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Original Research Article

Strategies to prevent surgical site infection and current antibiotic prophylaxis in surgery

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Abstract

Background: Surgical site infections (SSIs) are the most common nosocomial infections, causing significant morbidity and mortality. The development of SSIs is influenced by various factors, including the indiscriminate use of antibiotics, which has led to the emergence of antibiotic-resistant strains. An antibiogram is essential for summarizing the most important antibiotic resistance patterns in a hospital, and this study helps prepare one by identifying bacterial isolates and correlating antibiotic usage with their susceptibility patterns.

Objectives: This study aims to determine the bacteriological profile of SSIs and their respective antibiotic susceptibility patterns. The study aims at strategies to prevent surgical site infection and current antibiotic prophylaxis in surgery.

Methods: The study is an observational, cross-sectional, ambispective analysis conducted in the Department of Surgery. A total of 100 patients who met the inclusion criteria were enrolled. A predesigned proforma was used to collect data on demographics such as age and sex, as well as variables like BMI, comorbidities, prophylactic antibiotic use, and preoperative and postoperative waiting periods. These variables were compared between infected and non-infected groups. Statistical analysis was performed using Microsoft Excel and SPSS software, with significant risk factors analyzed via binary logistic regression.

Results: Out of the 100 patients, 15 developed SSIs, with a higher incidence seen in females (8 cases) compared to males (7 cases). The incidence of SSIs was higher with increased preoperative stay and longer post-operative days. The most commonly used prophylactic antibiotic was Wakcef 1.5g. The highest incidence of SSIs was found in OBG (36.3%), followed by Orthopedics (28.5%) and General Surgery (6.15%).

Conclusion: The organisms isolated included **E. coli**, **Acinetobacter baumannii**, **MSSA**, **MRSA**, **Klebsiella aerogenes**, and **Klebsiella pneumoniae*, with **Klebsiella pneumoniae**, **E. coli**, and **MRSA** being the most prevalent.This study highlights the importance of understanding SSIs to aid in diagnosis, early intervention, and better antibiotic use, ultimately reducing SSIs and improving healthcare efficiency.

Keyword: Surgical site infection, Surgical Antibiotic Prophylaxis, Antibiogram, Antibiotic susceptibility pattern,Surgical site infection prevention,Risk factors affecting surgical site infection.

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1. Introduction

Surgical site infections (SSIs) are infections that occur after any surgical procedure, typically within one month if no implant is used, or within one year if an implant is involved. In our population, common risk factors for SSIs include diabetes mellitus, smoking, prolonged preoperative and postoperative hospital stays, advanced age, and obesity.

In the second half of the 19th century, Ignaz Philip Semmelweis discovered that effective handwashing with antiseptics could prevent puerperal sepsis in postnatal mothers. Joseph Lister's introduction of antiseptics, particularly carbolic acid, significantly reduced infections in surgical patients. Louis Pasteur, Oliver Wendell Holmes, and Theodor Kocher all contributed to the understanding of infectious diseases. William Halsted demonstrated that aseptic and antiseptic techniques were crucial in preventing postoperative infections.[3]

The discovery of penicillin by Alexander Fleming in 1928 revolutionized the treatment of wound infections.

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However, the widespread and indiscriminate use of antibiotics today has made it increasingly difficult to prevent and control such infections. The rising incidence of serious infections is often linked to longer, more complicated surgeries, an aging population with chronic conditions, the use of implants, the use of immunosuppressive drugs in organ transplant patients, and advanced diagnostic techniques that increase exposure to microorganisms.[1]It is the surgeon's responsibility to manage these infections, which requires a thorough understanding of aseptic and antiseptic techniques. Proper use of prophylactic and therapeutic antibiotics is essential. Additionally, adopting effective surgical techniques plays a key role in reducing the incidence of surgical site infections.

2. CDC Classification of Surgical Wound Infections

2.1. Incisional infections

These are further divided into two types:

2.2. Superficial Deep

Organ/Space Infections

These occur within 30 days following surgery and involve any part of the anatomy (e.g., organs or spaces) other than the incision that was opened or manipulated during the procedure.

3. Classification of Surgical Site Infections (SSI)

3.1. Clean wound

An uninfected operative wound showing no signs of inflammation and not involving entry into the respiratory, alimentary, genital, or uninfected urinary tract. Clean wounds are primarily closed.

3.2. Clean contaminated wound

An operative wound in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions without unusual contamination.

3.3. Contaminated wound

This category includes operations with significant breaches in sterile technique, gross spillage from the gastrointestinal tract, or incisions where acute, non-purulent inflammation is observed.

3.4. Dirty wound

In this case, organisms are already present in the wound prior to surgery. This includes old traumatic wounds that exhibit clinical infection.**Error! Reference source not found.**

4. Infection Risk by Wound Type

1. Clean: 1-5%
2. Clean Contaminated: 3-11%
3. Contaminated: 10-17%
4. Dirty: 27%

5. Risk Factors for Surgical Site Infections (SSI)

In addition to the specific details of the surgical procedure, various clinical characteristics and patient factors contribute to the risk of developing an SSI. Despite numerous studies on these risk factors following abdominal surgeries, it is challenging to regulate the large amount of available data and adjust for all variables when calculating individual risk. A thorough understanding and evaluation of these complex factors is necessary to improve the standard of surgical care.[11]

5.1. Bacterial Factors

The bacterial load and virulence factors at the surgical site are key contributors to infection. Virulence factors that inhibit phagocytosis include the slime layer of coagulase-negative Staphylococci and the capsule of Klebsiella. Surface components, such as endotoxins or lipopolysaccharides in gram-negative bacteria and exotoxins in certain gram-positive bacteria, can establish infections within 1-5 days.[3]

Bacterial load (or inoculum) is an inevitable factor in causing infections. Conditions associated with bacterial load include:

1. Length of preoperative stay
2. Preoperative shaving, which increases the risk of infection and bacterial burden.

5.2. Local wound factors

Several factors contribute to infection risk at the wound site, including:

1. The invasiveness of the surgery
2. The skill of the surgeon
3. Breaks in the body's barrier defenses (e.g., skin or the mucosa of the gastrointestinal tract)
4. Proper use of sutures, drains, and foreign bodies, such as implants.

5.3. Patient-related factors

The following factors increase the risk of surgical site infections:

1. Age, immunosuppression, steroid use, malignancy, smoking, diabetes, and malnutrition.
2. Maintaining normothermia.
3. Enhancing oxygen tension and white blood cell function in the operating room.
4. Proper management of blood sugar levels in the perioperative period.[3]

6. Perioperative Antimicrobial Prophylaxis

Exogenous microorganisms, such as those from water, air in the operating room, surgical equipment, or theatre staff, can lead to infections. Studies by the CDC have shown that common pathogens causing surgical site infections include *Escherichia coli* (*E. coli*), *Klebsiella pneumoniae*, *Methicillin-resistant Staphylococcus aureus* (MRSA), *Methicillin-sensitive Staphylococcus aureus* (MSSA), *Acinetobacter baumannii*, and *Klebsiella aerogenes*.

Escherichia coli remains the most common cause of surgical site infections in clean-contaminated and contaminated procedures. Understanding the microbiology of surgical site infections is essential for effective treatment and prophylaxis. Key strategies to reduce bacterial load at surgical sites include:

1. Adhering to aseptic practices
2. Following antiseptic protocols
3. Using antimicrobial prophylaxis.

However, the indiscriminate use of antibiotics has led to the emergence of antibiotic-resistant strains, contributing to an increase in the incidence of surgical site infections.[3]

7. An Antimicrobial Agent for Surgical Prophylaxis Should:

1. Prevent surgical site infections (SSIs).
2. Reduce SSI-related morbidity and mortality.
3. Decrease the length and cost of medical care.
4. Have no adverse effects.
5. Not disrupt the patient's microbiological flora. Inappropriate or prolonged postoperative antibiotic prophylaxis can alter an individual's and an institution's bacterial flora, leading to changes in colonization rates and an increase in antibiotic resistance.[9]

8. Worldwide Recommendations for Preventing Surgical Site Infections

On November 3, 2016, the first global recommendations for preventing SSIs were released, with a revised edition published in December 2018 that included updates. These guidelines provide 29 specific recommendations based on 28 systematic reviews covering 23 topics related to SSI prevention before, during, and after surgery. The 2018 edition included a revised recommendation regarding the use of 80% fraction of inspired oxygen (high FiO2) for surgical patients under general anesthesia with tracheal intubation, along with an updated section on its application. The World Health Organization (WHO) conducted an updated systematic review on the effectiveness of high FiO2 in reducing SSIs, commissioning an additional review to assess potential adverse effects. This review, carried out between 2017 and 2018, led the Guideline Development Group (GDG) to downgrade the recommendation from firm to conditional based on the new evidence.[5]

9. Key Recommendations

1. **Mupirocin 2% ointment:** Should be administered intranasally to patients found to harbor *S. aureus* in their noses, either alone or in combination with chlorhexidine gluconate body wash.
2. **Colorectal surgery:** In adult patients undergoing elective colorectal surgery, mechanical bowel preparation should be used alone without oral antibiotics.
3. **Shaving:** Shaving should be avoided or restricted to clipping if necessary. It is strictly prohibited to shave the surgical site in the operating room or before surgery.
4. **Surgical antibiotic prophylaxis (SAP):** Should be administered before the surgical incision is made.
5. **Timing of SAP:** Surgical antibiotics should be administered within 120 minutes prior to incision, accounting for the antibiotic’s half-life.
6. **Surgical hand preparation:** Prior to donning sterile gloves, surgical hand preparation should be performed using antimicrobial soap and water or an alcohol-based hand rub.
7. **Skin preparation:** Patients should have the operative site prepared with alcohol-based antiseptic solutions containing chlorhexidine gluconate (CHG).
8. **Oxygenation:** Adult patients receiving general anesthesia with endotracheal intubation should receive 80% inspired oxygen during the procedure, and, if possible, during the first six hours postoperatively.
9. **Post-procedure SAP:** The administration of surgical antibiotic prophylaxis should be discontinued after the procedure is completed.45

9.1. Important considerations

While adequate SAP is essential for reducing the risk of SSIs, it should not replace other infection prevention strategies. Antibiotics alone cannot prevent SSIs. Comprehensive prevention should include:

1. Maintaining a sterile hospital and operating room environment
2. Adhering to proper hand hygiene protocols
3. Using careful surgical techniques to minimize tissue damage
4. Implementing sterilization protocols for medical equipment
5. Optimizing patient risk factors during surgery
6. Managing temperature, hydration, and oxygenation during the procedure
7. Controlling blood sugar levels

8. Ensuring proper care of surgical wounds

9.2. Conditional guideline recommendations

1. Immunosuppressive medication
2. Nutritional formulas
3. Bathing before surgery
4. Intranasal mupirocin
5. Antibiotics & MBP
6. Antimicrobial sealants
7. Warming devices
8. Blood glucose control
9. Fluid therapy
10. Drapes and gowns
11. Adhesive drapes
12. Wound protectors
13. Saline wound irrigation
14. Povidone iodine irrigation
15. Antibiotic irrigation
16. Neg pressure wound therapy
17. Coated sutures
18. Laminar flow ventilation
19. Peri-operative antibiotics
20. Wound drains
21. Advanced dressings.[Error! Reference source not found.]

9.3. Antibiogram

An antibiogram is a comprehensive profile of an organism's susceptibility to various antimicrobial drugs that are routinely tested and used in clinical practice. Most hospitals issue an antibiogram annually, which provides an overview of the hospital's key antibiotic resistance patterns. This study aims to develop an antibiogram for surgical site infections (SSIs) through a retrospective analysis. The study will identify bacterial isolates and correlate antibiotic usage with susceptibility patterns, ultimately preparing the antibiogram.[2]

Typically, three categories of Minimum Inhibitory Concentrations (MIC) are defined: Susceptible (S), Intermediate (I), and Resistant (R**)**, according to the Clinical and Laboratory Standards Institute (CLSI) criteria. These categories are used to interpret susceptibility reports, guiding clinicians in making therapeutic decisions for patients with infections. The antibiotic susceptibility test results are interpreted using CLSI guidelines, which promote the relevant and cost-effective use of antibiotics. The guidelines are continually refined to optimize antibiotic usage.

Antimicrobial susceptibility testing helps clinicians select the best antibiotic agents for patients while controlling the use of inappropriate antibiotics in clinical practice. With the increasing incidence of antibiotic-resistant bacteria in many hospitals, the concept of an antibiogram has become crucial. According to the CLSI, an antibiogram is "an overall profile of the antibiotic susceptibility of an organism to a collection of antimicrobial agents routinely tested and used.[2]

Most hospitals issue an antibiogram chart annually, summarizing the most significant antibiotic resistance patterns observed throughout the year. Antibiograms help clinicians assess local susceptibility rates, guide the selection of empiric antibiotic therapy, and monitor resistance trends over time. The antibiogram should present the susceptibility of the most frequently isolated gram-positive and gram-negative bacteria to commonly prescribed antibiotics, preferably in a tabular format.[2]

A one-time download of WHONET software simplifies the process of preparing an antibiogram. WHONET provides uniform instructions for conducting antibiotic susceptibility tests. It converts laboratory data into standard codes and file formats, facilitating national or international collaboration on antibiotic resistance surveillance. The WHONET software includes an integrated analysis program that assists in developing hospital drug policies, identifying outbreaks, and improving laboratory quality control.[3]

10. Antimicrobial Resistance Monitoring (ARM)

The World Health Organization (WHO) has launched an initiative called *Antimicrobial Resistance Monitoring (ARM)* to address the issue of antimicrobial resistance. To support decision-making at local, national, and international levels, reliable, publicly accessible data on antibiotic resistance is essential. To this end, WHO developed WHONET, a computerized system designed to manage and analyze microbiology data with a particular focus on antibiotic susceptibility results. WHONET is freely available for download and can be used to track antimicrobial resistance trends.

Surveillance of antimicrobial resistance and antibiotic consumption, along with the preparation of cumulative antibiograms at the local level, supports clinical decision-making, infection control interventions, and strategies for containing antimicrobial resistance.[3]

10.1 Advantages of antibiograms

1. **Estimation of impact**: Helps assess the impact of changes and determine infection control strategies and antibiotic usage policies.
2. **Prevention of duplication**: Includes only the first isolate per patient in the analysis to avoid duplication.
3. **Stratification of data**: Provides susceptibility percentage data for multi-drug resistant organisms.
4. **Quality assurance**: Ensures the quality of antibiotic treatment.[4]

10.2. Antibiotic policies

An antibiotic policy refers to a set of strategies and activities aimed at organizing antimicrobial treatment in a hospital to achieve positive health outcomes for patients. The primary goal of an antibiotic policy is to reduce antimicrobial resistance. It ensures that antibiotics are not used indiscriminately and emphasizes the importance of reserving powerful broad-spectrum antibiotics for later stages of treatment.[10]

Both national and state-level antibiotic policies are developed to tackle antimicrobial resistance (AMR). For example, the Government of Kerala has established a state antibiotic policy aligned with national and global action plans on AMR. The national antibiotic policy aims to provide evidence-based empirical or specific treatments for common infections and promote the rational use of antibiotics to minimize bacterial resistance in the community.[3]

10.3. Importance of early treatment for SSIs

Since complications are more likely with infections at surgical sites, early treatment is essential. An extensive study of the organisms causing SSIs and their antibiotic susceptibility will be valuable in reducing the incidence of such infections. This study is being conducted across multiple departments—Orthopaedics, Surgery, Obstetrics, and Neurology—to identify the bacteriological profile of SSIs and their corresponding antibiotic susceptibility patterns. The optimal choice, frequency, and duration of antibiotics are critical components in the prophylaxis and treatment of SSIs.[6]

11. Aim and Objectives

11.1. Aim

The aim of this study is to explore strategies for preventing surgical site infections (SSIs) and to evaluate current practices in antibiotic prophylaxis during surgical procedures.

11.2. Objectives

1. To identify the bacteriological profile of SSIs and determine the predominant organisms responsible for these infections.
2. To assess the antibiotic sensitivity of the bacterial isolates.
3. To evaluate the risk factors associated with SSIs.
4. To determine the incidence rate of SSIs among patients undergoing surgery in the Department of Surgery.

To compare the prevalence of SSIs and the bacteriological profile across different wound classifications.

5. To develop and describe an antibiogram for SSIs.

12. Materials and Methods

12.1. Study design

This was an observational, cross-sectional, ambispective study conducted with approval from the Institutional Ethics Committee and prior permission from the hospital administration.

12.2. Study site

The study was conducted at the Department of Surgery, PK DAS Institute of Medical Sciences, Vaniyamkulam. Ethical approval for the study was obtained from the Institutional Ethics Committee of Nehru College of Pharmacy.

12.3. Study duration

The study was carried out from November 2023 to October 2024, with data collection spanning 6 months.

12.4. Study population

A total of 100 patients were included in the study based on the inclusion and exclusion criteria. The sample size was calculated using the formula:

n=Z2×P(1−P)d2n=\frac{Z^2\timesP(1-P)}{d^2}n= d2Z2×P(1−P)

Where:

1. nnn = required sample size
2. ZZZ = value from the standard normal distribution corresponding to the desired confidence level (Z = 1.96 for 95% Confidence Interval)
3. PPP = expected true proportion
4. ddd = absolute precision desired on either side (half-width of the confidence interval)

Based on studies, the average wound infection rate was found to be 5.1%, with the overall incidence rate for all types of wounds at 7.4%. Considering an absolute precision of 10% on either side, the calculated sample size was 95, and 100 patients were conveniently selected for the study.

12.5. Inclusion criteria

1. All elective surgeries
2. Clean and contaminated surgeries
3. Patients who stayed at least 5 days post-operatively

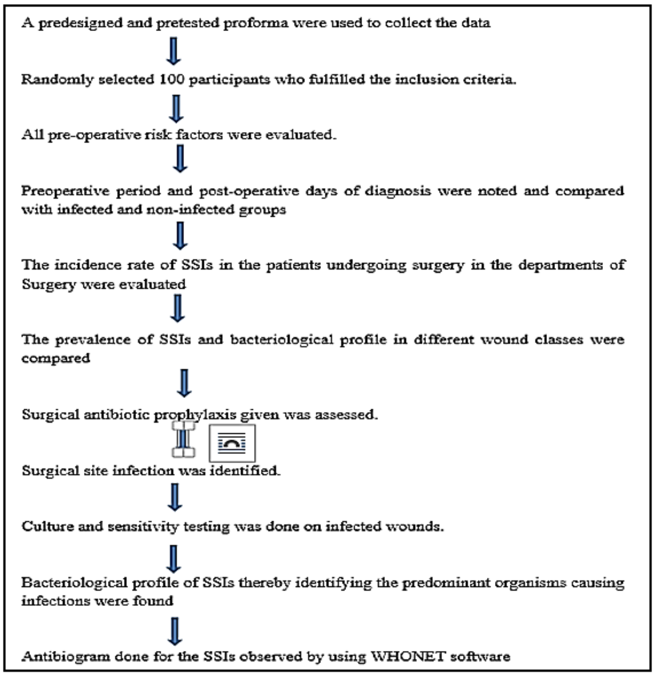
12.6. Exclusion criteria

1. Grossly contaminated or infected wounds/procedures
2. Daycare surgeries

12.7. Study materials

1. Informed consent form
2. Designed data collection form

12.8. Study plan



12.9 Methodology

This observational, cross-sectional, ambispective study was conducted on surgery patients at a tertiary care hospital. Prior approval was obtained from the medical superintendent of the hospital to conduct the study. Only surgery patients who met the inclusion criteria and were willing to participate were included in this study. The study also received approval from the institutional ethics committee, and written informed consent was obtained from all participants.

12.10. Data collection

Informed consent was obtained from all participants. A structured data collection form was used to gather the required information. Demographic details such as age, gender, height, weight, BMI, comorbid conditions, and social habits were recorded from patient medical records. Additional details including the type of surgery, date, duration, surgical site, wound classification, prophylactic antibiotics used, postoperative antibiotics given, preoperative waiting period, and postoperative days until diagnosis were collected. Information on past medical history, specifically diabetes mellitus, was also recorded. Laboratory investigations, including culture and antibiotic susceptibility tests, were entered into the data collection form.

For assessing SSIs, a total of 100 patients who underwent surgery were selected. Risk factors associated with SSIs were recorded. Among these patients, 15 developed SSIs. Wounds were graded according to their classification, and the bacteriological profile of SSIs was analyzed to identify the predominant organisms responsible for the infections. An antibiogram was prepared from the culture sensitivity reports to evaluate the sensitivity patterns of the organisms.

12.11. Statistical analysis

Data analysis will be performed using Microsoft Excel and SPSS software. Risk factors that were found to be statistically significant ($p < 0.05$) in univariate analysis using chi-square tests will be entered into a binary logistic regression model to evaluate the risk of each factor, adjusting for other variables.

12.12. Data analysis and antibiogram

The collected data will be entered and organized into a Microsoft Excel 2013 spreadsheet. Subsequently, the data will be analyzed using the WHONET software (Version 5.6). WHONET is a Windows-based database software used for managing microbiology laboratory data and analyzing antimicrobial susceptibility test results. The software structure has three main components:

1. **Laboratory Configuration File**: This allows for the entry and modification of laboratory-specific information.
2. **Data Entry Interface**: This supports the entry of susceptibility results, including Disc Diffusion, MIC, etc. Results are recorded as interpreted (e.g., Resistant (R), Intermediate (I), Sensitive (S)).
3. **Analysis and Reporting of Resistance Data**: From a single screen, users can select the type of analysis to run, the bacterial species to analyze, the subsets of isolates to include, and the antimicrobial agents and time periods to examine. The software generates resistance data, including the percentage of results categorized as Resistant, Intermediate, or Sensitive, based on standard or other breakpoints.

13. Results

This observational cross sectional ambispective study was conducted in the Surgery department of PK DAS Hospital, Vaniyamkulam. 100 patients were included in the study as per inclusion - exclusion criteria.

1. **Based on gender distribution:** Out of 100 clinically diagnosed cases, SSIs rate was more in females than males.
2. **Based on age distribution of pateints:** SSIs rate was more in 61 and above age groups compared to others.
3. **Based on SSIS and NON SSIs:** Out of 100 cases, 15 cases were found with SSI and 85 cases without SSI**.**

Correlation between SSIS and prehospital stay (**Table 1**)

Table 1: SSIs and pre-hospital stay

Preoperative Stay	Cases	SSI	%
1	43	3	6.97
2	39	7	17.9
3	5	1	20
4	8	2	25
5	5	2	40
Total Frequency (n=100)	100	15	15

X^2 value = 5.613, p-value = 0.230 >0.05, there is no statistically significant correlation between SSIs and Prehospital Stay.

Preoperative stay of 5 and above showed high SSIs rate

13.1. SSIs in relation to postoperative day of diagnosis

X^2 value = 36.379, p-value <0.001, there is statistically significant association between SSIs and Post-operative day of diagnosis. Ie, increase in SSIs with respect to Increase in post-operative day of diagnosis.

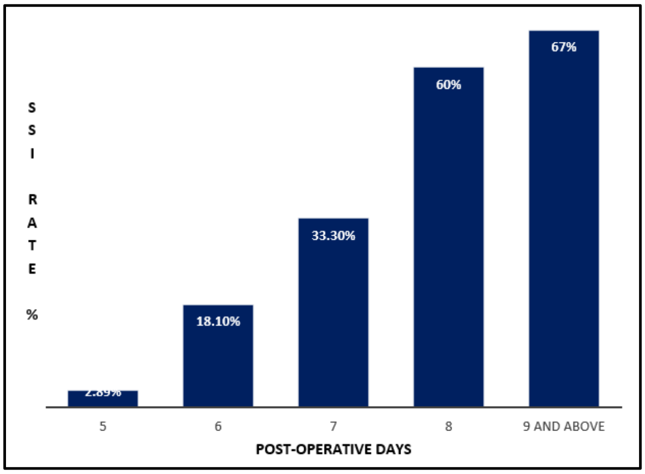


Figure 1: SSIs and post-operative day of diagnosis

Post-operative stay of 9 and above showed high SSIs rate (**Figure 1**)

*13.2. Distribution of Ssi in various surgical units (**Table 2**, **Figure 2**)*

Table 2: Distribution of SSIs in various surgical units

S. No	Surgical units	No. of cases	SSI	%
1	General Surgery	65	4	6.15
2	Neurology	3	1	33.3
3	Obstetrics And Gynaecology	11	4	36.3
4	Orthopedics	21	6	28.5
Total Frequency (n=100)		100	15	15

X^2 value = 11.75, p-value =0.008<0.05, there is statistically significant association between SSIs and surgical units. General Surgery unit has less SSI (6.15%) than others.

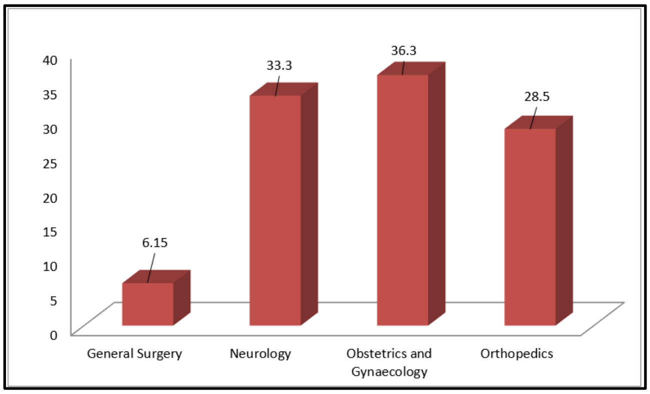


Figure 2: Distribution of SSIs in various surgical units

Out of 100 cases, 15 SSIs were found and among that obstetrics and gynaecology SSIs are more followed by neurology, orthopedics, general surgery.

*13.3. SSIs according to various wound classes (**Table 3**, **Figure 3**)*

Table 3: SSIs in relation to various class of wound

SL.NO	Wound class	Cases	SSIs	%
1	I	28	10	35.7
2	II	5	0	0
3	III	7	5	71.4
Total (n=100)	Frequency	100	15	15

X^2 value = 6.476, p-value= 0.039<0.05, there is statistically significant association between SSIs and surgical units.

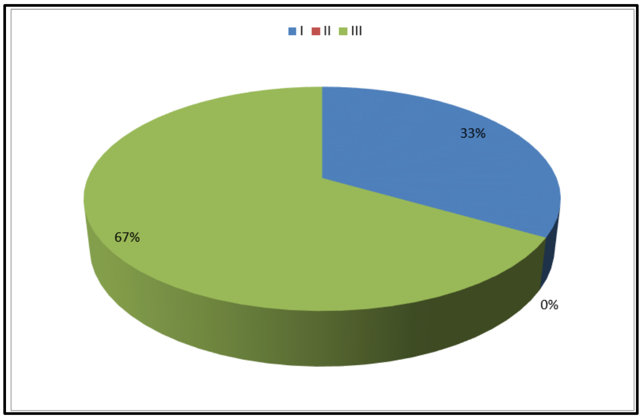


Figure 3: SSIs in relation to various class of wound

Among clinically diagnosed cases, contaminated wounds are more than clean wounds.

13.3. Spectrum of bacterial isolates in various surgical units

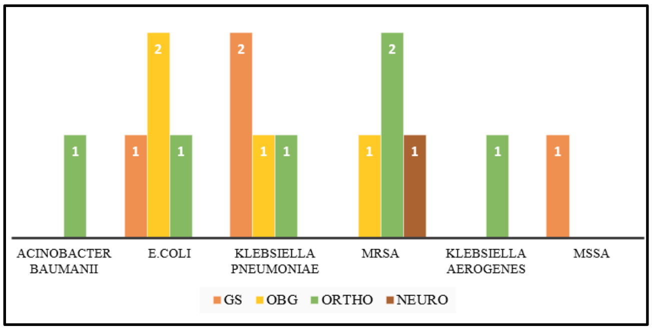


Figure 4: Spectrum of bacterial isolates in various surgical units

Out of 15 bacterial isolates, SSIs in General surgery had more isolates of Klebsiella pneumoniae. E.coli infection was more common in Obstetrics and gynaecology cases. MRSA was frequently isolated from orthopedic cases. MRSA was found in Neurology cases. (**Figure 4**)

*13.4. Spectrum of organisms isolated from different classes of wounds (**Figure 5**)*

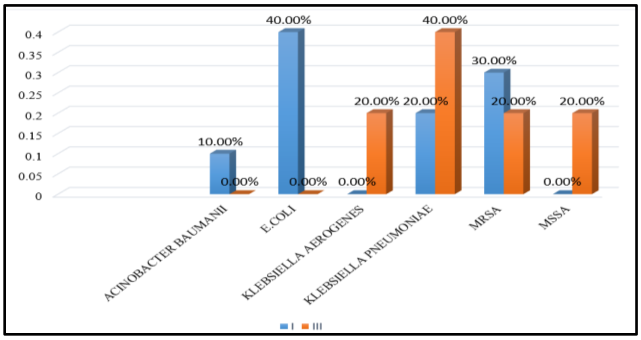


Figure 5: Spectrum of organisms isolated from different classes of wounds

*13.5. Sensitivity pattern of organisms (**Figure 6**)*

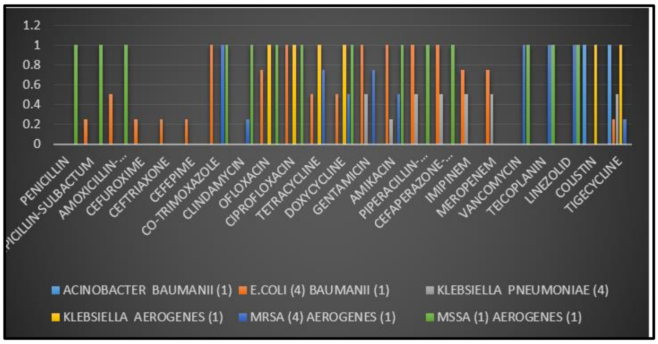


Figure 6: Sensitivity pattern of organisms

*13.6. Surgical antibiotic prophylaxis used (**Figure 7**)*

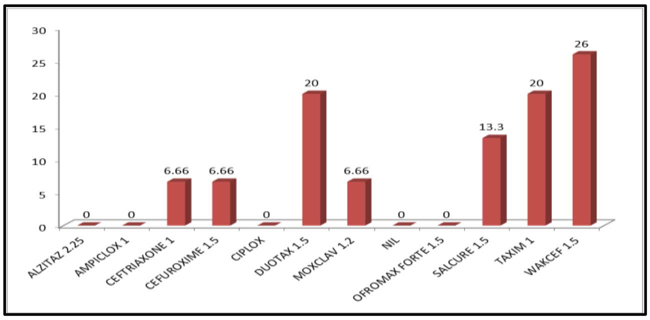
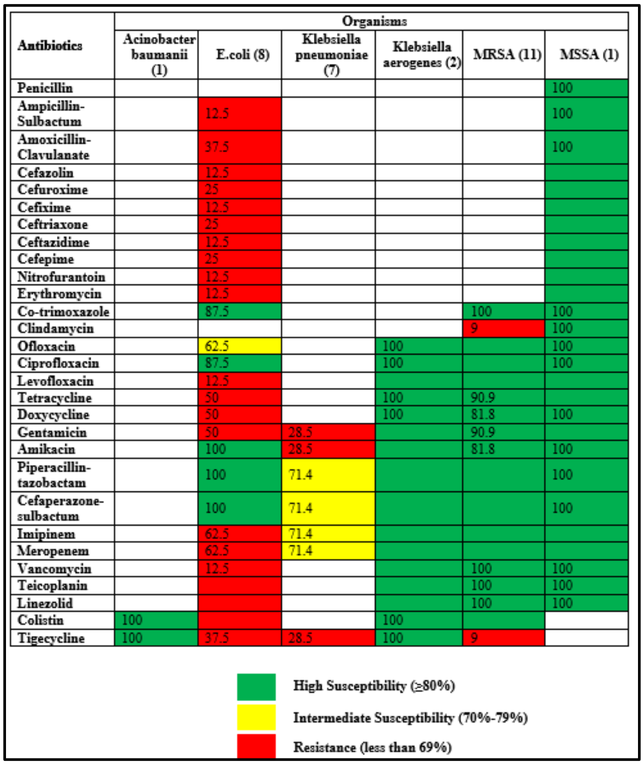


Figure 7: Surgical antibiotic prophylaxis used

*13.7. Antibiogram of SSIs (**Figure 8**)*



Antibiotics	Organisms					
	Acinobacter baumanii (1)	E.coli (8)	Klebsiella pneumoniae (7)	Klebsiella aerogenes (2)	MRSA (11)	MSSA (1)
Penicillin						100
Ampicillin-Sulbactum		12.5				100
Amoxicillin-Clavulanate		37.5				100
Cefazolin		12.5				
Cefuroxime		25				
Cefixime		12.5				
Ceftriaxone		25				
Ceftazidime		12.5				
Cefepime		25				
Nitrofurantoin		12.5				
Erythromycin		12.5				
Co-trimoxazole		87.5			100	100
Clindamycin					9	100
Ofloxacin		62.5		100		100
Ciprofloxacin		87.5		100		100
Levofloxacin		12.5				
Tetracycline		50		100	90.9	
Doxycycline		50		100	81.8	100
Gentamicin		50	28.5		90.9	
Amikacin		100	28.5		81.8	100
Piperacillin-tazobactam		100	71.4			100
Cefaperazone-sulbactum		100	71.4			100
Imipinem		62.5	71.4			
Meropenem		62.5	71.4			
Vancomycin		12.5			100	100
Teicoplanin					100	100
Linezolid					100	100
Colistin	100			100		
Tigecycline	100	37.5	28.5	100	9	

High Susceptibility (≥80%)
Intermediate Susceptibility (70%-79%)
Resistance (less than 69%)

Figure 8: Antipogram of SSI

14. Discussion

14.1. Age and gender distribution

This study found that patients over 70 years of age had a higher rate of surgical site infections (SSIs). However, Patel Sachin et al. conducted a study that showed a higher infection rate in patients over 50 years, which they attributed to factors like malnutrition, low immunity, and malabsorption, conditions more common in older age groups. In terms of gender distribution, this study found that female patients had a higher infection rate than male patients.[13] Conversely, Anand Saxena et al. reported a higher infection rate in male patients, which they linked to increased mobility in males and associated risk factors.[13]

1. **Bacteriological profile:** This study revealed that among the culture-positive cases, *E. coli*, *MRSA*, and

Klebsiella pneumoniae were the most commonly isolated organisms. Similarly, Krunal D. Mehta et al. conducted a cross-sectional descriptive study and found that *Klebsiella pneumoniae* was the most frequently associated bacterium in SSIs, followed by *Staphylococcus aureus*, *Escherichia coli*, and other pathogens.[14]

2. **Incidence of SSIs in different departments:** The study found that the highest rate of SSIs occurred in the Obstetrics & Gynecology unit (36.3%), followed by the Orthopedic unit (28.5%) and the General Surgery unit (6.15%). In contrast, a study by Dr. D.B. Shanthi et al. showed a higher incidence of SSIs in the Orthopedic unit (40.9%), followed by General Surgery (38.6%) and Obstetrics & Gynecology (20.5%).[3]

3. **Antibiotic Sensitivity Pattern:** This study showed that *Klebsiella* organisms exhibited higher sensitivity to ciprofloxacin, tetracycline, colistin, and tigecycline. *E. coli* was found to be sensitive to cotrimoxazole, amikacin, piperacillin-tazobactam, and cefoperazone-sulbactam. Similarly, Mohd Yasir et al. conducted a prospective study that found *Klebsiella* organisms to be sensitive to ciprofloxacin (65.8%, n=38), and *E. coli* was sensitive to ciprofloxacin (71%, n=31).[7]

4. **Risk factors:** The study identified several risk factors associated with SSIs, including smoking, diabetes, obesity, longer preoperative hospital stays, longer surgery durations, and advanced age. Similarly, Hong Li et al. conducted a comprehensive retrospective study and highlighted intraoperative blood loss, anemia, drainage tube placement, smoking, and diabetes mellitus as key risk factors for SSIs following cardiothoracic surgery.[6]

5. **Bacteriological profile in different wound classes:** This study found that the SSI rate was higher in contaminated and clean-contaminated wounds compared to clean wounds. Similarly, Varsha Shahane et al. observed the significant impact of wound contamination on infection rates. Their analysis showed that the SSI rate in contaminated wounds was 12.3%, 8% in clean-contaminated wounds, and 4.6% in clean wounds.[8]

15. Conclusion

This study has provided valuable insights into the risk factors that contribute to Surgical Site Infections (SSIs) and their incidence within our hospital. It has also helped identify the bacteriological profile of the organisms responsible for SSIs, as well as their antibiotic sensitivity patterns.

Inappropriate and excessive use of antibiotics can lead to resistance against commonly used drugs. Therefore, antibiotic usage should be guided by local trends and the current patterns of prevalent pathogens and their sensitivity profiles. By understanding the bacteriological profile and resistance patterns, we can assist surgeons in making informed decisions for the treatment and prophylaxis of SSIs.

The Hospital Infection Control Committee (HICC) plays a crucial role in preventing nosocomial infections. Effective infection control measures and antibiotic policies must be implemented in every hospital and closely monitored by the HICC to prevent the emergence of antibiotic-resistant strains.

A thorough understanding of SSIs aids surgeons in diagnosing and treating infections, as well as in the early detection and intervention for surgical patients. While it is impossible to completely eliminate surgical wound infections, reducing the infection rate to a minimum is achievable, thus reducing the burden on patients and their families. Interventions aimed at reducing SSIs contribute to cost savings and improve the overall efficiency of the healthcare system.

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None.

18. Conflict of Interest

None.

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