance amikacia and meropenem. 11 resistant cultures ceftriaxone and cirprofloxacin.



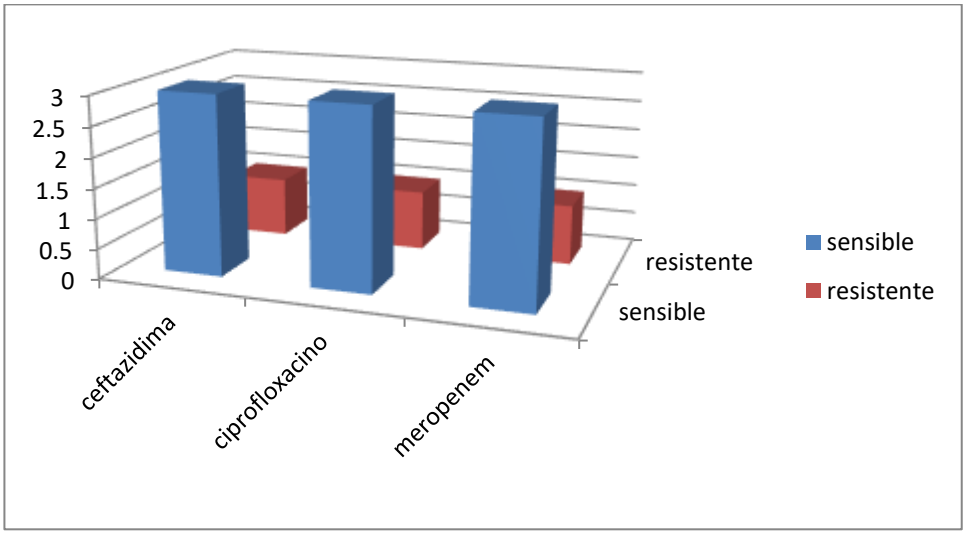

*Enterococcus faecalis* (6 cultures), 1 with multiresistance, 5 with multisensitivity.



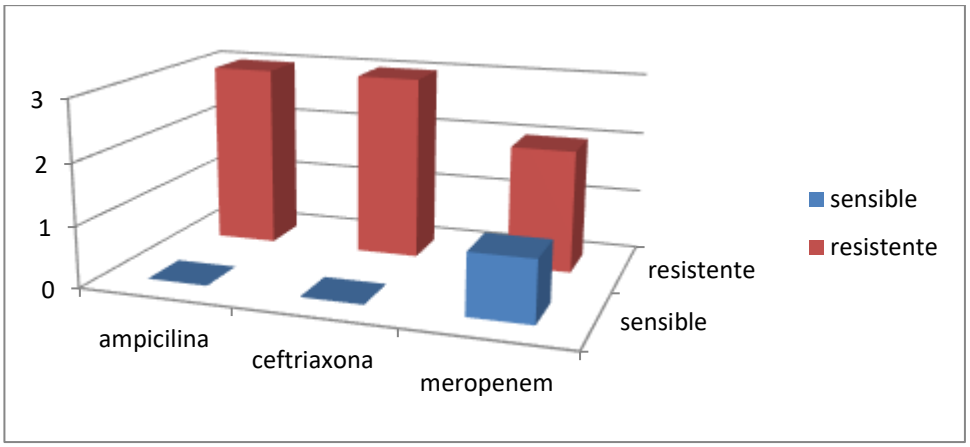

*Staphylococcus aureus* (4 cultures), without vancomycin or linezolid resistance, one oxacillin resistant culture and 3 clindamycin-resistant cultures.



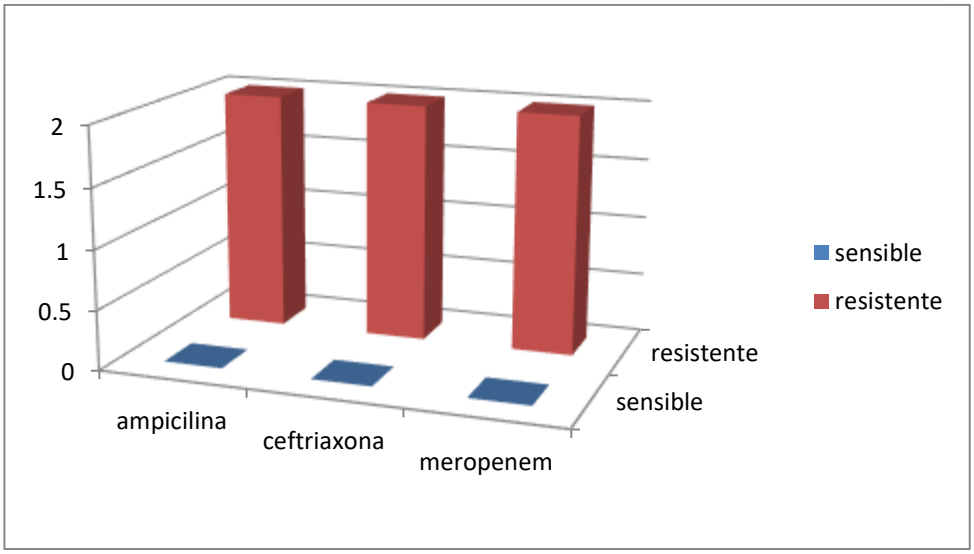

*Enterococcus faecalis* (6 cultures), 1 multiresistant culture, 5 multisensitive.



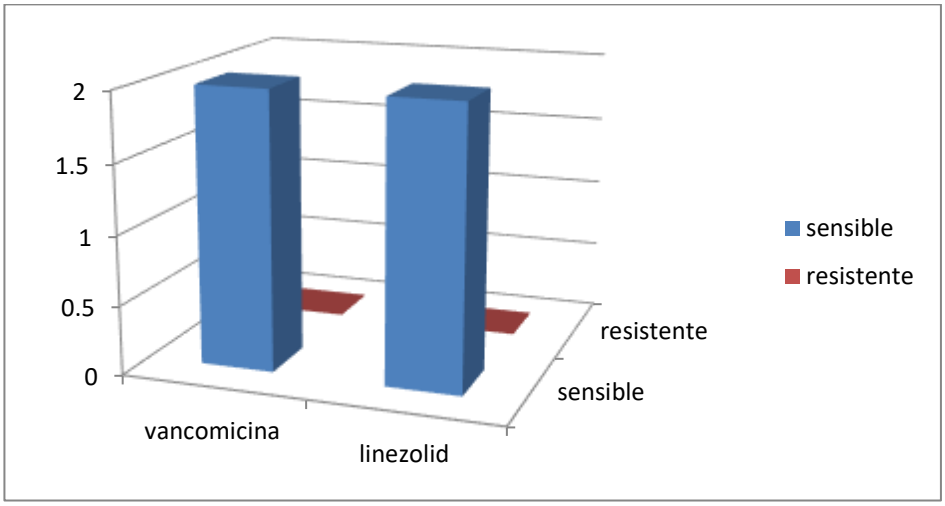

*Pseudomonas aeroginosa* (4 cultures), one multidrug-resistant, 3 multi-sensitive.




*Klebsiella pneumoniae* (3 cultures), all with ampicillin resistance and ceftriaxone, 1 resistant meropenem.




*Enterobacter aerogenes* (2 cultures), both multidrug-resistant.




*Staphylococcus epidermidis* (2 cultivos), multisensibles.

**Final considerations**

The data presented indicate that the frequency of surgical site infection in the pediatric surgery service is within the acceptable range (4.48%), as reported in the literature. An analysis of the percentages pertaining to the classification of surgical wounds (clean, clean-contaminated, contaminated, and dirty) indicates that the percentages are also within the acceptable parameters set forth by international standards.

It was observed that there were variables with very similar presentation percentages, namely male/female (4.29/4.82) and malnutrition/eutrophic (4.70/4.12). It is noteworthy that the percentage of malnourished patients is slightly higher than that of eutrophic patients, which is contrary to the findings reported in the existing literature.

The variables with the highest prevalence of surgical site infection were as follows (in descending order): previous surgery (18%), dirty surgery (16.66%), neonates (13.79%), older infants (9.8%), contaminated surgery (8.4%), obesity (6.6%), and immunocompromised patients (6.47%). As in the adult population, obesity represents a significant risk factor for the development of surgical site infection (SSI). It is therefore prudent to emphasize that, in this cohort, obesity presented a higher percentage than malnourishment.

During the data collection period, SSIs were identified in patients who underwent reoperation via the same surgical approach within the first 30 days of the initial surgery. Of the 74 patients who presented this variable, 14 (18%) had SSI. This was the most frequently presented variable.

Secondly, surgeries classified as "dirty" represent 16.66% of the total. This variable correlates directly with the findings reported in the literature, as well as with surgery performed during the neonatal period and contaminated surgery. In the older infant age group, 9.8% of SSI was present, and no factors could be identified as contributing to this condition. It may be hypothesized that the high prevalence of immunosuppression and associated comorbidities in this age group is a potential explanation, given that the population of this age that necessitates hospitalization in our hospital generally has some systemic disease that requires third-level care.

The variables exhibiting the lowest prevalence of surgical site infection are as follows: outpatient surgery (0.92%), clean surgery (1.31%), adolescents (1.49%), school (3.42%), and immunocompetent patients (3.46%).

A total of 57 surgeries presented with SSI, with 56% classified as superficial, 29.8% as deep, and 14.2% as a spatial organ. Of these, 20 (35%) were appendicitis cases. This finding is directly correlated with the microbiological data documented in the cultures. It is noteworthy that gram-negative bacteria

exhibit 100% sensitivity to amikacin and high resistance to ceftriaxone. The examination of anaerobic cultures was not within the purview of the protocol. All patients who developed SSI required in-hospital treatment, with an average length of stay of 9.4 days from the beginning until discharge. This was either due to a successful treatment outcome or due to meeting the criteria for outpatient management. The reference case was an appendicular picture with perforation that evolves satisfactorily and can be discharged from the service in 72 hours. However, if the patient presents with ISQ, their hospital stay is tripled, and there is an increase in the need for supplies.

It was not possible to include the following variables in the protocol:

Furthermore, additional variables that were not included in the protocol were: hemodynamic stability, hypothermia, oliguria, hypoglycemia, trans and post-surgical hypoxia, hydroelectrolyte imbalance, presence of metabolic acidosis, trade name of the prophylactic antibiotics used, complete nutritional assessment, anaerobic cultures, and peritoneal fluid cultures in search of multiresistant microorganisms from the community.

These variables represent significant shortcomings in the protocol that must be addressed in future research to ensure accurate analysis.

The surgical team bears significant responsibility for the patient's prognosis, considering the potential impact of surgical site infection from a variety of perspectives. The sole definitive course of action for the prevention of this adverse event is the comprehensive analysis of the pertinent data. This protocol represents a viable and readily reproducible option for that purpose.

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