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Incidence and Risk Factors of Surgical Site Infections: Evaluating Reoperation Rates and Infection Outcomes in Clean and Contaminated Surgical Procedures

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Abstract

Objective: to find the relationship between the incidence of surgical site infections (SSI) and the requirement for a re-examination in patients having both clean and possibly contaminated procedures.

Materials and Methods: Data were gathered utilizing a survey form assessing sociodemographic and clinical features of the 72 infected patients in cohort study from DHQ hospital Layyah. By calculating the odds proportion and its 95% confidence interval, the association was evaluated.

Results: Readmissions are ten times more probable to require a surgical re-approach (p=0.000), patients hospitalized for non-related reasons are four times more probable to do so (p=0.011), and leukocytosis (p=0.002) and changes in the c-reactive protein value (p=0.016) were linked to the requirement for a second procedure. In the orthopaedic specialty, the reason was five times greater (p=0.003). Protective factors for re-approach included positive culture (p=0.001) and curative antibiotic (p=0.04).

Conclusion: The statistics show that surgical reoperation is significantly influenced by SSI, providing guidance to hospitals that share this profile.

Keywords: Cross Infection; Surgical Wound Infection; General Surgery; Orthopedic Procedures; Medical-Surgical Nursing.

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INTRODUCTION

According to the degree of engagement, surgical site infections (SSIs) are divided into three categories: superficial incisional infection, deep incisional disease, and organ/space infection. SSSIs can occur after surgical operations performed on both inpatients and outpatients regardless of the inserting of implants (1). The Centres for Disease Control and Prevention (CDC) in the United States report that surgical site infections (SSIs) account for 20% of infections related to healthcare and are linked to a 2-to 11-fold higher chance of mortality (2). Approximately 9.3% to 33.6% of hospital infections in Pakistan are classified as SSIs, ranking third among all infections (1).

Among the biggest threats to patient security in Brazilian healthcare systems are surgical area infections, which are the leading cause of readmissions, longer hospital stays, and the requirement for additional surgeries to restore damaged tissue (3-4). The length of the procedure, the patients' medical histories (overweight, cigarette smoking, diabetes), the length of the preoperative hospitalization, and the rating of the surgery as neat, possibly infected, contaminated, or infested are some of the variables that elevate the risk of surgical site infections (SSIs) (5). A clean surgery is one in which there is no technical error, no inflammatory or contagious process, and the incision is made on sterile or decontaminated tissues (1). Procedures that include tissues colonized by microbial flora, procedures in which there are no discernible intraoperative technical problems and surgeries without infection or inflammation are considered potentially contaminated (6). Operations carried out on tissues exhibiting a high level of germs and not undergoing decontamination are classified as contaminated, while those exhibiting severe contamination or a localized infectious process are classified as infected (7).

In order to improve the quality of care given, surveillance measures that target the characteristics that contribute to the prevalence of SSI must be developed. This requires research into these factors. Therefore, the core components of wellness are the avoidance and control of HAIs. It takes a shift in patient care practices, attitudes, and culture to lower the risks of avoidable HAIs. To enable the enhancement of medical procedures in order to lower the incidence of SSIs and promote patient safety, it is imperative that these modifications take place. To do this, it is crucial to have a clear understanding of the variables that enhance the patient's risk of contracting the disease and the possibilities that arise should he ultimately result in establishing an SSI (8).

In order to learn more about the health status of patients experiencing surgery, the study set out to confirm the correlation between the incidence of surgical site infections (SSIs) and the

necessity for a reevaluation in patients having both clean and possibly contaminated procedures.

Materials and Methods

This is cohort study that includes individuals with SSI in 2022 that were undergoing orthopedic and general surgery procedures and were categorized as either clean or possibly contaminated. This study was carried out at DHQ Hospital Layyah

Patients were assessed with respect to sociodemographic information, duration of stay, readmission requirements, surgical reoperations, the existence of signs reminiscent of SSI, laboratory testing, and the application of preventive and medicinal antibiotics.

Individuals who underwent clean or possibly hazardous orthopaedic and surgical general procedures in 2022 and received SSI, ranging in age from 14 to 89, were enrolled. Surgery for children was not included.

Patients suffering SSI were determined using physical forms that were used to verify the epidemiology and disease control nucleus's HAI criteria. This data gathering tool was turned into a spreadsheet created in Excel using Microsoft Office 2007 after being converted into a Google Forms® form.

Descriptive statistics were used to analyse the data, and outcomes were reported as straightforward percentages, ratios, and gauges of central tendency. Both the odds ratio (OR) and the confidence intervals (95% CI) were used to assess the relationship between the factors. Depending on how the variables were distributed, the chi-square test was computed for the categorical factors and the Student's t test or Mann-Whitney test has been performed for the numerical values. The statistical analyses were conducted using IBM SPSS Statistical Products and Service Solutions software, version 23.

RESULTS

A total of 351 HAIs were discovered at the hospital under survey in 2022, 149 of which were connected to SSIs, or 42.7% of all HAIs. Within the parameters of this investigation, during the course of a year, infections occurred in 72 patients following both clean and possibly contaminated procedures. Of them, 36.3% (26) were women and 62.7% (44) were men. The average age was 53.2 years; 44% (32) of the hospital's patients originated from the city in which it was situated; 37.8% (27) of the patients had accidents from outside sources, and 42.7% (32) had digestive system disorders.

In terms of how operations were categorized, 80% (58) had been elective procedures, 20% were urgently required, 41.3% (31) were clean procedures, 59.7% (43) possibly infected

procedures, 30.7% (22) orthopedic specialty procedures, and 69.7% (50) general procedures. Of the patients, 79.9% had an infection seven days after an operation, 41.3% (28) spent more than ten days in a medical facility, and 57.3% (41) needed another procedure. 53.3% (38) of the infections were identified as organ/space diseases, 41.3% (29) as deep incisional illnesses, and 5.3% (4) as superficial incisional diseases. Purulent discharge 89.3% (64), discomfort 34.7% (24), hyperemia 28% (20), fever 14.7% (10), suture dehiscence 13.3% (9), and the clinical identification of an illness in 20% (14) of the instances constituted the most frequent clinical indicators of infection.

Out of the 77 patients, 50 (65.3%) had positive samples. The most common bacteria were Escherichia coli (20%) (10), Staphylococcus aureus (12%), and Klebisiella pneumoniae (06.7%). Of the patients, 80% (40) took preventive antibiotics; cephalosporins were the most commonly utilized class, with 76% (38) of the individuals using them. Only 20% (15) did not utilize them. 96% (48) of the patients received treatment with antibiotics; 42.7% (22) of these prescriptions belonged to the cephalosporin family. In laboratory testing, leukocytes had a median of 9,830/mm3 and a mean of 9,160.66 cells/mm3 (SD=6,682.38). C-reactive protein (CRP) levels were 19.40 mg/dL on average, with a mean of 39.12 mg/dL (SD=39.94).

In comparison to other hospitalization diagnoses, patients hospitalized due to wounds from external sources were approximately fourfold more probable to require surgical reoperation [OR= 3.74 (95% CI=1.33-10.47); p=0.011], according to an evaluation of the relationship between exposure variables and the likelihood of surgical reconstruction. With a five-fold increased likelihood compared to general surgery, this result was also observed in the orthopedic surgical specialty [OR= 5.54 (95% CI=1.65-18.55); p=0.003]. Comparing to other patients, returned patients have a ten-fold increased risk of requiring a second surgery (Table 1).

Table 1 – surgical reoperation in patients with surgical site infection based on hospitalization features.

	Surgical reoperation						
Characteristics	**YES**		**NO**		**OR***	**95% IC†**	***p value***
	n	**%**	**N**	**%**			
> 60 years							
Yes	20	69	9	31	2,10	0,80-5,59	0,130
No	21	50,0	22	50,0			

External Causes							
Yes	20	74	7	26	**3,74**	**1,33-10,47**	**0,011**
No	20	44.5	25	55.6			
Risk classification							
Urgency	10	77	3	23	2,40	0,68-8,41	0,164
Elective	31	52.5	28	47.5			
Surgical topography							
Orthopedic	18	82	4	18	**5,54**	**1,65-18,55**	**0,003**
General surgery	23	46	27	54			
Contamination potential							
Clean	19	61.3	11	36.7			
Potentially contaminated	23	54.8	19	45.2	1,31	0,51-3,36	0,563
Surgery-related readmission							
Yes	25	86.2	4	13.8	**10,70**	**3,18-36,00**	**0,000**
No	16	37.2	27	62.7			
Length of Stay > 5 Days							
Yes	13	44.8	10	34.2	1,01	0,22-4,72	0,982
No	4	50	4	50			

* Odds Ratio: reference category: 1; † Confidence interval.

Protective variables that in turn turned out to be the curative antibiotic and the positive environment. In comparison with the other individuals, those lacking a positive culture had a six-fold increased risk of requiring a surgical reoperation [(OR=0.17(95% CI=0.06-0.50); p=0.001]. This proportion was twice greater in patients who skipped antibiotic therapy [OR=0.40 (95% CI=0.30-0.53); p=0.04)]. (Table II). The research did not discover statistical relevance when comparing the positive culture to the preventive and medicinal antibiotic, indicating that the antimicrobial prescriptions didn't clarify the positive culture as a protective feature.

Table 2 – surgical reoperation in cases where the patient's clinical and categorization features indicated the need for surgery.

	Surgical reoperation						
Characteristics	**YES**		**NO**		**OR***	**95% CI†**	***p value***
	n	**%**	**n**	**%**			

Superficial infection							
Yes	1	33.4	2	66.7	0.23	0.02-2.32	0.182
No	40	58	29	42			
Deep incisional infection							
Yes	20	67.7	10	32.3	2.1	0.80-5.46	0.129
No	20	50	22	50			
Organ/space infection							
Yes	20	52.7	18	47.4	0.65	0.25-1.64	0.369
No	22	64.7	12	35.3			
Positive culture							
Yes	33	72	13	28	**0.17**	**0.06-0.50**	**0.001**
No	8	32	17	68			
Medical diagnosis							
Yes	7	46.7	8	53.3	0.58	0.18-1.82	0.354
No	32	60.0	21	40.0			
Use of prophylactic antibiotic							
Yes	32	60.0	21	40.0	1.71	0.54-5.35	0.350
No	7	46.7	8	53.3			
Use of therapeutic antibiotic							
Yes	41	58.6	29	41.4	**0.40**	**0.30-0.53**	**0.042**
No	0	0.0	2	100.0			

* Odds Ratio: reference category: 1; † Confidence interval.

Laboratory tests performed on the sufferers were also assessed, and a correlation between the changes in testing and the requirement for surgery was discovered. The leukocyte count in patients undergoing surgical reoperations was 9,160.66 cells/mm3 on average (SD=6,682.38) and 9,830 cells/mm3 on median (p=0.002). The median CRP value was 19.40 (p=0.016), with a mean of 39.12 (SD=39.94).

The other variables, which included age >60 years [OR=2.10 (95%CI=0.80-5.5); p=0.13], whether the surgery was classified as elective or urgent [OR=2.40 (95% CI=0.68-8.41); p=0.16], the category of contamination risk [OR=1.31 (95% CI=0.51-3.36) p=0.182], the categorization of superficial incisional disease [OR=0.23 (95% CI=0.02-2.32) p=0.182], the

deep incisional illness [OR=2.10 (95% CI=0.80-5.46); p=0.12], and organs or space [OR=0.65 (95% CI=0.25-2.72) p=0.001], medical evaluation [OR=0.58 (95% CI=0.18-1.82) p=0.354], and utilisation of prophylactic antibiotics [OR=1.71 (95% CI=0.54-5.35) p=0.350] (Tables 1 and 2).

DISCUSSION

The study's primary conclusions indicated that approximately one-third (⅓) of HAIs are SSIs. Men and individuals over 50 had a higher percentage of surgical site diseases. Five percent of surgeries appeared critical over half took place in possibly infected settings, and readmission following operations was linked to orthopaedic surgeries, positive cultures, external reasons, and the administration of curative antibiotics.

The World Health Organisation (WHO) projects that 230 million procedures are carried out globally year, resulting in seven million negative outcomes and the death of one million patients. HAIs and intraoperative complications, which also raise the risk of SSIs, are examples of surgical-related adverse occurrences (9).

In contrast to other results in the literature, which indicate that the proportions of SSIs are around 14 and 20%, surgical site infections accounted for 41,7% of the HAIs and are thought to be the main kind of illness at the medical centre of the present investigation (2-10).

Elevated rates of surgical site infections (SSIs) have been a global concern since 2008. The World Health Organization (WHO) established patient safety objectives to guarantee surgical site integrity and avoid consequences (11).

Identical to a study analyzing patients hospitalized to an intensive care unit (ICU) and developing SSI, the majority of surgical reoperations in this study involved males (12). The average age was fifty years old, which is comparable to the number of SSI patients who had general surgery (13).

It is hypothesized that, among those under 60, SSIs are associated with procedures brought on by jobs and auto accidents, including patients who are of working age and potentially burdening the health and welfare systems in addition to the personal and family load. However, susceptibility to risk factors, including as falls in the elderly, mobility difficulties, and loss of sight and hearing acuity, also contributes to the prevalence of this patient description in hospital settings (14).

The International Classification of Diseases (ICD-10) states that illnesses of the digestive tract (found in Chapter XI) and wounds, poisonings, and other external causes (found in Chapter XIX) are the primary reasons of hospitalization. A comprehensive study confirmed

the prevalence by classifying two thirds of surgical disciplines as general surgery and over a third as orthopaedic procedures (8).

Patients with many injuries from outside sources need immediate evaluation and treatment, which increases the number of urgent procedures. In these situations, the team's mobility is required, which lowers compliance to the safe surgery protocol and obstructs the use of antibiotic prophylaxis, anesthetic-surgical setup, and procedure modifications that could raise the likelihood of infection.15–16 20% of the patients in this study had urgent procedures performed; this number is comparable to that of a study assessing patient infection hazard variables, which identified 16.3% of surgeries to be urgent (17).

There are several things that make a surgical patient more likely to get an infection. These variables comprise the individual's age, clinical status, surgical time, level of preoperative setup, and categorization about the likelihood of surgical site exposure due to microbial presence (5).

Surgery is categorized based on the probability for pollution along with to the emergency risk categorization, which aids in estimating the likelihood of SSI. For clean procedures, the risk is predicted to be as high as 2%, and for possibly infected surgeries, it is as high as 10% (7). In this study, 41.3% of procedures were clean and 58.7% were probably contaminated. Clean operations are those carried out on tissues that have been decontaminated or are sterile, free of infection or inflammatory processes as well as technical errors (1). Procedures with distinct intraoperative technical errors in addition to tissues colonized by microbial flora lacking mechanisms of infection or swelling are considered potentially polluted (17).

The incidence of surgical site infections (SSI) suggests that factors associated with its development should be investigated, even if the likelihood of infection from clean and possibly infected operations is minimal (7). In accordance to the findings of an investigation that assessed this profile of healthcare facilities, it is imperative to consider all the factors that may cause the higher incidence of infection, like the hospital's status as a school of medicine, which raises the risk of negative outcomes, involving SSIs (9).

It is essential to perform a situational examination. Evaluating hospital actions involves going over protocols and putting process indicators into place. The inconsistency observed in the execution of surgical procedures highlights the population's vulnerability. Expert education and established standards are easy and efficient ways to increase adherence to SSI preventive efforts (18).

Regarding the duration of hospitalization, the current study discovered that a significant proportion of individuals who stayed for longer than 10 days acquired the virus after just 7 days. Along with to other variables influenced by the surroundings, the efficiency of

healthcare providers, and the medical circumstances of the individuals, the hospital surroundings presents a biological profile characterized by multiresistant microbes, which increases the likelihood of infection (19).

However, the existence of SSI increases the likelihood that the patient will remain in a hospital setting for the duration of the infection's medication, which raises costs—especially those associated with antibiotic treatment, further testing, and the requirement for new surgical operations (20).

Reoperations following surgery are regarded as unfavorable events and can have both transmissible and not transmissible reasons.20 Surgical reoperation was necessary for over fifty percent of the patients in our study, which is consistent with data from trauma patients admitted to a Salvadorian hospital where reoperation is among the most common infection-related morbidity (21). However, a review of individuals who had experienced orthopedic trauma revealed that those who suffered from prior surgery were four times more likely to acquire SSIs (22).

The experience of having more surgeries negatively impacts the standard of life for those undergoing surgery, who may end up immobilized for extended periods of time, incapable of carry out everyday tasks, dealing with pain, and running the possibility of pressure wounds (23).

When the relationships between surgical reoperation and the other variables were assessed, it was discovered that injuries resulting from outside sources increase the likelihood of requiring a surgical reoperation. This conclusion was also reached when comparing the orthopedic specialization to general surgery.

Along with leading to elevated death rates, outside events result in factors that make patients more chronic, necessitating further operations and maybe an extended hospital stay because of the seriousness of the infection. The orthopedic specialty, which treats breakages and ligament deformities brought on by trauma and improper posture of the body, is closely related to outside factors. Procedures in this field are marked by the use of specialized equipment, the requirement for external anchorage, and the use of implants all of which raise the possibility of SSIs. Due to the necessity of removing it, one of the most prevalent kinds of infection that necessitates additional surgical procedures is the development of biofilm on the installation (22).

The medical staff takes on a significant role in preventing diseases in the operating room by minimizing preventable risk factors, enforcing rigorous entrance and exit controls, maintaining aseptic technique throughout every step of the procedure, properly disinfecting

and sterilizing the supplies and tools used, and keeping an eye on the surgical wound's healing process after surgery (24).

The results showed that individuals who get admitted again have a ten-fold increased risk of requiring a new operation. These findings are consistent with an investigation that assessed post-surgical patients being readmitted and discovered that surgical reoperations linked to SSIs constitute the most frequent reasons for readmissions (25).

There was also a correlation found between modifications to laboratory testing and the requirement for a novel surgical strategy. The existence of a developed inflammation or infectious disease is indicated by the detection of leukocytosis and the change in CRP. Given that individuals who experienced an SSI are at greater risk to require additional surgical procedures, the link can be clarified through the existence of infection. The first treatment is compromised by an outbreak of infections, necessitating severe debridement, implanted removal, and re-implantation, which results in additional hospital stays and surgical procedures (22).

Early SSI identification is crucial for promoting patient safety; hence, post-discharge supervision is a strategy that is critical for case detection, expediting monitoring and response, and averting problems (26).

Organ/space infections had been the most common, indicating a delay in diagnosis that exacerbates the situation. This is in contrast to a study that assessed orthopedic surgery patients and found that superficial infections were common, with a significant number only discovered when the individual was monitored after discharge (20).

In order to collect precise markers and enable the early detection of social service illnesses, care following discharge is crucial for the epidemiological supervision of infections (26). According to the guidelines set by leading bodies, only qualified professionals can diagnose the existence of an infection. This highlights the significance of the healthcare facility's infection control service (CCIH), which serves as a liaison between monitoring and concern bodies and keeps the team informed about the required standards.

Purulent discharge, discomfort, hyperemia, a high temperature, and sutures dehiscence constituted the most prevalent clinical indicators of infection, according to an investigation that assessed patients with SSI23. In 20% of the instances, a medical conclusion was made.

Certain parameters, such as the acquisition of cultures, host understanding, therapeutic microbiology, and antibiotic mode of action, are missing from the selection of antibiotics. It is therefore feasible to consider the notion that culture plays the role of a protective element in this inquiry since it influences the selection of the antibiotic used in therapy, increasing its efficacy and preventing side effects (27).

Being part of an encouraging patient culture helps the nursing staff pay closer attention to wound management and therapy, which helps prevent infection from worsening and avoiding the need for additional surgical intervention. A positive culture was thought to be associated with the start of early antibiotic care; however, when the research compared the positive culture to medicinal and preventive antibiotics, it found no statistical relevance, and the antimicrobial medication did not clarify positive culture as a protective element.

Regarding the microbiological description, the most common microbes identified were Staphylococcus aureus, Escherichia coli, and Klebisiella pneumoniae. These findings are consistent with previous research assessing surgical patients (9,23).

Considering that germs can spread through close proximity or a shared source, hospital environments require close monitoring of these infections. Basic precautions like wearing an apron, sterile gloves, a cap, and a face shield during surgery, washing your hands constantly, using an aseptic method when carrying out procedures like changing the dressing on your surgical incision, and using antimicrobials sparingly are essential for preventing unfavorable outcomes associated with infections.

In this research, prophylactic treatment with antibiotics was elevated, with cephalosporins comprising the most commonly used class. This helps to avoid SSI. Additional research that assessed the incidence of antibiotic prophylaxis also observed this finding. Good absorption into surgical wounds, safety and efficacy against a range of gram-positive and gram-negative germs, and affordability are all considered when selecting a preventive antibiotic.23 Prophylaxis aims to avoid surgical site infections (SSIs) by lowering the level of bacteria at the surgical site. This is achieved by needing an efficient serum and tissue level of the antibiotic above the minimal inhibitory amount at the moment of skin incision, particularly in surgeries that are thought to be possibly contaminated (26).

The incorrect application of surgical prophylaxis raises expenses and increases the possibility of bacterial resilience.16 Thus, in order to direct prescribers about the right amount and amount of prophylaxis in each surgical area of expertise, a surgical prophylaxis guideline must be put in place. However, in the current study, 25% of individuals were not given prophylaxis; this could be explained by the reality that emergency procedures do not permit sufficient time for preoperative preparation. This percentage does, however, encompass elective individuals who did not receive appropriate prophylaxis, highlighting the necessity of raising team awareness of the significance of prophylactic antibiotic administration. Prophylactic antibiotics, however, do not take the place of other precautionary measures, which call for widespread adherence to preventive steps from the time leading up to surgery through the recovery phase. Nearly all of the patients in the study received antibiotic

medication, which is thought to have been a protective component. The most often recommended categories were quinolones and cephalosporin. It is stressed that factors including the extent of the illness, the medication's efficacy, the prior usage of antibiotics, the ability to resist of the microbes, the duration of hospital stay, and the epidemiological effect must all be taken into consideration when prescribing antibiotics (28).

Early infection care, which averts more problems, explains why antibiotics are present as a preventive measure. This work addresses important subjects from an epidemiological perspective, which can direct to other medical centers that treat patients with similar profiles, and adds to the inquiry aspects that have not been thoroughly covered in the literature. It also highlights the significance of new research in this field that assesses other factors in the backdrop of surgical reoperation.

The study's limitations are noted, including its local scope, development in a single medical care, sample size, the features of the group under study, and its one-year duration, which made it impossible to conduct a historical series given the pandemic's backdrop. The challenge of gathering retrospective data regarding the calibre of data found in medical documents and infection threshold closing form is also notable.

The information uncovered indicates that ongoing assessment of the procedures designed to improve patient welfare in a medical setting is required. Hospital infection management, the patient safety centre, ongoing education, healthcare managers, and medical professionals all have a collaborative role in preventing HAIs, therefore increasing public understanding of the preventative process is crucial.

CONCLUSION

The necessity for second surgical operation was found to be associated in this study with external reasons, orthopedic surgical specialization, changed laboratory test findings, and a return to the hospital. Reoperations were prevented by the use of curative antibiotic treatment and a positive culture. The information shows that the existence of SSIs is a significant influencing element in the process, adding to our comprehension of the parameters that determine when a new surgical procedure is necessary. The work serves as an expression of the significance of performing ongoing contextual diagnosis within medical units, which is vital to increase team awareness and promote patient wellbeing. In order for tracking the risk faced by the population of infection and determine which additional variables may be connected to surgical reoperation, more research using a prospective methodology and a bigger sample size is advised.

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