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A Study of Prevalence and Root Causes of Surgical Site Infections in an Acute Care Facility in Sharjah, United Arab Emirates

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Abstract:-

- ***Introduction:***

Hospital-acquired infections are a well-known cause of morbidity and can have negative consequences for patients, particularly surgical site infections (SSIs), which affect up to 5% of surgery patients. Evidence suggests that around 60% of SSIs could be prevented through the use of evidence-based measures.

- ***Objective:***

This study aims to identify the risk factors that contribute to SSIs among patients undergoing major surgery.

- ***Methodology:***

This study was conducted at a teaching hospital in the Unites United Arab Emirates (UAE). To investigate the risk factors for surgical site infections (SSIs) in patients undergoing major surgery, Qualified infection control professionals (ICPs) conducted a hospital-based retrospective descriptive approach. A total of 200 patients who underwent surgery during the first half of 2022 were included in the study. Additionally, a survey was conducted to evaluate the infection control practices and knowledge related to the surgical pathway of patients. To analyze the data collected, the procedure and SSI data were used to generate descriptive reports. Logistic regression analysis was performed to examine the factors associated with SSIs. Odds ratios (ORs) with 95% confidence intervals were used to assess the associations between the dependent variable and other variables.

- ***Results:***

The study revealed that 11 out of 200 patients (5.5%) developed SSIs. The factors found to be associated with SSIs were the patient's ASA score (OR = 4.74; 95% CI = (0.045-490)), length of preoperative stay (OR = 6.09; 95% CI = (0.308-120)), premorbid illness (OR = 4.8; 95% CI = (0.036-640)), and premorbid illness treatment status (OR = 2.04; 95% CI = (0.096-43.286)), mainly focusing on the type of wound, preoperative hospital stay, and comorbid illness. The staff questionnaire proved useful in identifying the risk factors associated with SSIs, while also highlighting the need for more training and education on this important health issue. The survey results showed that responders had a relatively high level of knowledge about the safe surgical pathway, with an overall mean score of 3.43 out of 5 based on the 20 questions provided.

- ***Conclusion:***

To conclude, our study found that 5.5% of the 200 operated patients developed a surgical site infection, with factors such as the type of wound, preoperative hospital stays, and co-morbid illness identified as significant risk factors. Our study also highlighted a lack of knowledge about surgical site infections among some staff members, indicating a need for training in this area. The results underscore the importance of continued research on the prevalence and risk factors of SSIs to improve patient outcomes and reduce healthcare costs. Future research could focus on the effectiveness of prevention interventions, patient factors, microbiological causes, healthcare disparities, and cost-effectiveness of interventions. By identifying effective prevention strategies and improving our understanding of the underlying causes of SSIs, we can work towards reducing the incidence of this significant healthcare complication.

Keywords:- *Surgical Site Infection; Risk Factor; Hypertension; Diabetes Mellitus; SSI; Risk Factors.*

I. INTRODUCTION

- *Overview of the Chapter*

Infections acquired in hospitals are recognized as being associated with significant morbidity and mortality. While advances have been made in infection control practices, including improved operating room ventilation, sterilization methods, less barriers to proper surgical technique, and the availability of antimicrobial prophylaxis, surgical site infections remain a substantial cause of morbidity, prolonged hospitalization, and death.

Thus, the main aim of this study was to determine the prevalence and root causes of surgical site infection among patients undergoing major surgery at an acute care facility.

A hospital based retrospective descriptive study covering the first half of the year 2022 planned to conduct in an inpatient unit of a tertiary care center. Planned to do it retrospectively from January 2022 to June 2022. A total of 200 patient medical records who underwent operative procedures will be selected randomly. Cases will include patients of both sexes who were undergoing operative procedures, having the age of >13 years. Patients with Infection present at time of surgery will be excluded from the study. Also, a survey to assess the staff knowledge about the risk factors associated with Surgical site Infections from Infection Control Point of view. This survey will be distributed to approximately 100 healthcare staff across Al Qassimi Hospital, Sharjah. After collecting the data and Once procedure (denominator) and surgical site infection (numerator) data are collected, the data can be analyzed/visualized in various ways including with descriptive analysis reports and Standardized Infection Ratio (SIR) reports. After understanding the number of Surgical site infection in the facility and corelating the same with associated risk factors will give us better solution to prevent future surgical site infection occurrences.

➢ *Background to the Study*

In our environment, the occurrence of SSI has posed a lot of stress on healthcare providers as well as patients, and much still needs to be done in order to achieve a reduction in the rate of SSI. In conclusion the expected outcome of this study is, the modifiable and non-modifiable risk factors will be directly proportional to the surgical site infection prevalence rate. This is also expected to identify the gaps in our infection control practices and therefore identify areas of focus to reduce the burden of SSIs.

Surgical site infections (SSIs) are a major complication of surgical procedures that can result in prolonged hospitalization, increased morbidity, and mortality. In the Gulf Cooperation Council (GCC) countries, SSIs pose a significant healthcare challenge due to their high prevalence and associated economic burden. Despite advances in surgical techniques and infection control measures, the incidence of SSIs in GCC remains high, affecting patients across various surgical specialties.

Several risk factors have been identified that increase the likelihood of developing SSIs, including patient-related factors such as age, obesity, diabetes, and immune-compromised status, as well as procedure-related factors such as the duration of surgery, type of surgery, and the use of certain surgical devices or implants. In GCC countries, factors such as high rates of diabetes and obesity, a high volume of surgical procedures, and inadequate infection control measures have contributed to the high prevalence of SSIs.

Efforts to reduce the incidence of SSIs in GCC countries have focused on implementing evidence-based infection prevention strategies, such as preoperative screening and decolonization, appropriate antibiotic prophylaxis, and strict adherence to surgical and infection control protocols. These interventions have shown promising results in reducing the incidence of SSIs and improving patient outcomes.

Given the significant impact of SSIs on patient outcomes and healthcare costs, further research is needed to identify additional risk factors and effective prevention strategies in the GCC region.

➢ *Purpose and Objectives*

The main purpose of the study is to determine the prevalence and root causes of surgical site infection among patients undergoing major surgery at an acute care facility and to find out the association of modifiable and non-modifiable risk factors to the Surgical site Infections prevalence rate. Thus, this study aims:

- To rule out the risk factors associated with surgical site infection among patients undergoing major surgery by using staff questionnaire and by retrospective study of patient medical records.
- To determine the prevalence of surgical site infection among patients undergoing major surgery at an acute care facility.
- To compare the Risk factors and Surgical site Infections prevalence rate.

➢ *Research Questions*

The main question in the study in relation to the objectives is: Did the risk factors have direct impact on the development of SSI? There are three specific questions to meet the research objectives:

- What are the variables directly related to the development of SSI?
- What is the level of staff knowledge about the safe surgical pathway?
- What is the prevalence rate of SSI in an acute care facility from January 2022 to June 2022?

➢ *Structure of the Dissertation*

This dissertation is divided into chapters covering the literature review, methodology, results, analysis and discussion, conclusion, references, and appendices.

II. LITERATURE REVIEW

A. *Overview of the Chapter*

The literature review chapter includes conceptual analysis, theoretical framework, review of previous studies related to the proposed topic, and main findings from the literature.

B. *Conceptual Analysis*

Infections acquired in hospitals are recognized as being associated with significant morbidity. Up to 5% of patients undergoing surgery will experience the negative consequences of an SSI, including extended length of stay in hospital and impacted quality of life (Smyth ET et al. (2008) Four Country Healthcare Associated Infection Prevalence Survey 2006: Overview of the results. Journal of Hospital Infection; 69:230–48., p. 1). However, around 60% of SSIs are estimated to be preventable with the use of evidence-based measures (Meeks DW, Lally KP, Carrick MM et al. Compliance with guidelines to prevent surgical site infections: As simple as 1-2-3? Am J Surg 2011; 201(1):76–83). Surgical site infections (SSI) are one of the most common healthcare-associated infections, affecting approximately 2-5% of all surgical patients. These infections result in increased morbidity, mortality, and healthcare costs. Therefore, identifying the prevalence and risk factors associated with SSI is crucial in reducing their incidence.

Numerous studies have been conducted to investigate the prevalence of SSI in different settings, with rates varying widely depending on the type of surgery, patient population, and surveillance methods used. A systematic review and meta-analysis of 75 studies conducted by Allegranzi et al. (2016) reported an overall SSI rate of 6.8% for all surgeries, with higher rates for specific types of surgeries such as orthopaedic, cardiovascular, and neurosurgical procedures.

Several risk factors have been identified for the development of SSI. Patient-related risk factors include advanced age, obesity, diabetes, smoking, malnutrition, immunosuppression, and pre-existing infection. Surgical-related risk factors include longer operating time, higher American Society of Anaesthesiologists (ASA) score, contamination of the surgical site, use of prosthetic materials, and inadequate surgical technique. Hospital-related risk factors include inadequate sterilization of equipment, poor environmental hygiene, and overcrowding.

Surgical site infections (SSIs) are a major concern for patients undergoing surgical procedures worldwide. In the Gulf Cooperation Council (GCC) countries, which include Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates, SSIs are a significant healthcare challenge due to the high prevalence of risk factors such as diabetes, obesity, and a high incidence of chronic diseases. Additionally, the warm and humid climate of the region can increase the risk of bacterial growth and infections. Despite advancements in surgical techniques and infection prevention measures, the incidence of SSIs in the GCC countries remains high, leading to increased morbidity, mortality, and healthcare costs. In this context, it is important to explore the current status of SSI prevention and management in the GCC countries and identify areas for improvement to ensure better patient outcomes.

In addition to these traditional risk factors, emerging evidence suggests that the microbiome of the surgical site may play a role in the development of SSI. The microbiome refers to the collection of microorganisms that inhabit a specific site, and changes in this community can impact the risk of infection.

C. Theoretical Framework

- ➢ *Definitions*

- ➢ *Surgical Site Infection Event Details For The Data Collection*

- ➢ *Surgical Site Infections Event Identifing Instructions*

CDC criteria were used to define the type of surgical wound i.e., Superficial Incisional SSI, Deep incisional SSI, and Organ Space SSI. (https://www.cdc.gov/nhsn/pdfs/checklists/ssi-checklist-508.pdf)

- ➢ *Expected Risk Factors Associated with Surgical Site Infection:*

- *Modifiable Risk Factors in Surgical Site Infection:*

(Savage JW, Anderson PA. An update on modifiable factors to reduce the risk of surgical site infections. Spine J. 2013;13:1017–1029. doi:10.1016/j.spinee.2013.03.051 [PubMed] [Google Scholar])

The use of tobacco products, including cigarettes, causes microvascular vasoconstriction due to nicotine and activation of the sympathetic nervous system. (Fig. 2).

- *Lack of Exercise can Contribute to the Development of SSI in Several Ways:*

- ✓ Impaired circulation: Exercise improves circulation by increasing blood flow throughout the body. When you don't exercise, blood flow can become stagnant, which can impair the body's ability to deliver oxygen and nutrients to the surgical site. This can create an environment that is more conducive to bacterial growth and infection.
- ✓ Poor immune function: Exercise has been shown to boost the immune system, which helps the body fight off infections. When you don't exercise, your immune system may not function as efficiently, which can increase your risk of developing an infection after surgery.
- ✓ Delayed wound healing: Exercise has been shown to promote wound healing by increasing blood flow and delivering nutrients to the site of the wound. When you don't exercise, wound healing may be delayed, which can increase the risk of infection.
- ✓ Increased risk of obesity: Lack of exercise can contribute to the development of obesity, which is a known risk factor for SSI. Obesity can impair immune function and increase the risk of wound complications after surgery.

In summary, lack of exercise can contribute to the development of SSI by impairing circulation, weakening the immune system, delaying wound healing, and increasing the risk of obesity. It is important to maintain an active lifestyle both before and after surgery to reduce the risk of developing an infection.

Pre and postoperative anemia can contribute to the development of surgical site infections (SSI) in several ways. Anemia refers to a lower-than-normal level of red blood cells in the blood.

- Impaired immune function: Anemia can compromise the immune system, making it harder for the body to fight off infections, including SSIs.
- Delayed wound healing: Anemia can cause a delay in wound healing, which can increase the risk of infection. When the body is low on red blood cells, it has less oxygen available to promote tissue repair and regeneration.

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- Increased blood transfusions: In some cases, patients with anemia may require blood transfusions before or after surgery to address the condition. However, blood transfusions are associated with an increased risk of SSIs.
- Reduced oxygen delivery: Anemia can lead to reduced oxygen delivery to tissues, including the surgical wound site, which can impair the immune response and promote bacterial growth.

Therefore, it is important to identify and treat anemia before and after surgery to reduce the risk of SSI and improve patient outcomes.

- *Poor oral Health and Malnutrition can Contribute to the Development of Surgical site Infections (SSI) in Several ways:*

✓ Poor oral health: The mouth is a common site of colonization for bacteria, including those that can cause SSI. Poor oral health can lead to an increase in the number of bacteria in the mouth, increasing the risk of bacterial contamination during surgery. Additionally, poor oral hygiene can lead to gingivitis and periodontitis, which can result in bacteremia (bacteria in the blood), increasing the risk of SSI.

✓ Malnutrition: Malnutrition can weaken the immune system, making it more difficult for the body to fight off infections. Malnourished individuals may also have lower levels of certain nutrients, such as vitamin C and zinc, that are important for wound healing. This can lead to delayed wound healing and an increased risk of SSI. Additionally, malnutrition can lead to muscle wasting and weakness, which can make it more difficult for individuals to move and change positions, increasing the risk of pressure ulcers and other types of skin breakdown that can lead to SSI.

Overall, maintaining good oral hygiene and proper nutrition before and after surgery can help reduce the risk of SSI.

Remote infections can contribute to the development of SSI in several ways. Firstly, if a patient has an infection in a different part of their body, their immune system is already working to fight off that infection. This can make it more difficult for the immune system to respond effectively to a new infection at the surgical site, increasing the risk of SSI. Secondly, bacteria from a remote infection can travel through the bloodstream and settle at the surgical site, leading to a secondary infection. This is especially true for infections that are caused by bacteria that are commonly found in both the remote infection and the surgical site. Finally, if a patient is taking antibiotics to treat a remote infection, the normal bacteria in their gut may be disrupted, allowing opportunistic bacteria to overgrow. This can increase the risk of bacterial colonization at the surgical site and subsequent infection.

Therefore, it is important for healthcare providers to screen for and manage remote infections prior to surgery to reduce the risk of SSI.

Obesity has been shown to lead to an increased rate of postoperative complications, including surgical site infection, in several studies.

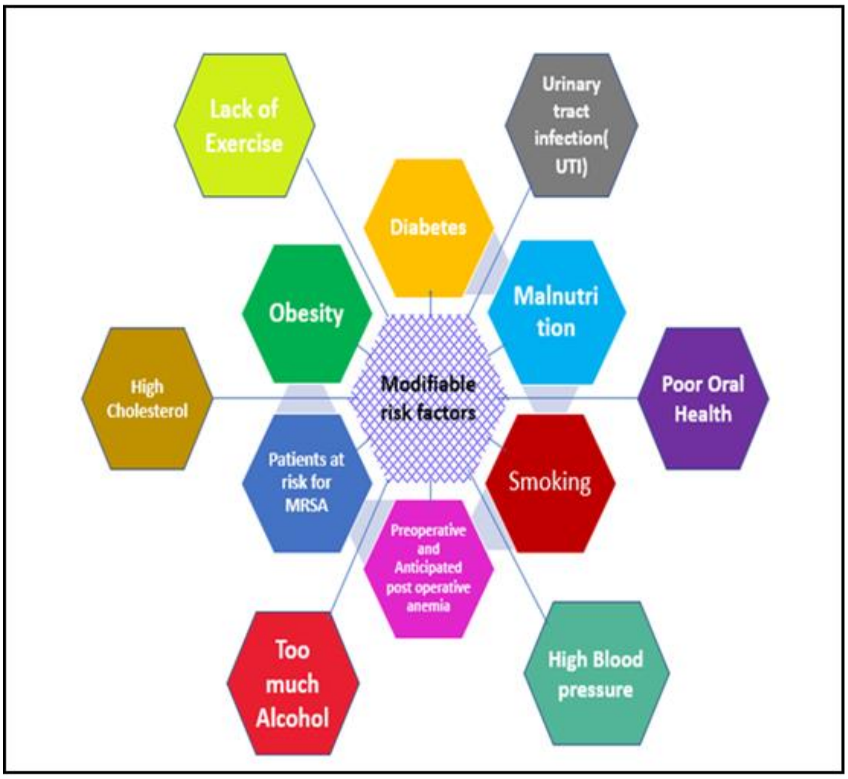

Fig 1 “Modifiable risk factors. Many patients have risk factors that make them more susceptible to the development of infections. A number of those infections may be preventable through the identification and treatment of modifiable risk factors. (MRSA = methicillin-resistant Staphylococcus aureus).”

Urinary tract infections are generally classified into upper and lower tract infections. In patients being evaluated for elective surgery, lower urinary tract infections, particularly cystitis, are most common.

Postoperative anemia treated with allogenic blood transfusion has been reported as a risk factor for surgical site infection.

- *Non-Modifiable Risk Factors in Surgical Site Infection:*

There are certain patient factors that cannot be modified, such as age, gender, and comorbidities, which can contribute to the development of surgical site infections (SSIs). Here are some examples:

- Age: Older adults may have a weaker immune system, making them more susceptible to infections. They may also have chronic medical conditions that increase their risk of SSIs.
- Gender: Women are more likely to develop SSIs after certain types of surgeries, such as abdominal and pelvic procedures.
- Comorbidities: Patients with certain medical conditions, such as diabetes, obesity, and heart disease, are at an increased risk of developing SSIs due to impaired wound healing, decreased immune function, and other factors.
- Genetic factors: Some individuals may have genetic predispositions to certain infections or wound healing complications, which can increase their risk of developing SSIs.

It is important for healthcare providers to assess these non-modifiable patient factors and take appropriate measures to reduce the risk of SSIs. This may include optimizing medical management of comorbidities, using specialized wound dressings, and implementing infection control measures during surgery.

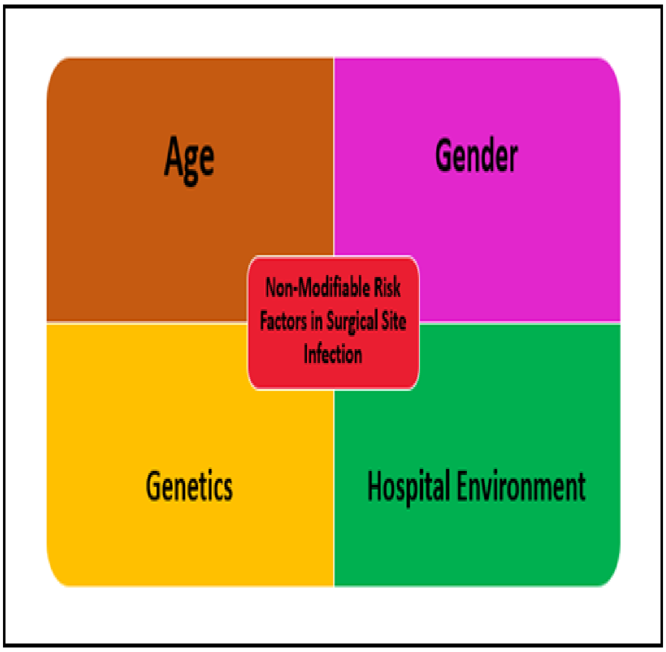

Fig 2 Non-Modifiable Risk Factors

D. Review of Related Literature

After understanding the theories of risk factors associated with the development of Surgical Site Infections, studies from the literature will be mentioned regarding the same.

The Centers for disease control and preventions healthcare-associated infection prevalence survey found that there were an estimated 110,800 surgical site infections associated with inpatient surgeries in 2015 (2. Umscheid CA, Mitchell MD, Doshi JA et al. Estimating the proportion of healthcare-associated infections that are reasonably preventable and the related mortality and costs. Infect Control Hosp Epidemiology 2011; 32(2):101–114). Based on the 2020 Healthcare Associated Infections data results published in the Healthcare Associated Infections Progress Report, about a 5% decrease in the Surgical site Infections standardized infection ratio related to all operative procedure categories combined compared to the previous year was reported in 2020 (4. Anderson, Deverick J., et al. Strategies to Prevent Surgical Site Infections in Acute Care Hospitals: 2014 Update. Infection Control and Hospital Epidemiology. 2014; 35(6): 605–627.).

It is reported, Surgical Site Infections accounts for 20% of all Healthcare associated Infections and is associated with a 2-to 11-fold increase in the risk of mortality with 75% of Surgical Site Infection-associated deaths directly attributable to the Surgical Site Infection. Surgical Site Infection is the costliest Healthcare Associated Infection type with an estimated annual cost of $3.3 billion, and extends hospital length of stay by 9.7 days, with cost of hospitalization increased by more than $20,000 per admission. Surveillance of Surgical Site Infection with feedback of appropriate data to surgeons has been shown to be an important component of strategies to reduce Surgical Site Infection risk. A successful surveillance program includes the use of epidemiologically-sound infection definitions and effective surveillance methods, stratification of Surgical Site Infection rates according to risk factors associated with Surgical Site Infection development, and data feedback. The most recent Centers for Disease prevention and Control and Healthcare Infection Control Practices Advisory Committee Guideline for the Prevention of Surgical Site Infection was published in 2017; this guideline provides evidence-based strategies for Surgical Site Infection prevention. (https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf)

Despite modern surgical techniques and the use of antibiotic prophylaxis, surgical site infection remains a burden for the patient and health system. It is a major cause of morbidity, prolonged hospital stays, and increased health costs. Thus, the main aim of this study was to determine the prevalence and root causes of surgical site infection among patients undergoing major surgery at an acute care facility. And there by alert the surgeons and healthcare staff about the modifiable and non-modifiable risk factors. This study will help to understand the risk factors related to post-operative infections. There by, it will help the surgeons to work on the modifiable risk factors to reduce the number of Surgical Site

Infections. The aim of this study is to contribute to the reduction of postoperative infections and to improve the surgical management of patients.

III. METHODOLOGY

➢ *Overview of the Chapter*

This methodology chapter includes the following: the philosophy of methodology, data collection plan, instruments, data analysis, delimitation, and ethical consideration.

➢ *Introduction*

A hospital based retrospective descriptive study covering the first half of the year 2022 planned to conduct in an inpatient unit of a tertiary care center. Planned to do it from January 2022 to June 2022. A total of 200 patient medical records who underwent operative procedures will be selected randomly. Cases will include patients of both sexes who were undergoing operative procedures, having the age of >13 years. Patients with Infection present at time of surgery (PATOS) will be excluded from the study. Also, a survey to assess the staff knowledge about the risk factors associated with Surgical site Infections from Infection Control Point of view. This survey will be distributed to approximately 100 healthcare staff across Al Qassimi Hospital, Sharjah.

➢ *Research Approach*

The philosophy of methodology depends on the research topic and research objectives. The current research topic is “A Study of Prevalence and root causes of Surgical Site Infections in an Acute Care Facility.” There are two main objectives: 1. To rule out the risk factors associated with surgical site infection among patients undergoing major surgery by using staff questionare.2. To determine the prevalence of surgical site infection among patients undergoing major surgery at an acute care facility. The research methodology uses a mixed methods approach. The current study requires statistical data that reflect the study's statistical relationship between the variables. Therefore, it is essential to test the relation between the variables through quantitative data. Moreover, this study requires qualitative data to determine the staff understanding about the associated risk factors.

➢ *Study Goal*

To determine the prevalence and root causes of surgical site infection among patients undergoing major surgery at an acute care facility and to find out the association of modifiable and non-modifiable risk factors to the Surgical site Infections prevalence rate.

➢ *Objectives*

- To rule out the risk factors associated with surgical site infection among patients undergoing major surgery by using staff questionnaire and by retrospective study of patient medical records.
- To determine the prevalence of surgical site infection among patients undergoing major surgery at an acute care facility.
- To compare the Risk factors and Surgical site Infections prevalence rate.

➢ *Study Design*

A hospital based retrospective descriptive study covering the first half of the year 2022 planned to conduct in an inpatient unit of a tertiary care center. Planned to do it retrospectively from January 2022 to June 2022. A total of 200 patient medical records who underwent operative procedures will be selected randomly. Cases will include patients of both sexes who were undergoing operative procedures, having the age of >13 years. Patients with Infection present at time of surgery will be excluded from the study. Also, a survey to assess the staff knowledge about the risk factors associated with Surgical site Infections from Infection Control Point of view. This survey will be distributed to approximately 100 healthcare staff across Al Qassimi Hospital, Sharjah. After understanding the number of Surgical site infection in the facility and corelating the same with associated risk factors will give us better solution to prevent future surgical site infection occurrences.

- *Inclusion Criteria for the Retrospective Data Collection:*

✓ Includes Superficial, Deep & Organ/Space SSIs
✓ Superficial & Deep incisional SSIs limited to primary incisional SSIs only
✓ Includes SSIs identified on admission, readmission & via post-discharge surveillance
✓ Patients of both sexes who were undergoing operative procedures, having the age of >13 years

- *Exclusion Criteria for the Retrospective Data Collection:*

✓ Procedure excluded due to procedure duration being less than 5 minutes or exceeding the IQR5 (greater than five times the interquartile range) value
✓ Procedure excluded if the patient's age at time of procedure is 109 years or older
✓ Procedure excluded because it was reported as an outpatient procedure
✓ Procedures performed in pediatric patients (LESS THAN 13 YEARS) are excluded
✓ Procedure excluded if the adult patient's BMI is less than 12 or greater than 60.
✓ Patients with Infection present at time of surgery (PATOS) will be excluded from the study.

- *Target Population for Retrospective Study:*

✓ A total of 200 patient medical records who underwent operative procedures in Al Qassimi Hospital, Sharjah from January 2022 to June 2022.

- *Inclusion Criteria for the Staff Survey:*

✓ Full time healthcare staff including nurses and surgeons working in inpatient departments Al Qassimi Hospital, Sharjah.

- *Exclusion Criteria for the Staff Survey:*

✓ Healthcare staff working in the outpatient departments and day care centers.

- *Target Population for Staff Survey:*

✓ 100 Full time healthcare staff including nurses and surgeons working in inpatient departments, Al Qassimi Hospital, Sharjah.

➢ *Data Collection Plan*

These methods include:

- Review of medical records or surgery clinic patient records
- Visit the ICU and wards – staff survey by questionnaire and talk to primary care staff.
- ___Any combination of these methods__

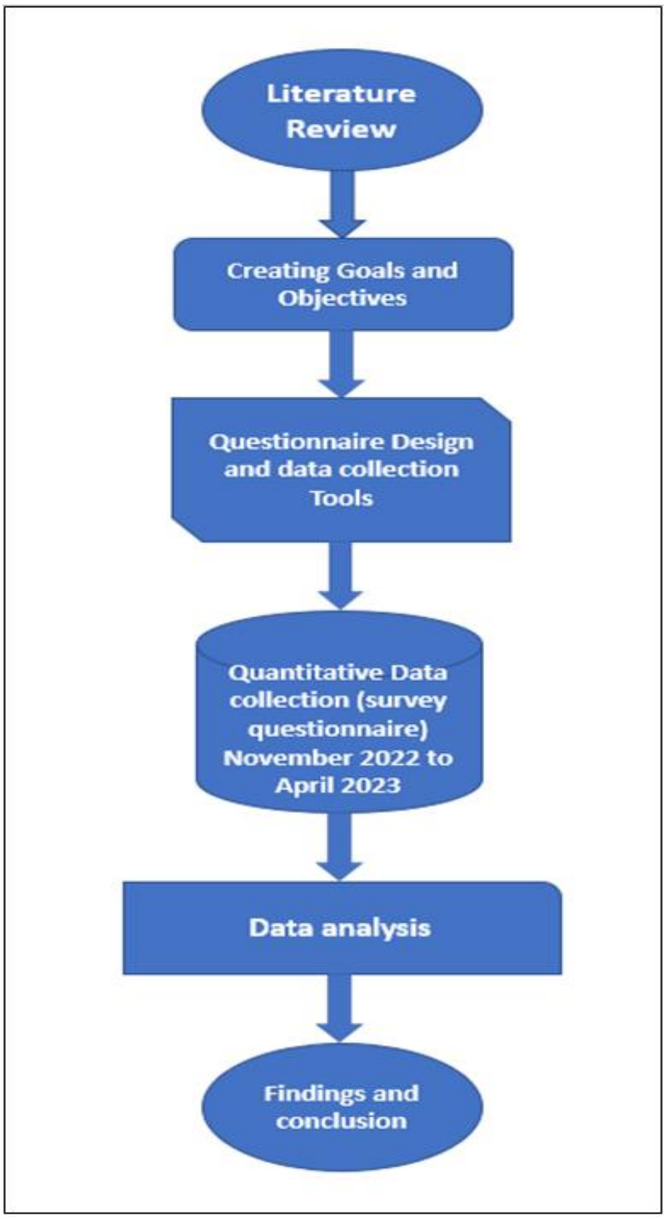

Fig 3 Graphic Outline of the Methods Adopted in this Research

➢ *Instruments*

This section discusses the quantitative and qualitative data instruments, how they were developed, validated and used.

The study measured the staff knowledge using the 22 online questionnaires. The questions are scored on a 4-point Likert scale, from yes (4) to No (1). The demographic questions covered the designation, department and Years of experience.

➢ *Data Analysis Plan*

- *Statistical Analyses*

All statistical analyses were performed using IBM SPSS Statistics for Windows, Version 20.0 (IBM Corp., Armonk, NY, USA). Categorical data are presented as n of patients (%) and were compared using Pearson's $\chi 2$-test. Continuous variables are presented as mean ± SD and were compared using independent sample t-test or analysis of variance. Multivariate logistic regression was used to analyze the factors affecting the SSI rate and a likelihood ratio test was used to verify the correlations between variables and SSI rate. In the logistic regression analyses, the variables included Sex, Education, Smoking ,BMI kgm2, ASA scoring, Patient admission method, Preoperative hospital stay (days), Premorbid illness ,Premorbid illness treatment status, Shaving of the operating site, Preoperative antibiotic therapy, Intraoperative antibiotic therapy, Type of Anesthesia, Placement of a urinary catheter, Placement of an implant or prosthesis, Installation of a drain, Intra operation duration in minutes and Wound Classification. Odds ratio (OR) and 95% confidence interval (CI) were estimated. Juveniles were excluded when hypertension and diabetes mellitus were analyzed since they may have different risk factors for SSI from adults. All the tests were two tailed and a P-value < 0.05 was considered statistically significant.

➢ *Safety Considerations*

I agree to:

- Keep all research information secure while it is in my possession.
- Whenever possible, will retain research data without any identifiers so that individual participation is anonymous and the data collected cannot be linked to the individual.
- Access to patient records will be limited

➢ *Follow Up*

Not applicable in this type of study.

➢ *Trustworthiness*

The quantitative data were reliable because the responses were consistent, which was shown when running the correlation between the variables. Regarding the validity of the data, the instruments measure what is meant to be measured. Although collecting the data has all been done online, communication between the staff and the data collector ensured reliability.

IV. RESULTS, ANALYSIS AND DISCUSSION

➢ *Overview of the Chapter*

The following chapter is divided into two sections, including the analysis and discussion of quantitative data, and qualitative data.

➢ *Data Management and Statistical Analysis*

After understanding the number of Surgical site infection in the facility and corelating the same with associated risk factors will give us better solution to prevent future surgical site infection occurrences.

- *Surgical Site Infection Rate Reports:*

Surgical site infection rates per 100 operative procedures are calculated by dividing the number of surgical site infections by the number of operative procedures and multiplying the results by 100. Surgical site Infections will be included in the numerator of a rate based on the date of procedure, not the date of event.

✓ Total number of Selected Surgeries from January 2022 to June 2022 = 200
✓ Total number of Surgical Site infection from January 2022 to June 2022 = 11
✓ So, Surgical Site Infection Rate = (11/200) *100 = 5.5

- *Sample Size:*

Most statisticians agree that the minimum sample size to get any kind of meaningful result is 100. If your population is less than 100 then you really need to survey all of them. (https://tools4dev.org/resources/how-to-choose-a-sample-size/)A good maximum sample size is usually around 10% of the population. In this retrospective study, the total number of surgeries from January 2022 to June 2022 is 1707. So, 200 patients medical records will cover 11.7% of the total major surgeries during that time.

For the staff survey, the total number of full-time healthcare staff working in inpatient department is approximately 200. So, 100 staff will cover almost half (50%) of the staff population. This is the maximum number of staffs whom the research can cover in this limited period of time. The decisions that will be made based on the results of the survey are very important.

- *Analysis of Quantitative Data:*

As discussed previously, the survey sent to the staff includes two parts: the demographic information, and the knowledge about risk factors associated with surgical site infections. The researcher will analyze the survey based on the research question, and it consisted of several types of analysis, including descriptive analysis, t-test and correlation.

A total of 200 patients that underwent surgery between January 2021 and June 2022 were reviewed and included in the study. Among the patients, 146 (73 %) were male and their age ranged from 13 to 89 years old. Of the 200 adult patients, 74 (37%) had diabetes mellitus and hypertension.

Of the included 200 patients, SSI occurred in 11 patients giving an SSI rate of 5.5% (11 of 200). The percentage of ASA scoring I, II and III were 22.5% (45), 33.5%(67) and 44% (88) respectively; and the infection rates in these types of incisions were 2.2% (n=1), 7.46% (n=5), 5.68% (n=5), respectively (Table 1) (Figure 5). The percentage of preoperative hospital stay less than one day, 1 to 4 days and more than 4 days were 40% (n= 80), 38%(n=76) and 22%(n=44) respectively; and the infection rates in these types of patients were 3.75% (n=3), 6.58%(n=5) and 6.82% (n=3), respectively (Table 1) (Figure 4). The infected patients with premorbid illnesses such as Hypertension and Diabetes were 11.76% (n=4) compared to other comorbidities. (Table 1) (Figure 6).

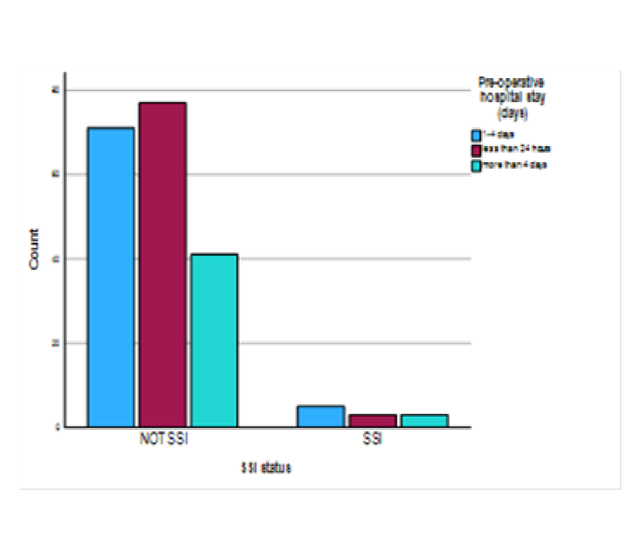

Fig 4 SSI Status Related to Preopreative Hospital Stay

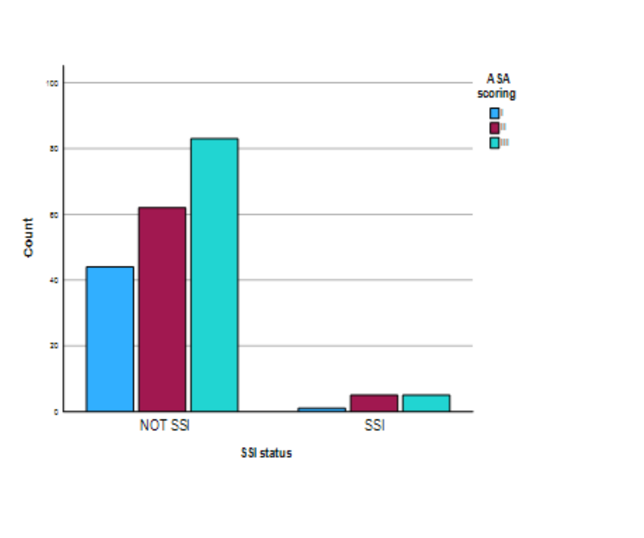

Fig 5 SSI Status Related to ASA Scoring

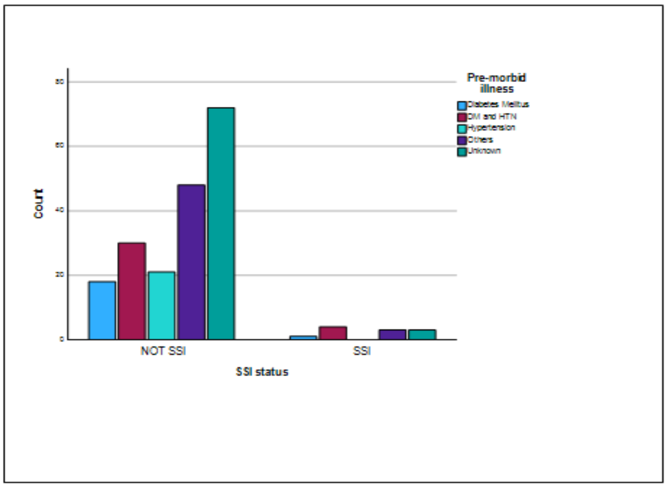

Fig 6 SSI Status Related to Pre-Morbid Illness

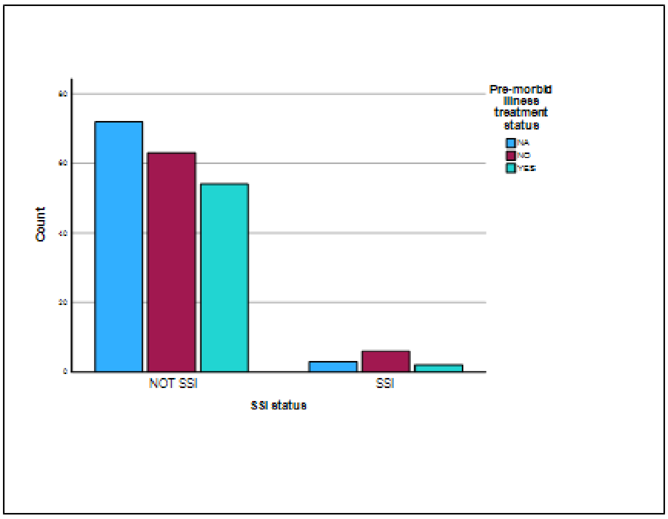

Fig 7 SSI Status Related to Pre-Morbid Illness Treatment Status

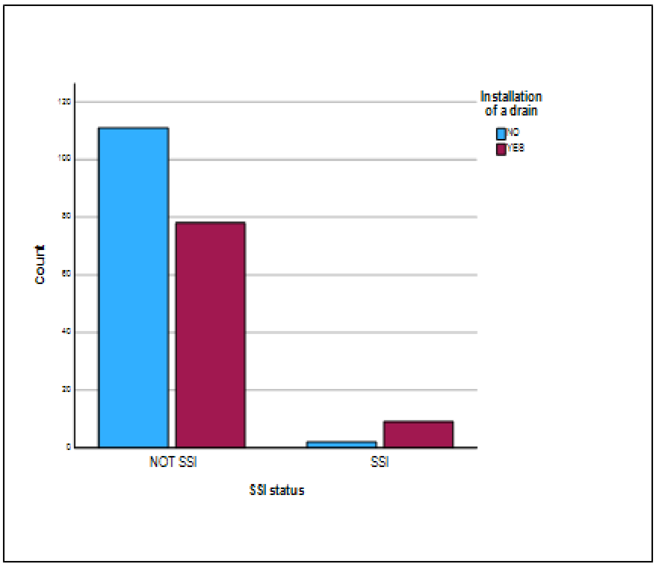

Fig 8 SSI Status Related to Installation of Drain

Logistic regression analysis showed that High ASA scoring, Preoperative Hospital stay, Premorbid illness (hypertension and diabetes mellitus) and their treatment status were significant risk factors for SSI. (Table 2)

Table 1 Multivariate Analysis of Factors Associated with SSI in First Half of 2022

SL NO			Patients with SSI		Patients without SSI		Total	
	VARIABLES		n	%	n	%	n	%
1	Age (years)	13-24	0	0.00%	26	100.00%	26	13.00%
		25-34	4	11.43%	31	88.57%	35	17.50%
		35-60	3	3.09%	94	96.91%	97	48.50%
		Over 60	4	9.52%	38	90.48%	42	21.00%
2	Sex	male	9	6.16%	137	93.84%	146	73.00%
		Female	2	3.70%	52	96.30%	54	27.00%
3	Education	Primary school	1	1.85%	53	98.15%	54	27.00%
		Secondary school	2	4.44%	43	95.56%	45	22.50%
		Higher Education	0	0.00%	30	100.00%	30	15.00%
		Unknown	8	11.27%	63	88.73%	71	35.50%
4	BMI (kg/m2)	Under weight (< 18)	0	0	0	0	0	0.00%
		normal weight (18–25)	6	4.44%	129	95.56%	135	67.50%
		Overweight (26–29)	5	7.69%	60	92.31%	65	32.50%
5	ASA scoring	I	1	2.22%	44	97.78%	45	22.50%
		II	5	7.46%	62	92.54%	67	33.50%
		III	5	5.68%	83	94.32%	88	44.00%
6	Type of Anesthesia	General Anesthesia	11	5.95%	174	94.05%	185	92.50%
		Spinal	0	0.00%	15	100.00%	15	7.50%
7	Intra-operation duration	1-2 h	3	4.84%	59	95.16%	62	31.00%

		Less Than 1 h	0	0.00%	40	100.00%	40	20.00%
		Greater Than 2 h	8	8.16%	90	91.84%	98	49.00%
8	Pre-operative hospital stays.	Less Than 1 day	3	3.75%	77	96.25%	80	40.00%
		1 to 4 days	5	6.58%	71	93.42%	76	38.00%
		Greater Than 4 days	3	6.82%	41	93.18%	44	22.00%
9	Wound Classification	Clean	7	5.00%	133	95.00%	140	70.00%
		Clean-contaminated	3	5.08%	56	94.92%	59	29.50%
		Contaminated	1	100.00%	0	0.00%	1	0.50%
10	Pre-morbid illness	Diabetes Mellitus	1	5.26%	18	94.74%	19	9.50%
		DM and HTN	4	11.76%	30	88.24%	34	17.00%
		Hypertension	0	0.00%	21	100.00%	21	10.50%
		HIV	0	0	0	0	0	0.00%
		Others	3	5.88%	48	94.12%	51	25.50%
		Unknown	3	4.00%	72	96.00%	75	37.50%
11	Post-operative hospital stays	Less Than 7 days	2	1.69%	116	98.31%	118	59.00%
		7-14 days	4	7.14%	52	92.86%	56	28.00%
		Greater Than14 days	5	19.23%	21	80.77%	26	13.00%
12	Shaving of the operating site	clipping done	8	7.69%	96	92.31%	104	52.00%
		shaving done	0	0	0	0	0	0.00%
		not done	3	3.13%	93	96.88%	96	48.00%
13	Placement of a urinary catheter	YES	10	8.85%	103	91.15%	113	56.50%
		NO	1	1.15%	86	98.85%	87	43.50%
14	Placement of an implant or prosthesis	YES	1	4.17%	23	95.83%	24	12.00%
		NO	10	5.68%	166	94.32%	176	88.00%
15	Installation of a drain	YES	9	10.34%	78	89.66%	87	43.50%
		NO	2	1.77%	111	98.23%	113	56.50%
16	Intraoperative antibiotic therapy	YES	11	5.56%	187	94.44%	198	99.00%
		NO	0	0.00%	2	100.00%	2	1.00%
17	Patient admission method	Elective	6	6.38%	88	93.62%	94	47.00%
		Emergency	5	4.72%	101	95.28%	106	53.00%
18	Pre-operative antibiotic therapy	YES	11	5.64%	184	94.36%	195	97.50%
		NO	0	0.00%	5	100.00%	5	2.50%
19	Smoking	YES	9	8.41%	98	91.59%	107	53.50%
		NO	2	2.15%	91	97.85%	93	46.50%
20	Alcohol use	YES	4	6.45%	58	93.55%	62	31.00%
		NO	7	5.07%	131	94.93%	138	69.00%

The data in the table shows that patients with contaminated wounds had a 100% occurrence of surgical site infections (SSIs). Meanwhile, those with clean wounds had a lower incidence of SSIs at 5.00%, while those with clean-contaminated wounds had a slightly higher incidence at 5.08%.

Therefore, we can infer that there is a relationship between wound classification and the occurrence of SSIs. Specifically, patients with contaminated wounds are at a higher risk of developing SSIs compared to those with clean or clean-contaminated wounds. It is essential to note, however, that the sample size for patients with contaminated wounds is relatively small (n=1), and thus, the results may not be generalizable to a larger population.

From the given data, it appears that patients in the age group of 25-34 have a higher percentage of SSI (Surgical Site Infection) compared to patients over the age of 60. Specifically, 11.43% of patients in the 25-34 age group had SSI, while only 9.52% of patients over the age of 60 had SSI.

It is important to note that the overall number of patients in the age group of 25-34 is smaller than the number of patients over the age of 60. This means that the percentage of patients with SSI in the 25-34 age group may be more influenced by a few cases, whereas the percentage in the over 60 age group is based on a larger sample size.

There could be several reasons why the percentage of SSI is higher in the 25-34 age group compared to the over 60 age group. For instance, patients in the 25-34 age group may have more active lifestyles and engage in activities that increase the risk of SSI, such as sports or outdoor activities. On the other hand, patients over the age of 60 may have weaker immune systems and may be more susceptible to infections in general, but may have fewer active lifestyles that may expose them to less risk of SSI.

However, without additional data or context, it is difficult to draw a definitive conclusion. Further analysis of other relevant factors, such as pre-existing health conditions, type of surgery, and postoperative care, may be necessary to fully understand the observed differences in SSI rates between the age groups.

The research question was to identify the variables that are directly related to the development of SSI (surgical site infection).

The table (2) contains the results of the regression analysis with each predictor variable's coefficient (B), standard error (SE), Wald statistic, degrees of freedom (df), significance level (Sig.), exponentiated coefficient (Exp(B)), and the 95% confidence interval for the exponentiated coefficient.

The coefficient (B) indicates the direction and strength of the relationship between the predictor variable and the outcome variable (SSI). A positive coefficient indicates a positive relationship (increase in predictor variable leads to an increase in the outcome variable), while a negative coefficient indicates a negative relationship (increase in predictor variable leads to a decrease in the outcome variable).

The standard error (SE) is the standard deviation of the sampling distribution of the coefficient. It represents the uncertainty in the estimate of the coefficient.

The Wald statistic is a measure of the significance of the coefficient. The larger the Wald statistic, the more significant the coefficient.

The degrees of freedom (df) represent the number of observations minus the number of variables in the model. The significance level (Sig.) is the probability of observing a Wald statistic as extreme or more extreme than the one obtained if the null hypothesis were true. A significance level of 0.05 (5%) or less is typically considered statistically significant.

The exponentiated coefficient (Exp(B)) is the ratio of the odds of the outcome variable (SSI) occurring when the predictor variable increases by one unit compared to when it does not increase. An Exp(B) greater than 1 indicates that the predictor variable is associated with an increase in the odds of the outcome variable, while an Exp(B) less than 1 indicates that the predictor variable is associated with a decrease in the odds of the outcome variable. The 95% confidence interval for the exponentiated coefficient represents the range of values that the true Exp(B) is likely to fall within with 95% probability. If the confidence interval does not include 1, the coefficient is considered statistically significant.

Table 2 Logistic Regression Analysis of Variables

	B	S.E.	Wald	df	Sig.	Exp(B)	95% CI.for EXP(B)	
							Lower	Upper
Age (in years)			3.179	3	.365			
Age (in years) (1)	-19.700	5528.398	.000	1	.997	.000	.000	.
Age (in years) (2)	-.715	2.377	.091	1	.763	.489	.005	51.564
Age (in years) (3)	-3.714	2.268	2.680	1	.102	.024	.000	2.080
Sex (1)	-1.928	2.167	.792	1	.374	.145	.002	10.165
Education			2.469	3	.481			
Education (1)	-3.972	2.570	2.389	1	.122	.019	.000	2.900
Education (2)	-19.161	4578.940	.000	1	.997	.000	.000	.
Education (3)	-.848	1.780	.227	1	.634	.428	.013	14.014
Smoking (1)	-6.425	2.944	4.761	1	.029	.002	.000	.520
BMI (kg/m2) (1)	-1.577	1.767	.796	1	.372	.207	.006	6.598
ASA scoring			1.694	2	.429			
ASA scoring (1)	1.549	2.371	.427	1	.514	4.705	.045	490.176
ASA scoring (2)	2.278	1.751	1.693	1	.193	9.755	.316	301.599
Patient admission method (1)	-.146	1.251	.014	1	.907	.864	.074	10.043
Pre-operative hospital stays(days)			1.606	2	.448			
Pre-operative hospital stays (days) (1)	1.808	1.523	1.409	1	.235	6.098	.308	120.640
Pre-operative hospital stays (days) (2)	-.661	1.795	.136	1	.713	.516	.015	17.400
Pre-morbid illness			2.222	4	.695			
Pre-morbid illness (1)	1.573	2.494	.398	1	.528	4.823	.036	640.577
Pre-morbid illness (2)	1.930	2.300	.704	1	.401	6.889	.076	625.226
Pre-morbid illness (3)	-18.535	6743.506	.000	1	.998	.000	.000	.
Pre-morbid illness (4)	3.581	2.472	2.099	1	.147	35.920	.283	4565.883
Pre-morbid illness treatment status			.210	1	.647			
Pre-morbid illness treatment status (2)	.714	1.558	.210	1	.647	2.043	.096	43.286
Shaving of the operating site (1)	3.506	2.379	2.172	1	.141	33.310	.315	3526.622
Pre-operative antibiotic therapy (1)	-16.588	19383.995	.000	1	.999	.000	.000	.
Intraoperative antibiotic therapy (1)	26.265	33784.242	.000	1	.999	255097869644.682	.000	.
Type of Anesthesia (1)	24.605	6782.420	.000	1	.997	48521765461.763	.000	.
Placement of a urinary catheter (1)	-1.209	2.312	.274	1	.601	.298	.003	27.702
Placement of an implant or prosthesis (1)	-5.811	3.619	2.579	1	.108	.003	.000	3.603
Installation of a drain (1)	-.791	2.178	.132	1	.716	.453	.006	32.394

Intra-operation duration (in minutes)			.413	2	.813			
Intra-operation duration (in minutes) (1)	20.108	4256.336	.000	1	.996	540710494.134	.000	.
Intra-operation duration (in minutes) (2)	18.800	4256.336	.000	1	.996	146121063.952	.000	.
Wound Classification			1.520	2	.468			
Wound Classification (1)	-31.411	40192.977	.000	1	.999	.000	.000	.
Wound Classification (2)	-28.193	40192.977	.000	1	.999	.000	.000	.
Constant	-10.868	40982.840	.000	1	1.000	.000		

The logistic regression analysis showed that procedure type and wound classification were both statistically significant predictors of SSI status with $p < 0.001$.

Procedure type refers to the type of surgical procedure performed on the patient. The statistical significance of this variable suggests that the type of procedure performed is a strong predictor of the development of SSI. It is likely that certain types of procedures are more prone to causing infections than others due to their location, duration, or invasiveness. For example, procedures involving the digestive or urinary tracts may carry a higher risk of infection due to the presence of bacteria in those areas. Therefore, it is important to take the type of procedure into consideration when assessing a patient's risk of developing SSI.

Wound classification refers to the assessment of the wound based on the potential risk of infection, ranging from clean to contaminated. The statistical significance of this variable suggests that wound classification is also a strong predictor of SSI development. A contaminated or dirty wound is more likely to become infected than a clean wound, and this variable can be used to help identify patients at higher risk of developing SSI. It is important to properly classify wounds and take appropriate measures to prevent infection, such as using proper sterile techniques and administering prophylactic antibiotics when appropriate.

- *Assessment of the Staff's Level of Knowledge about Surgical Site Infections*

Staff questionnaires were revealed that there is a need for continuous training of staff on nosocomial infections in order to be able to strengthen their knowledge of the risk infectious. Despite the capacity building of staff by the Al Qassimi hospital Infection control team and the Committee for the Fight against Nosocomial Infections, much remains to be done in raising the awareness of nursing staff on the prevention and control of Surgical Site Infections. Most of the staffs need training on the below points especially. *"Do not remove patient hair, or if absolutely necessary, remove with a clipper, do not shave is the same across categories of Years of Experience.* ***Significance: 001****"; "consider prophylactic negative pressure wound therapy (primary in closed surgical incisions in high-risk wounds) is the same across categories of Years of Experience.* ***Significance :0.26****"; "Consider using triclosan- coated sutures is the same across categories of Years of Experience.* ***Significance: 001"; "***Do not continue *surgical antibiotic prophylaxis due to the presence of a drain. is the same across categories of Years of Experience.* ***Significance:0.011****"; Remove wound drain when clinically indicated is the same across categories of Years of Experience.* ***Significance: 0.013****".*

Table 3 Staff Knowledge about the Surgical Pathway in an Infection Control Point of view: Hypothesis Test Summary

Hypothesis Test Summary				
	Null Hypothesis	**Test**	**Sig.^{a,b}**	**Decision**
1	The distribution of Patient bathes or showers on the day of the operation or the day or night before with a plain or antimicrobial soap so that patients are prepared before entering the intraoperative area/period. is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.348	Retain the null hypothesis.
2	The distribution of Used 2 % mupriocin decolonization in known nasal carriers of staphylococcus aureus in cardiac and orthopedic surgeries (consider for other surgeries) is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.855	Retain the null hypothesis.
3	The distribution of Do not remove patient hair, or if absolutely necessary, remove with a clipper, do not shave is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.001	Reject the null hypothesis.
4	The distribution of Administered surgical antibiotic prophylaxis in the 120 minutes preceding surgical incision. (depending on the type of operation and the half-life of the antibiotic) is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.932	Retain the null hypothesis.

5	The distribution of Prepared hands for surgery by scrubbing, using the correct technique with a suitable antimicrobial soap and water OR an alcohol-based hand rub. (before donning sterile gloves) is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.390	Retain the null hypothesis.
6	The distribution of Administered oral or enteral multi nutrient enhanced formulas in underweight patients (undergoing major surgical operations) as per the instructions. is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.083	Retain the null hypothesis.
7	The distribution of Preoperative oral antibiotics combined with Mechanical Bowel Preparation (MBP) should be used to reduce the risk of SSI in adult patients undergoing elective colorectal surgery is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.363	Retain the null hypothesis.
8	The distribution of Do not discontinue immunosuppressive medication prior to surgery for the purpose of preventing SSI is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.643	Retain the null hypothesis.
9	The distribution of clean and prepare the operating room environment for each surgical procedure; clean and sterilize/decontaminate surgical instruments and other equipment; maintain asepsis in the operating room. is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.392	Retain the null hypothesis.
10	The distribution of Alcohol-based antiseptic solutions based on CHG is used for surgical site skin preparation in patients undergoing surgical procedures. is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.333	Retain the null hypothesis.
11	The distribution of Consider irrigating incisional wound with an aqueous povidone iodine solution before closure (in clean and clean contaminated wounds) is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.781	Retain the null hypothesis.
12	The distribution of Do not perform antibiotic wound irrigation is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.272	Retain the null hypothesis.
13	The distribution of Consider using wound protector devices (in clean-contaminated, contaminated and dirty abdominal procedures) is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.105	Retain the null hypothesis.
14	The distribution of consider prophylactic negative pressure wound therapy (primary in closed surgical incisions in high-risk wounds) is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.026	Reject the null hypothesis.
15	The distribution of Consider using triclosan-coated sutures is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.001	Reject the null hypothesis.
16	The distribution of Maintain asepsis and discipline in the operating room is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.677	Retain the null hypothesis.
17	The distribution of Do NOT prolong surgical antibiotic prophylaxis in the post operative period is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.261	Retain the null hypothesis.

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18	The distribution of Do not continue surgical antibiotic prophylaxis due to the presence of a drain. is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.011	Reject the null hypothesis.
19	The distribution of Remove wound drain when clinically indicated is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.013	Reject the null hypothesis.
20	The distribution of Administer 80% FiO2 for 2-6 hours post-op is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.375	Retain the null hypothesis.
21	The distribution of Evaluate and manage wound appropriately, including cleansing, dressing and care, according to the given wound situation. is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.073	Retain the null hypothesis.
22	The distribution of Do not use advanced dressings of any sort (use standard dressings instead) is the same across categories of Years of Experience.	Independent-Samples Kruskal-Wallis Test	.477	Retain the null hypothesis.
a. The significance level is .050.				
b. Asymptotic significance is displayed.				

The above data (Table 3) Kruskal-Wallis test was used to analyze each hypothesis. This test is a non-parametric test used to compare three or more independent samples. The null hypothesis for each hypothesis test is that the distribution of a certain surgical procedure is the same across categories of Years of Experience, and the alternative hypothesis is that the distribution is different.

The significance level (alpha) was set at 0.05 for all the tests, which means that if the p-value is less than 0.05, the null hypothesis is rejected in favor of the alternative hypothesis. On the other hand, if the p-value is greater than or equal to 0.05, the null hypothesis is retained. Based on the summary table provided, it looks like the null hypothesis was retained for most of the hypotheses (hypotheses 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 17, and 20). This means that there is not enough evidence to suggest that the distribution of these surgical procedures is different across categories of Years of Experience. However, for hypotheses **3, 14, 15, 18, and 19**, the null hypothesis was rejected in favor of the alternative hypothesis. This means that there is enough evidence to suggest that the distribution of these surgical procedures is different across categories of Years of Experience.

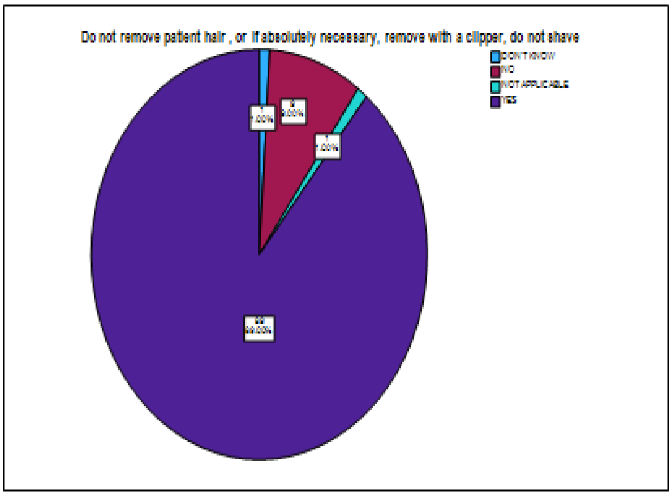

Fig 9 Staff Knowledge about "Do not Remove Patient Hair, or if Absolutely Necessary, Remove with a Clipper, do not Shave."

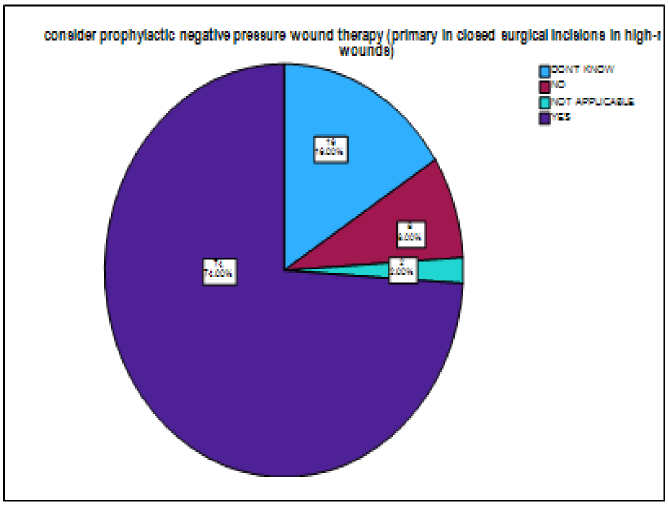

Fig 10 Staff Knowledge about "Consider Prophylactic Negative Pressure Wound Therapy (Primary in Closed Surgical Incisions in High-Risk Wounds"

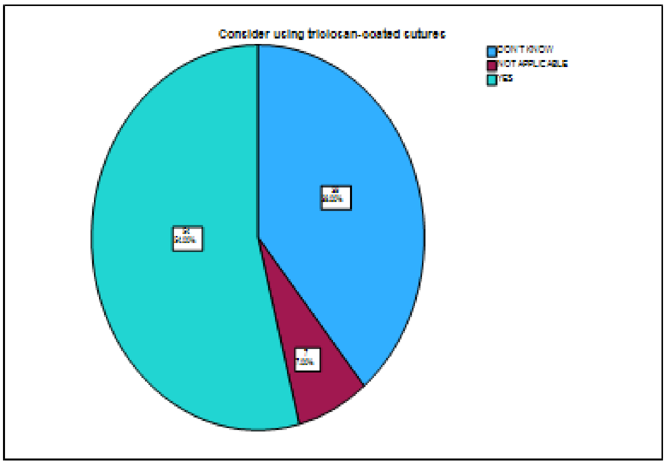

Fig 11 Staff Knowledge about "Consider using Triclosan-Coated Sutures"

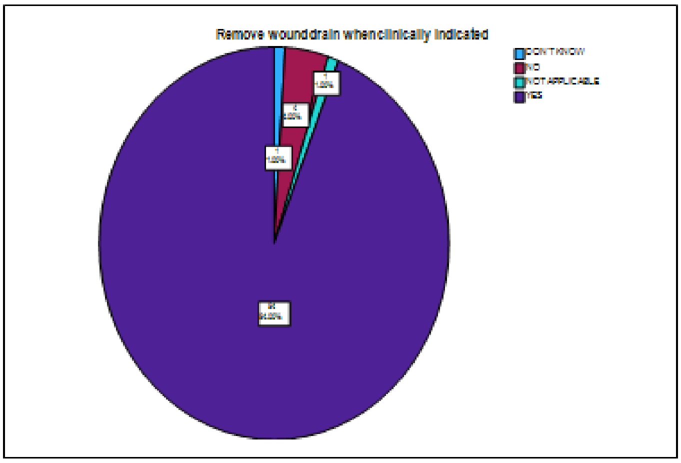

Fig 13 Staff Knowledge about "Remove Wound Drain when Clinically Indicated"

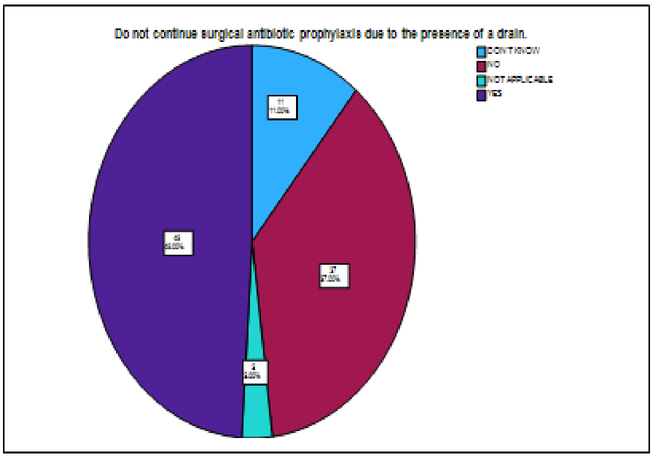

Fig 12 Staff Knowledge about "Do not Continue Surgical Antibiotic Prophylaxis due to the Presence of a Drain."

Table 4 Staff Knowledge about the Surgical Pathway in an Infection Control Point of view: A Descriptive Study

Descriptive Statistics						
	N	**Minimum**	**Maximum**	**Sum**	**Mean**	**Std. Deviation**
Patient bathes or showers on the day of the operation or the day or night before with a plain or antimicrobial soap so that patients are prepared before entering the intraoperative area/period.	100	1	4	385	3.85	.626
Used 2 % mupriocin decolonization in known nasal carriers of staphylococcus aureus in cardiac and orthopaedic surgeries (consider for other surgeries)	100	1	4	330	3.30	1.049
Do not remove patient hair, or if absolutely necessary, remove with a clipper, do not shave	100	1	4	370	3.70	.882
Administered surgical antibiotic prophylaxis in the 120 minutes preceding surgical incision. (depending on the type of operation and the half-life of the antibiotic)	100	1	4	361	3.61	.963
Prepared hands for surgery by scrubbing, using the correct technique with a suitable antimicrobial soap and water OR an alcohol-based hand rub. (before donning sterile gloves)	100	1	4	377	3.77	.694
Administered oral or enteral multi nutrient enhanced formulas in underweight patients (undergoing major surgical operations) as per the instructions.	100	1	4	313	3.13	1.178
Preoperative oral antibiotics combined with Mechanical Bowel Preparation (MBP) should be used to reduce the risk of SSI in adult patients undergoing elective colorectal surgery	100	1	4	334	3.34	1.075
Do not discontinue immunosuppressive medication prior to surgery for the purpose of preventing SSI	100	1	4	328	3.28	1.138

clean and prepare the operating room environment for each surgical procedure; clean and sterilize/decontaminate surgical instruments and other equipment; maintain asepsis in the operating room.	100	1	4	380	3.80	.586
Alcohol-based antiseptic solutions based on CHG is used for surgical site skin preparation in patients undergoing surgical procedures.	100	1	4	363	3.63	.884
Consider irrigating incisional wound with an aqueous povidone iodine solution before closure (in clean and clean contaminated wounds)	100	1	4	331	3.31	1.061
Do not perform antibiotic wound irrigation	100	1	4	288	2.88	1.183
Consider using wound protector devices (in clean-contaminated, contaminated and dirty abdominal procedures)	100	1	4	351	3.51	.904
consider prophylactic negative pressure wound therapy (primary in closed surgical incisions in high-risk wounds)	100	1	4	342	3.42	1.027
Consider using triclosan- coated sutures	100	2	4	315	3.15	.957
Maintain asepsis and discipline in the operating room	100	1	4	372	3.72	.726
Do NOT prolong surgical antibiotic prophylaxis in the post-operative period	100	1	4	351	3.51	1.059
Do not continue surgical antibiotic prophylaxis due to the presence of a drain.	100	1	4	264	2.64	1.404
Remove wound drain when clinically indicated	100	1	4	385	3.85	.626
Administer 80% FiO2 for 2-6 hours post-op	100	1	4	325	3.25	1.140
Evaluate and manage wound appropriately, including cleansing, dressing and care, according to the given wound situation.	100	1	4	393	3.93	.383
Do not use advanced dressings of any sort (use standard dressings instead)	100	1	4	335	3.35	1.132
Valid N (listwise)	100					

To determine if all responders were knowledgeable about the SSI pathway using these 20 questions, we can calculate the mean score for each question and then calculate the overall mean score across all questions. A score of 4 indicates a high level of knowledge, while a score of 0 indicates a low level of knowledge.

Descriptive statistics have already been provided for each question, including the minimum, maximum, sum, mean, and standard deviation. We can see that the mean score for each question is above 3, indicating a relatively high level of knowledge for each item.

To determine the overall mean score across all questions, we can calculate the sum of all scores and divide by the total number of responses (which is 100 for each question, since there are 100 responders).

The overall mean score would be the average of all the mean scores for each question, and would provide an indication of the overall level of knowledge among responders regarding the safe surgical pathway.

Based on the provided data (Table 4), the overall mean score across all questions is:

(3.85+3.3+3.7+3.61+3.77+3.13+3.34+3.28+3.8+3.63+3.31+2.88+3.51+3.42+3.15+3.72+3.51+2.64+3.85+3.25+3.93+3.35)/22 = 3.43

This indicates that, on average, responders had a relatively high level of knowledge about the safe surgical pathway based on the 20 questions provided, with an overall mean score above 3.

Table 5 Independent Samples Test on Assessing the Staff Knowledge about the Surgical Pathway in an Infection Control Point of view

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	**Sig.**	**t**	**df**	**One-Sided p**	**Two-Sided p**	**Mean Difference**	**Std. Error Difference**	**Lower**	**Upper**
Patient bathes or showers on the day of the operation or the day or night before with a plain or antimicrobial soap so that patients are prepared before entering the intraoperative area/period.	Equal variances assumed	1.233	.270	-.567	74	.286	.572	-.078	.138	-.354	.197
	Equal variances not assumed			-.582	73.916	.281	.562	-.078	.135	-.347	.190
Used 2 % mupriocin decolonization in known nasal carriers of staphylococcus aureus in cardiac and orthopedic surgeries (consider for other surgeries)	Equal variances assumed	.147	.703	.181	74	.429	.857	.045	.248	-.450	.539
	Equal variances not assumed			.182	72.778	.428	.856	.045	.246	-.445	.535
Do not remove patient hair, or if absolutely necessary, remove with a clipper, do not shave	Equal variances assumed	23.559	<.001	2.191	74	.016	.032	.294	.134	.027	.562
	Equal variances not assumed			1.968	33.000	.029	.058	.294	.149	-.010	.598
Administered surgical antibiotic prophylaxis in the 120 minutes preceding surgical incision. (depending on the type of operation and the half-life of the antibiotic)	Equal variances assumed	.039	.844	.155	74	.439	.877	.036	.235	-.431	.504
	Equal variances not assumed			.155	70.535	.439	.877	.036	.235	-.432	.505
Prepared hands for surgery by scrubbing, using the correct technique with a suitable antimicrobial soap and water OR an alcohol-based hand rub. (before donning sterile gloves)	Equal variances assumed	.085	.772	.132	74	.448	.895	.021	.159	-.296	.338
	Equal variances not assumed			.132	70.007	.448	.896	.021	.160	-.297	.339
Administered oral or enteral multi nutrient enhanced formulas in underweight patients (undergoing major surgical operations) as per the instructions.	Equal variances assumed	5.729	.019	2.560	74	.006	.013	.658	.257	.146	1.171
	Equal variances not assumed			2.510	64.033	.007	.015	.658	.262	.134	1.182
Preoperative oral antibiotics combined with Mechanical Bowel Preparation (MBP) should be used to reduce the risk of SSI in adult patients undergoing elective colorectal surgery	Equal variances assumed	.439	.510	.543	74	.294	.589	.134	.248	-.359	.628
	Equal variances not assumed			.541	70.030	.295	.590	.134	.248	-.361	.630

Do not discontinue immunosuppressive medication prior to surgery for the purpose of preventing SSI	Equal variances assumed	.783	.379	.343	74	.366	.732	.087	.253	-.417	.591
	Equal variances not assumed			.341	68.259	.367	.735	.087	.255	-.422	.596
clean and prepare the operating room environment for each surgical procedure; clean and sterilize/decontaminate surgical instruments and other equipment; maintain asepsis in the operating room.	Equal variances assumed	4.604	.035	1.102	74	.137	.274	.151	.137	-.122	.425
	Equal variances not assumed			1.072	61.066	.144	.288	.151	.141	-.131	.433
Alcohol-based antiseptic solutions based on CHG is used for surgical site skin preparation in patients undergoing surgical procedures.	Equal variances assumed	2.197	.142	-.778	74	.219	.439	-.158	.203	-.563	.247
	Equal variances not assumed			-.798	73.945	.214	.427	-.158	.198	-.553	.237
Do not perform antibiotic wound irrigation	Equal variances assumed	.446	.506	1.973	74	.026	.052	.531	.269	-.005	1.067
	Equal variances not assumed			1.984	72.128	.026	.051	.531	.268	-.002	1.064
Consider irrigating incisional wound with an aqueous povidone iodine solution before closure (in clean and clean contaminated wounds)	Equal variances assumed	.052	.821	-.103	74	.459	.918	-.027	.258	-.540	.487
	Equal variances not assumed			-.103	71.061	.459	.918	-.027	.257	-.540	.486
consider prophylactic negative pressure wound therapy (primary in closed surgical incisions in high-risk wounds)	Equal variances assumed	18.768	<.001	2.772	74	.004	.007	.620	.224	.174	1.066
	Equal variances not assumed			2.686	59.257	.005	.009	.620	.231	.158	1.083
Consider using wound protector devices (in clean-contaminated, contaminated and dirty abdominal procedures)	Equal variances assumed	8.146	.006	1.873	74	.032	.065	.356	.190	-.023	.734
	Equal variances not assumed			1.829	62.385	.036	.072	.356	.194	-.033	.744
Maintain asepsis and discipline in the operating room	Equal variances assumed	.026	.873	.122	74	.451	.903	.015	.126	-.235	.266
	Equal variances not assumed			.123	71.420	.451	.903	.015	.126	-.235	.266
Consider using triclosan-coated sutures	Equal variances assumed	1.901	.172	4.106	74	<.001	<.001	.824	.201	.424	1.223
	Equal variances not assumed			4.067	67.789	<.001	<.001	.824	.203	.419	1.228
Do not continue surgical antibiotic prophylaxis due to the presence of a drain.	Equal variances assumed	.022	.883	2.921	74	.002	.005	.901	.308	.286	1.515
	Equal variances not assumed			2.915	70.136	.002	.005	.901	.309	.284	1.517
Do NOT prolong surgical antibiotic prophylaxis in the post-operative period	Equal variances assumed	9.034	.004	1.629	74	.054	.108	.391	.240	-.087	.869
	Equal variances not assumed			1.580	59.539	.060	.120	.391	.247	-.104	.886
Administer 80% FiO2 for 2-6 hours post-op	Equal variances assumed	4.937	.029	1.511	74	.067	.135	.394	.260	-.125	.912
	Equal variances not assumed			1.478	63.103	.072	.144	.394	.266	-.138	.926

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Remove wound drain when clinically indicated	Equal variances assumed	2.511	.117	.771	74	.222	.443	.064	.084	-.102	.231
	Equal variances not assumed			.705	37.819	.243	.485	.064	.091	-.121	.249
Do not use advanced dressings of any sort (use standard dressings instead)	Equal variances assumed	.123	.727	-.030	74	.488	.976	-.008	.278	-.563	.546
	Equal variances not assumed			-.030	68.930	.488	.976	-.008	.280	-.567	.550
Evaluate and manage wound appropriately, including cleansing, dressing and care, according to the given wound situation.	Equal variances assumed	3.393	.069	-.899	74	.186	.372	-.024	.026	-.077	.029
	Equal variances not assumed			-1.000	41.000	.162	.323	-.024	.024	-.072	.024

The data (table 5) provided is the result of a series of independent samples tests, each comparing two groups on a particular factor that may influence the risk of surgical site infections. For each test, the results of Levene's Test for Equality of Variances and the t-test for Equality of Means are reported.

The Levene's Test assesses the equality of variances assumption, which is one of the assumptions for the t-test. If the p-value for Levene's Test is greater than 0.05, the assumption of equal variances is met, and the results for the t-test assuming equal variances are reported. If the p-value for Levene's Test is less than 0.05, the assumption of equal variances is violated, and the results for the t-test assuming unequal variances are reported.

The t-test assesses the significance of the difference in means between two groups. The "Mean Difference" column reports the difference in means between the two groups, and the "Std. Error Difference" column reports the standard error of that difference. The "95% Confidence Interval of the Difference" column provides a range of values within which the true difference in means is likely to fall with 95% confidence.

The "One-Sided p" and "Two-Sided p" columns report the p-values for the t-test, indicating the probability of observing a difference in means at least as extreme as the one observed, assuming there is no difference in the population. The "One-Sided p" is used when there is a directional hypothesis (i.e., a prediction about the direction of the difference in means), and the "Two-Sided p" is used when there is a non-directional hypothesis.

In summary, these tests are used to determine whether certain factors, such as using an antimicrobial soap or administering antibiotics prophylactically, are associated with a significant difference in the risk of surgical site infections. The results of these tests provide information about which factors may be effective in reducing the risk of surgical site infections and may help guide clinical practice.

- *Triangulation of the Two Data:*

The current study will use triangulation methods by incorporating mixed methods of quantitative and qualitative data collection. The purpose of using triangulation in research is to increase the credibility and validity of the data **(see Figure 4 below)**

Figure 4 below shows how triangulation is informed. As mentioned previously, the researcher used an online staff questionnaire and collected responses from 100 staff, then analyzed the results using statistical analysis. Then the researcher conducted a retrospective study of 200 patients' medical records and data will be coded and thematically analyzed. Both sets of the data will be analyzed separately then the results will compare together in this section.

V. CONCLUSION

- *Overview of the Chapter*

The following chapter discusses a summary of the study, key findings, recommendations, implications, problems anticipated, scope for further study, and concluding remarks.

- *Summary of the Study and Key Findings*

Nowadays, surgical site infections continue to be a major public health problem in all over the world. In Conclusion, among the 200 operated, 11 developed an infection of the surgical site (0.5%). The factors identified were focused mainly on the type of wound, the associated chronic pathology, the mode of admission, the shaving of the operating site. We also underlined the lack of knowledge of surgical site infections by few staff and the need for training in this health phenomenon. These results show the persistence of patient and care factors in the occurrence of surgical site infections. Need more studies to understand more factors associated with the development of SSI in detail.

The analysis of the data collected indicates that several variables are directly related to the development of SSI. These variables include patient-related factors such as age, and pre-morbid illness, as well as procedure-related factors such as the duration of surgery, type of surgery, and the use of certain surgical devices or implants. The results suggest that appropriate management of these variables may help reduce the incidence of SSI.

The results of the study indicate that the level of staff knowledge about the safe surgical pathway varies among different healthcare providers. While some providers have a high level of knowledge, others have significant knowledge gaps. The results suggest that further training and education may be necessary to ensure that all staff members are aware of the safe surgical pathway and adhere to it consistently.

The analysis of the data collected from the acute care facility from January 2022 to June 2022 indicates that the prevalence rate of SSI was 5.5%. This rate suggests that additional measures are needed to reduce the incidence of SSI in the facility. Factors that may contribute to the high prevalence rate include patient-related factors such as a high prevalence of diabetes and obesity, as well as procedure-related factors such as the type and duration of surgery.

➢ *Expected Outcome of the Study*

The expected outcome of this study is, the modifiable and non-modifiable risk factors will be directly proportional to the surgical site infection prevalence rate. This study will help to understand the risk factors related to post-operative infections. There by, it will help the surgeons to work on the modifiable risk factors to reduce the number of Surgical Site Infections.

➢ *Duration of the Project*

A hospital based retrospective descriptive study covering the first half of the year 2022 planned to conduct in an inpatient unit of a tertiary care center. Planned to do it retrospectively from January 2022 to June 2022. Staff survey by questionnaire were done in the month of February and March 2023 after getting consent from each participant and after ethical approval.

➢ *Problems Anticipated*

- *Issues with Research Samples and Selection:*

Expecting “selection bias” For example, the samples (participants) were asked to respond to the survey questions. However, the investigator will have limited ability to gain access to the appropriate type and scope of participants. In this case, the people who responded to your survey questions may not truly be a random sample.

RECOMMENDATIONS

Despite extensive efforts to prevent surgical site infections, they remain a significant cause of morbidity and mortality. Further research is needed to better understand the underlying causes of SSIs and develop more effective prevention strategies. One area of research that shows promise is the use of advanced wound dressings. While some studies have shown that advanced dressings may increase the risk of SSI, others have suggested that they can be effective in reducing the risk of infection. Further research is needed to determine which types of advanced dressings are most effective and in which patient populations they are most appropriate. Another area of research that warrants further exploration is the use of probiotics to prevent SSIs. Probiotics are live microorganisms that can provide health benefits when consumed. Some studies have suggested that probiotics can reduce the risk of SSIs by modulating the gut microbiome and boosting the immune system. However, more research is needed to determine the most effective probiotic strains and dosages, as well as the optimal timing of probiotic administration.

There is also a need for research on the role of antimicrobial stewardship in reducing SSIs. Antimicrobial stewardship programs aim to promote the appropriate use of antibiotics to prevent the development of antibiotic-resistant infections.

However, there is limited research on the impact of these programs on the incidence of SSIs. Further studies are needed to determine the most effective antimicrobial stewardship strategies for reducing SSIs, including the appropriate use of prophylactic antibiotics.

In addition to these areas of research, there is a need for more studies on the implementation and effectiveness of SSI prevention guidelines. While evidence-based guidelines exist, their adoption and implementation vary widely across healthcare settings. Further research is needed to identify barriers to guideline implementation and effective strategies for overcoming them.

Antimicrobial stewardship (AMS) is a vital aspect of healthcare, aimed at optimizing the use of antibiotics to reduce the development of antibiotic resistance, improve patient outcomes, and reduce healthcare costs. Effective AMS programs require appropriate knowledge and awareness of best practices among healthcare staff, including surgical teams. The finding (Figure 12) that 37% of staff were not aware of the practice of not continuing surgical antibiotic prophylaxis due to the presence of a drain indicates a potential gap in knowledge and understanding of AMS principles. This lack of awareness could lead to inappropriate or unnecessary use of antibiotics, which can contribute to the development of antibiotic resistance and other negative outcomes.

To address this issue, healthcare facilities may need to invest in educational and training programs for staff members to ensure they have a strong understanding of AMS principles and practices. This could include regular training sessions, informational materials, and guidance on best practices for antibiotic use in surgical settings, including the appropriate use of prophylaxis in the presence of drains.

Additionally, healthcare facilities may need to implement regular auditing and monitoring of antibiotic use in surgical settings to ensure that AMS principles are being followed appropriately. This can help identify areas where improvements are needed and allow for targeted interventions to address any gaps in knowledge or practice.

Overall, addressing the lack of adequate knowledge on AMS among staff members is essential for the effective implementation of AMS programs and the optimization of antibiotic use in surgical settings.

Overall, continued research is essential to reducing the incidence of SSIs and improving patient outcomes. By identifying risk factors, exploring new prevention strategies, and optimizing the use of existing interventions, researchers can work to reduce the burden of SSIs on patients, healthcare providers, and healthcare systems.

- *Implications*

The implications of a study on the risk factors associated with surgical site infection (SSI) are significant for patient care, healthcare systems, and public health. Identifying and understanding risk factors for SSI can help healthcare providers take appropriate preventive measures and reduce the incidence of SSI.

From a patient care perspective, understanding the risk factors associated with SSI can help patients take steps to reduce their risk, such as improving their hygiene and following their post-operative care instructions. Additionally, healthcare providers can use this information to assess patients' risk for SSI and take appropriate measures to reduce that risk, such as using prophylactic antibiotics or taking extra precautions during surgery.

From a healthcare system perspective, reducing the incidence of SSI can have significant cost savings. The cost of treating SSI can be significant, including extended hospital stays, additional surgeries, and increased use of antibiotics. By reducing the incidence of SSI, healthcare systems can save money and resources.

From a public health perspective, reducing the incidence of SSI can also help reduce the spread of antibiotic-resistant infections. The overuse of antibiotics can contribute to the development of antibiotic-resistant infections, which can be difficult to treat and can spread in healthcare settings. By reducing the incidence of SSI and using antibiotics appropriately, healthcare providers can help prevent the development and spread of antibiotic-resistant infections.

In summary, identifying and understanding the risk factors associated with SSI can have significant implications for patient care, healthcare systems, and public health. By taking appropriate preventive measures, healthcare providers can reduce the incidence of SSI, save resources, and prevent the development and spread of antibiotic-resistant infections.

- *Scope for Further Study*

The scope of further study on the prevalence and risk factors of surgical site infections (SSI) is broad and encompasses various areas of research. Some potential areas of focus for future studies include:

- Examining the effectiveness of different interventions to prevent SSIs, such as the use of prophylactic antibiotics, wound care techniques, and surgical techniques. Studies could also look at the impact of different hospital policies and protocols on SSI rates.
- Investigating the role of patient factors in the development of SSIs, including comorbidities, age, and immune status. Additional research could also explore the relationship between patient characteristics and the type and severity of SSIs.
- Identifying the microbiological causes of SSIs and exploring the impact of different types of pathogens on patient outcomes. This could include studies on the incidence of antibiotic-resistant organisms in SSI cases, as well as investigations into the virulence of different types of bacteria.
- Examining the impact of healthcare disparities on SSI rates, including differences in access to care, socioeconomic status, and race/ethnicity. Additional studies could also explore the impact of hospital and provider characteristics on SSI rates, such as hospital size, staffing levels, and provider experience.
- Investigating the cost-effectiveness of different interventions to prevent and treat SSIs. Studies could also explore the impact of SSIs on patient quality of life, hospital readmission rates, and overall healthcare costs.

Overall, further research on the prevalence and risk factors of SSIs is critical for improving patient outcomes and reducing healthcare costs. By identifying effective prevention strategies and improving our understanding of the underlying causes of SSIs, we can work towards reducing the incidence of this significant healthcare complication.

- *Concluding Remarks*

In conclusion, surgical site infections (SSI) remain a significant and preventable complication of surgical procedures that can lead to serious morbidity and mortality. The prevalence of SSI varies widely depending on the type of surgery, patient characteristics, and hospital factors. Understanding the risk factors associated with SSI is crucial for implementing effective prevention strategies and reducing the incidence of this complication.

The present study aimed to identify the prevalence and risk factors associated with SSI in a tertiary care hospital. The findings suggest that certain factors such as patient age, comorbidities, length of hospital stay, and type of surgery are associated with an increased risk of developing SSI. Additionally, inadequate staff knowledge about the infection control practices were identified as modifiable risk factors for SSI.

Further research is needed to evaluate the effectiveness of preventive measures and interventions aimed at reducing the incidence of SSI. Studies examining the role of innovative infection control techniques, such as the use of antimicrobial-coated surgical implants and wound dressings, as well as the implementation of enhanced recovery after surgery protocols, are warranted. Additionally, large-scale studies assessing the impact of multi-modal prevention strategies on the incidence of SSI are necessary to establish evidence-based guidelines for the prevention of SSI.

In conclusion, SSI is a major complication of surgery that imposes significant clinical and economic burdens. The identification of modifiable risk factors and the implementation of evidence-based prevention strategies are critical for reducing the incidence of SSI and improving patient outcomes.

- *Quality Assurance*

The quality of the study will be maintained starting from the planning phase to throughout each stage of the study. The principal investigator and the co-investigator both of them acquired Good Clinical Practice Certification which is a proof that the investigators have good knowledge and skills about the Research Studies.

- *Funding*

The authors received no financial support for the research, authorship.

- *Ethical Consideration*

The researcher ensured to get approval from two entities, including one university in India and the Ministry of Health and Prevention (MOHAP) in the UAE

- *Study Benefits*

The benefits of this study are to contribute to the reduction of postoperative infections and to improve the surgical management of patients. This study will help to understand the risk factors related to post-operative infections. There by, it will help the surgeons to work on the modifiable risk factors to reduce the number of Surgical Site Infections. Other benefits include;

- *Improved Patient Outcomes*:

Identifying the risk factors associated with SSIs can help healthcare providers take steps to prevent them. This, in turn, can lead to improved patient outcomes, including reduced rates of postoperative complications and hospital readmissions.

- *Cost Savings*:

SSIs can be costly to treat, so preventing them can result in significant cost savings for patients and healthcare facilities.

- *Better Resource Allocation*:

Understanding the prevalence and risk factors of SSIs can help healthcare facilities allocate resources more effectively. For example, if a particular risk factor is found to be especially common among a certain patient population, healthcare providers can focus their efforts on preventing SSIs in that group.

- *Improved Quality of Care*:

By studying the prevalence and risk factors of SSIs, healthcare providers can gain a better understanding of the factors that contribute to poor surgical outcomes. This can lead to the development of new and improved strategies for preventing SSIs, which can ultimately improve the overall quality of surgical care.

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