Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 1s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Assessing the role of prophylactic antibiotics in surgical site infections: a systematic review and meta-analysis

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Cite this paper as: Chandra Pratap Dhimar, Aayush Vaishnaw, (2025) Assessing the role of prophylactic antibiotics in surgical site infections: a systematic review and meta-analysis. *Journal of Neonatal Surgery*, 14 (1s), 102-109.

ABSTRACT

The most frequent nosocomial infection in surgical patients is surgical site infection. A cephalosporin is the suggested prophylactic antibiotic for the majority of patients having clean-contaminated operations (such as cardiothoracic, gastrointestinal, orthopedic, vascular, and gynecologic). The public is informed about hospitals' adherence to infection control protocols. Primary care doctors should be aware of the Surgical Care Improvement Project's recommendations since they assist with patients' pre- and postoperative care. This meta-analysis and systematic review aim to evaluate the effectiveness of prophylactic antibiotics in preventing surgical wound infections during various surgical procedures. By integrating data from observational studies, cohort studies, and randomized controlled trials (RCTs), this review seeks to demonstrate the impact of prophylactic antibiotic use in reducing the incidence of both superficial and deep surgical wound infections when compared to placebo or no antibiotics. The investigation will examine the effectiveness of different antibiotic regimens as well as the optimal timings, dosages, and durations of antibiotic administration. Additionally, the evaluation will examine the impact of patient-related factors, such as comorbidities, on the effectiveness of prophylaxis. The primary outcome will be the rate of surgical wound infections, with the length of hospital stay, adverse events, and medical costs acting as secondary outcomes. By addressing the gaps in current clinical practice, this review will offer evidence-based recommendations for the use of prophylactic antibiotics in surgical settings. Future clinical guidelines and practices will be guided by these suggestions in an effort to enhance patient outcomes and reduce healthcare expenses

Keywords: *Surgical site infection, Prophylactic antibiotics, Wound infection.*

1. INTRODUCTION

Surgical Site Infections (SSIs) represent a significant issue in contemporary medicine. The surgical site presents an immediate risk to the body because it may be a point of entry for external organisms, and infections cause wounds to take longer to heal. Reducing the bacterial burden around the incision site is the aim of the preoperative phase, which is seen to be the most important stage of a surgical surgery. One way to prevent Surgical Site Infections (SSIs), one of the most frequent avoidable post-surgery consequences including Healthcare-Associated Infections (HAIs), is to use antibiotics before the surgical incision. To effectively lower SSI rates, aparenteral prophylactic medication spectrum with corresponding possible microorganisms on specific surgical sites has recently been suggested. On the other hand, several preoperative techniques, like mechanical bowel preparation and hair removal, are now thought to be ineffective at lowering SSIs. When using preventive antibiotics, the financial impact of SSIs should be considered. A local inoculum that is strong enough to penetrate host defenses and initiate development is necessary for wound infection to begin [18]. The intricate process relies on the interplay of several microbial, host, and local tissue virulence factors. Preoperative improvement of comorbid ailment, control of the activity climate, suitable skin washing, and the utilization of aseptic careful procedure are a few instances of practices intended to keep away from wound disease. These actions by and large intend to adjust the host and neighborhood tissue factors. The viability and effect of anti-microbial prophylaxis have been demonstrated to be significant, notwithstanding the way that it is just a single somewhat little exertion among a few deterrent methodologies. Prophylactic anti-infection agents ought to be (1) proficient against pathogenic microorganisms, (2) gain adequate levels in nearby tissue, (3) make not many antagonistic impacts, (4) be sensibly estimated, and (5) not probably select for destructive creatures [13]. The decision of anti-infection might be affected by the emergency clinic climate and the microbiological setting of the injury, however inclusion ought to essentially target life forms known to cause postoperative contamination. Most tasks that don't

include an empty viscus or mucosa can bring about disease from Staphylococcus species. These prerequisites are much of the time met by original cephalosporins, which are remembered to give satisfactory prophylaxis to by far most of medical procedures. Cefazolin (Ancef, Kefzol) is the medicine that is most often managed [1]. Inclusion for genitourinary, hepatobiliary, and wholesome lot methods ought to likewise be affected by site-explicit verdure, including anaerobic and gram-negative organisms. Cefotetan (Cefotan) or cefoxitin (Mefoxin) are fitting specialists in these circumstances. While vancomycin (Vancocin) is a reasonable alternative to Staphylococcus in patients with established cephalosporin sensitivity, metronidazole (Flagyl) or clindamycin (Cleocin) combined with an aminoglycoside can be utilized to include anaerobic and gram-negative organisms separately [2]. In a similar situation, clindamycin and metronidazole can be used simultaneously, however Aztreonam (Azactam) cannot. A quinolone, like ciprofloxacin (Cipro), may also be useful for covering gram-negative bacteria, even though there is no information on the setting of prophylactic. The timing of the organization is crucial. The medication should be administered immediately following the point of intake, preferably within 30 minutes and, to a lesser extent, within 2 hours or less. The underlying measurement should be continually controlled before the skin entry point is played out [14]. For longer periods of time or twice the medication's half-life (at a comparable dosage), repeated administration of the medication is advised. Regardless of how long the exercise lasts, this guarantees appropriate tissue levels.

2. LITERATURE REVIEW

Discharge wounds have traditionally been treated using a mixture of worms, rose oil, and foliage from a mummy's skull collected at a full moon. In any event, various documents suggest that this bubbling mixture was left undone without taking into account young, little canines. Ambroise Paré's use of unboiled turpentine, rose oil, and egg yolk was said to be modest [11]. In the 1600s, redness, warmth, and purulence were considered to be essential components of wound healing since wound diseases were so prevalent [3]. Despite being shown to be effective in reducing puerperal sepsis in the 1800s, when it was first proposed by Holmes. As only patients who were still alive generated discharge, this is most likely the rationale behind the assurance of "commendable discharge." Lockjaw, fast progressing delicate tissue contaminations (streptococcal or mixed synergistic infections), and erysipelas almost always represented irresistible complications after major surgical procedures [7]. The corresponding pass rate was high. Following the introduction of carbolic corrosive splash, which was used on patients, specialists, and the entire working area, disease rates were drastically reduced to less than 10%. The "germ-free standard," however, was not widely adopted [10]. However, Lister's findings developed an approach more receptive to Pasteur's theory of rottenness, which maintained that organisms were the source of purulence [4]. After handwashing and the use of clean procedures, disease rates approached current levels [8]. Nonetheless, infection rates for gastrointestinal procedures remained high because of the bacteria's endogenous origin [9]. Antibiotics were administered either immediately before or after the organisms were implanted, resulting in lesions histologically equivalent to those induced by intradermal inoculation with deceased organisms [5]. The lesions created by even a three-hour delay in antibiotic treatment were identical to those observed in animals who did not receive antibiotics [15]. The importance of treatment timing for preventative effectiveness was widely acknowledged, and it was further shown that this timing is dependent on the presence of peak antibiotic levels in the tissue during a time when the local concentration of microorganisms would ideally be high [17]. Additional research has focused on establishing specific procedures, safeguards, and effectiveness.

Research question

Do patients having various procedures experience less surgical wound infections when taking preventative antibiotics?

Objectives

- To assess how well prophylactic antibiotics, work to prevent surgical wound infections in patients having different kinds of surgery (e.g., cardiovascular, abdominal).
- To determine the proportional risk of surgical wound infections in patients who are given preventive antibiotics as opposed to those who are given a placebo or no antibiotics at all.
- To investigate how hospital outcomes, such as length of stay, mortality rates, and medical expenses related to surgical wound infections, are affected by prophylactic antibiotic use.

3. METHODOLOGY

Study design: This systematic review and meta-analysis will cover Randomized Controlled Trials (RCTs), cohort studies, and other relevant observational studies that assess the use of prophylactic antibiotics versus no antibiotics or placebo in reducing surgical wound infections. The studies will be located using extensive database searches, including those carried out by the Cochrane Library, PubMed, and others. High-quality studies that include surgical wound infection rates, antibiotic delivery protocols, and patient outcomes will receive particular consideration. Which studies are included will depend on certain inclusion criteria, including the type of operation, open reporting of infection outcomes, and appropriate control groups.

Inclusion criteria: Only research showing the frequency of both superficial and deep surgical wound infections will be included. Furthermore, studies must involve adult patients (18 years or older) undergoing elective or emergency surgery, independent of the surgical specialization (e.g., abdominal, orthopedic, cardiac, or gynecological surgery). The trials must be clear about the kind of antibiotic used, when and how long it is given, and the infection outcomes that are measured. Only trials with a control group that is given a placebo or no antibiotic treatment will be included in order to facilitate direct comparisons. Studies including patients who had previous surgical wound infections or who were immunocompromised at the time of surgery will also be considered if the results are shown separately for these subgroups.

Exclusion criteria: trials without a control group, non-randomized research, or studies that don't explicitly state the results of surgical wound infections.

Intervention: This includes any antibiotic regimen used to lower the risk of surgical wound infections before, during, or immediately following surgery. The study will consider various antibiotic types, such as broad-spectrum antibiotics, cephalosporins, and penicillins, depending on the specific surgical operation, patient characteristics, and local patterns of antibiotic resistance. The timing and length of antibiotic administration will also be assessed, including whether the drugs are given at the moment of incision, an hour prior to surgery, or for a certain period of time following surgery. We will accept studies that compare the effectiveness of prophylactic antibiotics in preventing infections to alternative prophylactic regimens, a placebo, or no antibiotic treatment.

Data collection: to use a range of electronic resources, including PubMed, the Cochrane Library, Scopus, and others, to locate relevant studies that meet the inclusion criteria. The search will primarily focus on observational studies, Randomized Controlled Trials (RCTs), and cohort studies that compare the use of prophylactic antibiotics with no antibiotics or a placebo in surgical patients. The process will also entail manually searching the reference lists of significant articles, review articles, and clinical recommendations to ensure that no relevant studies are missed. Data from each study will be extracted using a standardized form that captures key study characteristics, such as sample size, patient demographics, surgical type, antibiotic regimen, and outcome measures (e.g., surgical wound infections, mortality, length of hospital stay, and adverse effects).

Prophylactic antibiotics in surgical wound infection related to abdominal procedure

For the majority of gastrointestinal procedures, prophylaxis is advised. The suggestion varies depending on the section of the gastrointestinal tract that is penetrated during the treatment since the quantity of creatures and the level of anaerobic life forms steadily ascend along the gastrointestinal lot. Methodology including the stomach, duodenum, and proximal small bowel carry a very low inherent risk of infection, which disproves the regular need for prophylaxis.

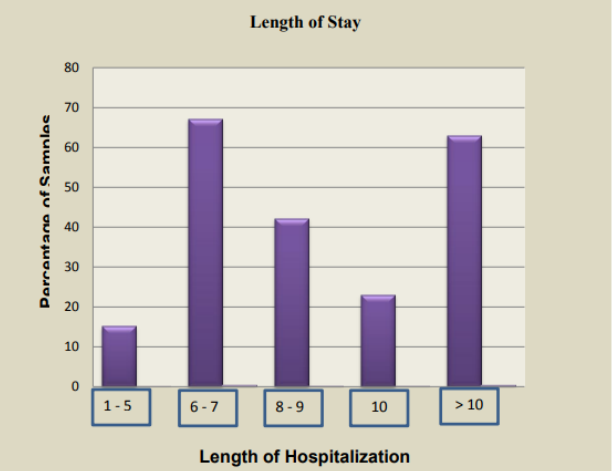

Figure 1: Distribution of length of hospital stay of patients

The majority of clinical practice, however, involves unique situations that change this advice. The quantity of germs and the danger of wound infection are significantly increased in any situation when there is a drop in stomach acidity. Thus, the patient is eligible for prophylaxis if they have previously used antacids, histamine blockers, or proton pump inhibitors [6].

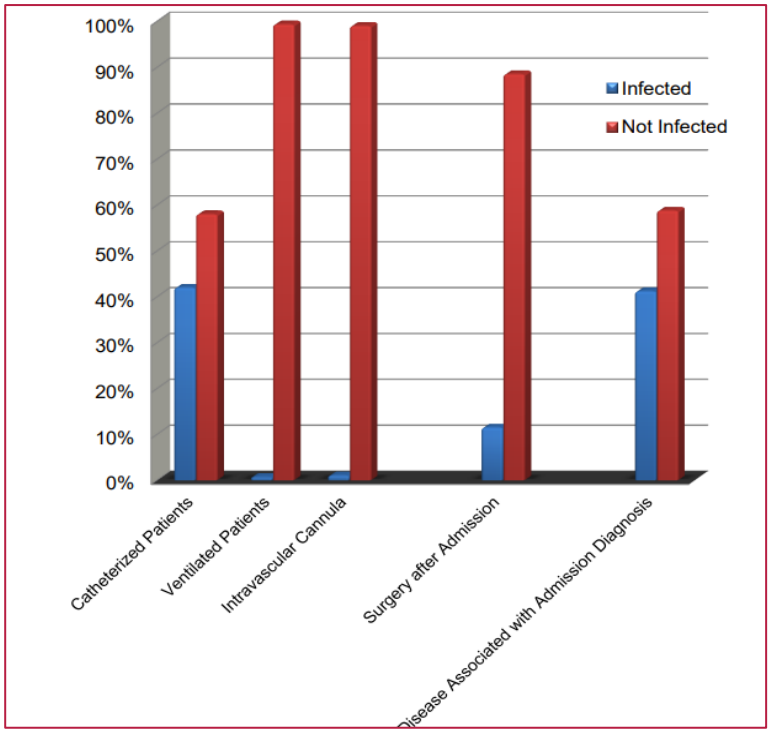

Figure 2: Distribution of risk factors of nosocomial infections

Prophylaxis is also recommended for procedures that address bleeding in the upper gastrointestinal tract. Prophylactic measures to remove blockage are necessary since stasis also raises bacterial numbers. Furthermore, prophylaxis is warranted in patients with advanced cancer and morbid obesity due to the elevated intrinsic risk of infection. Cefazolin is the suggested medication and offers sufficient prophylaxis, despite the fact that the local flora is changed in these patients.

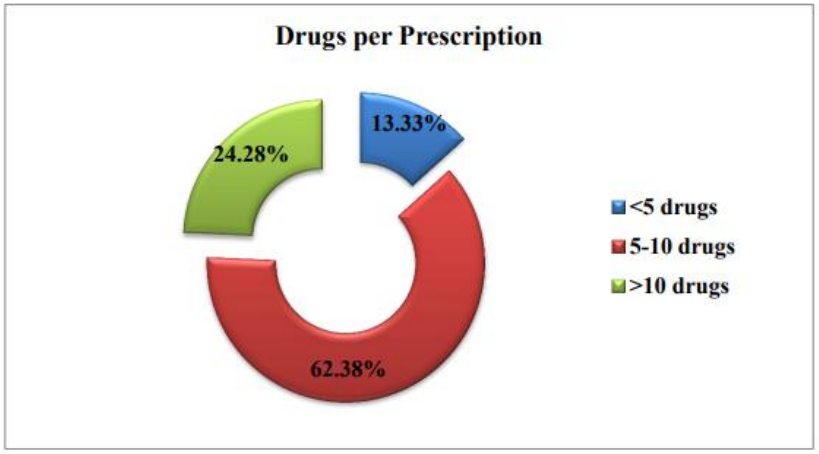

Figure 3: Distribution based on drugs per prescription

Additionally, prophylactic appendectomy is recommended. Regardless of whether the inherent risk of contamination is modest for a simple diseased appendix, the preoperative condition of the patient's supplement is usually unknown. Experts such as cefotetan or cefoxitin are suitable.

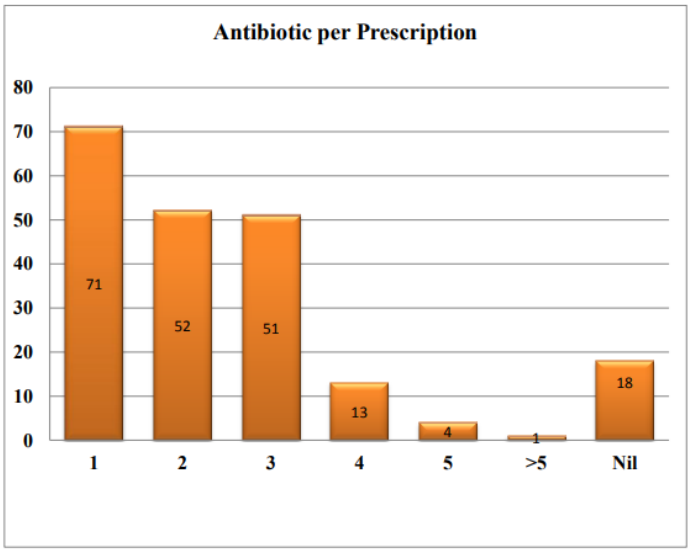

Figure 4: Distribution of antibiotics per prescription

It is also appropriate to use metronidazole in combination with a quinolone or an aminoglycoside. It is not necessary to extend coverage to the postoperative phase for simple appendicitis. Any thought of prevention is moot because complicated appendicitis (such as with concomitant perforation or gangrene) is a justification for antibiotic therapy [12].

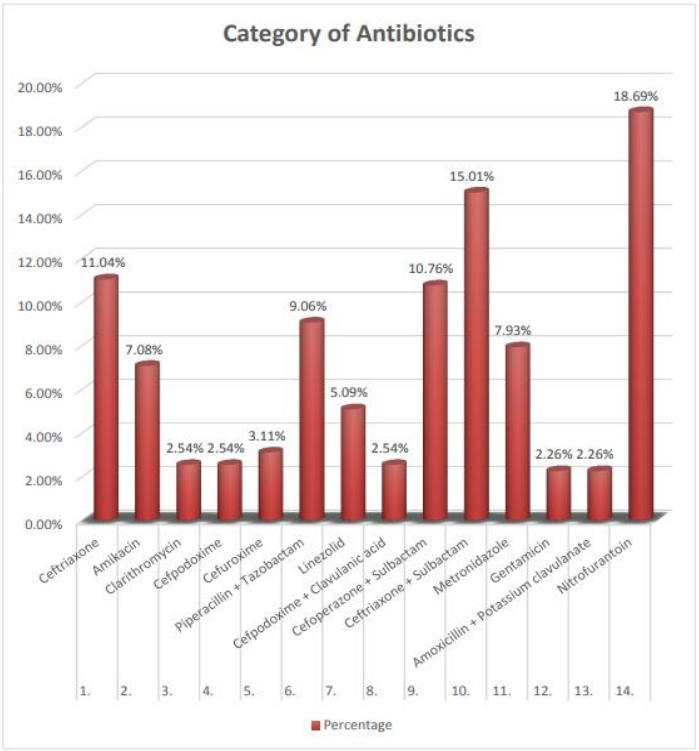

Figure 5: Distribution of category of antibiotics prescribed

Prophylactic antibiotics in surgical wound infection related to cardiac procedures

Prophylactic medication against S. aureus and S. epidermidis is recommended for patients undergoing cardiac surgery. Despite the small chance of illness, the likelihood of mediastinitis or sternal injury contamination is considerable. Numerous analyses have been conducted on antimicrobial regimens in light of vancomycin, penicillin, and first-, second-, or third-age cephalosporins. Despite the effectiveness of prophylaxis, no routine has been shown to be conspicuously common.

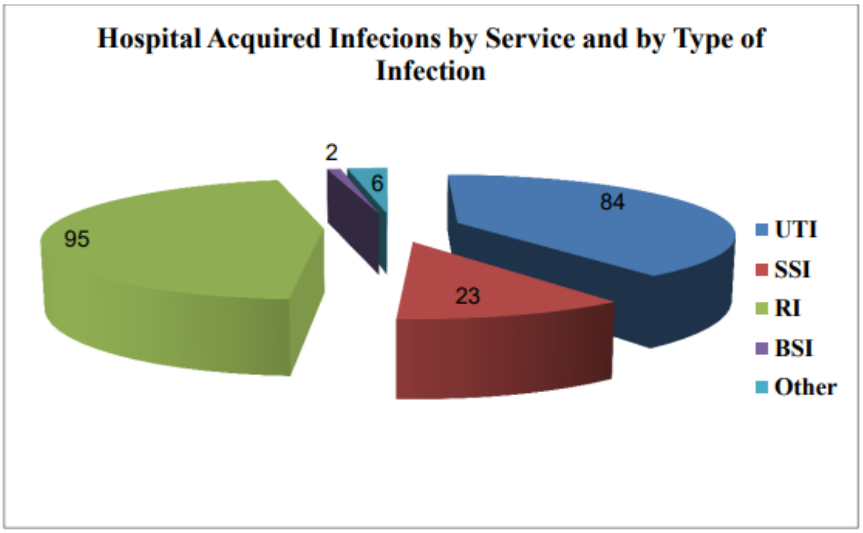

Figure 6: Hospital acquired infections by service and by type of infection

Results varied by institution in several instances, with methicillin-resistant S. aureus or S. epidermidis being found at abnormally high rates. Cefazolin is a suitable agent notwithstanding these exceptions. Importantly, cardiac bypass decreases medication excretion, therefore extra intraoperative dosages are usually not required [16].

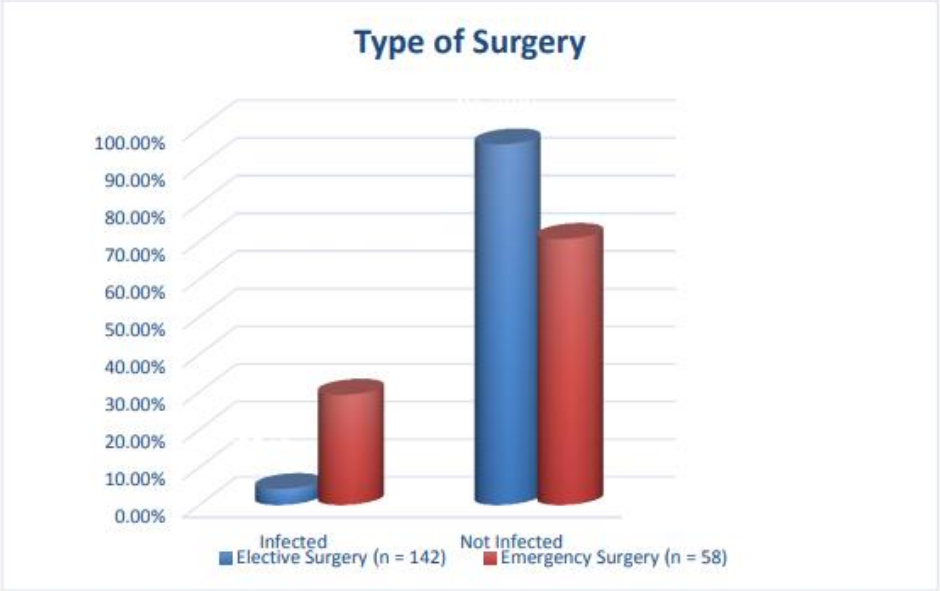

Figure 7: Type of surgery in patients

The ideal prophylactic duration is a topic of ongoing discussion; many clinicians recommend prophylaxis for more than 24 hours, or until chest tubes and obtrusive lines are withdrawn. The majority of specialists only treat patients for a day or so. Proof does not support or advise continuing to cover until all lines and cylinders have been removed.

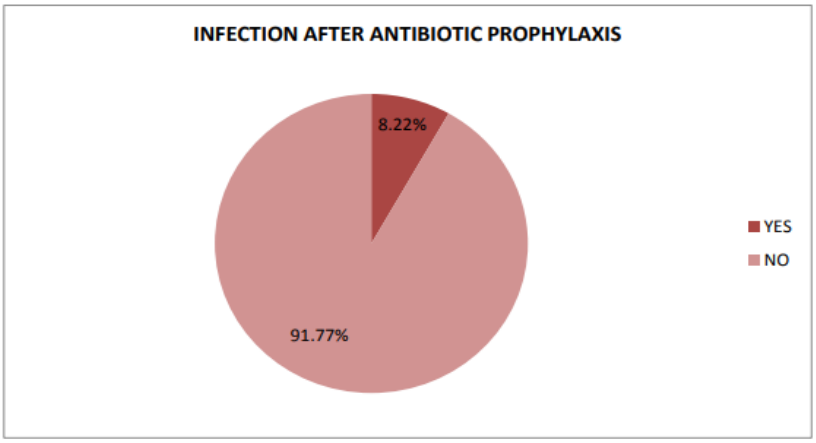

Figure 8: Type of surgery in patients

Procedures involving the skin and superficial soft tissues are not recommended for prophylaxis. Although it is acceptable, prophylactic therapy is not strongly advised for patients who have at least two significant risk factors. When treating damaging injuries, the patient's lockjaw immunization status should be taken into account. Even though a single antimicrobial component is permitted, the essential components of prophylaxis include mechanical washing and adhering to protocols for open delivery of wounds created more than 12 hours before treatment.

4. CONCLUSION

Healthcare is severely burdened by surgical site infections (SSIs), particularly in laparoscopic procedures. It is the primary cause of death, filth, and medical care expenses. Following stomach and heart surgery, SSIs are challenging problems. Its effects include increased grimness, mortality, and poor patient outcomes. Because it is essential to take precautions like sanitizing the surgical site and managing aseptically. Furthermore, it is important to utilize antibiotics to reduce SSIs. However, more nuanced approaches are required to address problems relating to antibiotic abuse that cause microbial resistance. The survey highlights some issues that need further investigation while acknowledging the limitations of exact audits, such as possible distribution bias and differences in focus methods. This systematic review essentially acts as a thorough resource for medical practitioners looking to improve SAP procedures in order to reduce the risk of SSIs following abdominal surgery. Healthcare professionals can help lower SSIs, enhance patient safety, and improve the standard of surgical care globally by incorporating evidence-based recommendations and encouraging responsible antibiotic management.

REFERENCES

[1] Najjar PA, Smink DS. Prophylactic antibiotics and prevention of surgical site infections. Surgical Clinics. 2015 Apr 1;95(2):269-83.

[2] Muhammed Jaseel EK, Kokila R. Application designed to revolutionize the way people discover and book sports grounds effortlessly (Game Snap). International Journal of Advanced Innovation Research [Internet]. 2024 Aug 5 [cited 2025 Jan 22];11(2):1-12. Available from: https://iaiest.com/iaj/index.php/IAJIR/article/view/IAJIR1108

[3] Polk Jr HC, Christmas AB. Prophylactic antibiotics in surgery and surgical wound infections. The American Surgeon. 2000 Feb;66(2):105-11.

[4] Mehrani MJ, Tashayoei MR, Ferdowsi A, Hashemi H. Qualitative evaluation of antibiotics in WWTP and review of some antibiotics removal methods. Int Acad J Sci Eng. 2016;3:11-22.

[5] Jalali N, Doosti M, Ighani M. A survey on abortion laws in Asian countries. Int Acad J Humanit. 2018;5(1):101-111. Available from: https://doi.org/10.9756/IAJH/V5I1/1810011

[6] Eckmann C, Aghdassi Johannes Sam, Brinkmann Alexander, Pletz Mathias, Rademacher Jessica. Perioperative antibiotic prophylaxis: indications and modalities for the prevention of postoperative wound infection. Deutsches Ärzteblatt International. 2024;121(7):233

[7] Tirkey S, Mishra D, Mahalik DK. A study on 'Why outsourcing in health care' by Friedman two-way analysis of variance method. Int Acad J Organ Behav Hum Resour Manag. 2020;7(1):1-8. Available from: https://doi.org/10.9756/IAJOBHRM/V7I1/IAJOBHRM0701

[8] Tran H, Ngoc D. The influence of effective management on hybrid work styles and employee wellness in

healthcare organizations. Global Perspect Manag. 2024;2(4):8-14.

[9] Hartigan P. Advancement of dose efficacy in pharmacogenomics with clinical practice. Clin J Med Health Pharm. 2024;2(2):1-10.

[10] Chen PJ, Hua YM, Toh HS, Lee MC. Topical antibiotic prophylaxis for surgical wound infections in clean and clean-contaminated surgery: a systematic review and meta-analysis. BJS open. 2021 Nov 1;5(6):zrab125.

[11] Mthembu T, Dlamini L. Thermodynamics of Mechanical Systems Principles and Applications. Association Journal of Interdisciplinary Technics in Engineering Mechanics. 2024 Sep 30;2(3):12-7.

[12] Freitas AC, Ferraz ÁA, Barchi LC, Boin ID. Antibiotic prophylaxis for abdominal surgery: When to recommend? Brazilian college of digestive surgery position paper. ABCD. Arquivos Brasileiros de Cirurgia Digestiva (São Paulo). 2023 Sep 15;36:e1758.

[13] Unger S. Exploring malacological observations on iNaturalist: Citizen science as a tool for monitoring freshwater mussels. International Journal of Aquatic Research and Environmental Studies.:0-.

[14] Hawn MT, Richman JS, Vick CC, Deierhoi RJ, Graham LA, Henderson WG, Itani KM. Timing of surgical antibiotic prophylaxis and the risk of surgical site infection. JAMA surgery. 2013 Jul 1;148(7):649-57.

[15] Heng S, Aimtongkham P, So-In C. A Novel Video-on-Demand Caching Scheme using Hybrid Fuzzy Logic Least Frequency and Recently Used with Support Vector Machine.

[16] Zukowska A, Zukowski M. Surgical site infection in cardiac surgery. Journal of Clinical Medicine. 2022 Nov 26;11(23):6991.

[17] Al Riyees L, Al Madani W, Firwana N, Balkhy HH, Ferwana M, Alkhudhayri A. Antibiotic prophylaxis against surgical site infection after open hernia surgery: a systematic review and meta-analysis. European Surgical Research. 2021 Oct 26;62(3):121-33.

[18] Adekunle Micheal A, Anjorin SO, Abdul Razak SF. Safety in Connected Health Network: Predicting and Detecting Hidden Information in Data Using Multilayer Perception Deep Learning Model. Journal of Internet Services and Information Security. 2024;14(4):524-41.