

2025

ADEELA NASIR

SU91-MSAHW-S23-043

FAHS

**Comparison of Surgical Site Infection in Elective versus Emergency
Abdominal Surgeries in Tertiary Care Hospital, Lahore**



SUPERIOR UNIVERSITY

Thesis Submitted to

The Superior University Lahore

In Partial Fulfilment of the

Requirement for the Degree of

Master of Science in Allied Health Sciences

By

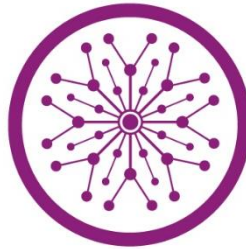
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Author's Declaration

I hereby state that my MS thesis titled **“Comparison of surgical site infection in elective versus emergency abdominal surgeries in tertiary care hospital, Lahore”** is my work and has not been submitted previously by me for taking any degree from this University,

The Superior University, Lahore,

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Adeela Nasir

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This is to certify that the research work presented in this thesis, titled **“Comparison of surgical site infection in elective versus emergency abdominal surgeries in tertiary care hospital, Lahore”** was conducted by **“Adeela Nasir”** under the supervision of **“Dr. Tayyaba Ayub.”**

No part of this thesis has been submitted anywhere else for any other degree. This thesis is submitted to the Faculty of Allied Health Sciences, The Superior University, Lahore in partial fulfillment of the requirements for the degree of Master of Science in the field of **“Allied Health Sciences”** in Faculty of Allied Health Sciences at The Superior University, Lahore.

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e) Dean: Prof. Dr. M. Naveed Babur _____ Signature: _____

f) Controller of Examination: Dr. M. Haris _____ Signature: _____

DEDICATION

This thesis is dedicated to my beloved family, whose unwavering support, encouragement, and sacrifices have been the cornerstone of my academic journey.

To my parents, whose love and guidance have inspired me to strive for excellence in every endeavor, and to my siblings, who have been my constant source of motivation and cheer.

To my teachers and mentors, whose wisdom and patience have shaped my intellectual growth and instilled in me a passion for learning and discovery.

Lastly, this work is dedicated to the countless healthcare professionals whose dedication to patient safety inspires research and progress in the field of infection control.

With deep gratitude and respect, I humbly offer this work to all who have been a part of this journey.

ACKNOWLEDGEMENT

In the name of Allah, the most Gracious, the most Merciful.

I am extremely thankful to Almighty ‘Allah’ Who is the entire source of knowledge and wisdom endowed to mankind, for providing me with the acumen and vision to complete this endeavor.

I would like to express my profound gratitude to my supervisor for his/her wise counsel and encouraging attitude towards this study. I am extremely grateful to him/her for immensely facilitating me during my study period by ensuring the provision of favorable circumstances and conducive environment. This project would not have been possible without his support and expert guidance.

In the end, I would like to extend my deepest gratitude to my family members. Without their encouragement, I would not have been able to complete this endeavor.

Adeela Nasir

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LIST OF ABBREVIATIONS

SSI	Surgical Site Infection
CDC	Centers for Disease Control and Prevention
WHO	World Health Organization
SPSS	Statistical Package for the Social Sciences
OR	Operating Room
CI	Confidence Interval
SD	Standard Deviation
ECDC	European Centre for Disease Prevention and Control
IHI	Institute for Healthcare Improvement
NICE	National Institute for Health and Care Excellence
HIV	Human Immunodeficiency Virus
HBsAg	Hepatitis B Surface Antigen
HCV	Hepatitis C Virus
CS	Cesarean Section
UTI	Urinary Tract Infection

ABSTRACT

Background: Surgical Site Infections (SSIs) are a major concern in hospitals, representing one of the leading causes of postoperative morbidity and mortality. Elective and emergency abdominal surgeries have varying risks associated with SSIs, with emergency surgeries often presenting higher rates due to patient and procedural factors. **Objective:** This study aimed to compare the frequency and risk factors of SSIs between elective and emergency abdominal surgeries in a tertiary care hospital in Lahore. **Methodology:** A comparative cross-sectional design was used on 216 patients with 108 in the elective surgery group and 108 in the emergency surgery group. Variables that were recorded included patient characteristics, coexisting diseases, type of surgical incision, duration of surgery and postoperative events. Data analysis was done using SPSS version 26.0 and significance of the relationship between variables was tested by chi-square tests at $p \leq 0.05$. **Results:** Overall, the data showed a two-fold rate difference in SSIs in emergency surgical cases (36.8%) compared to elective surgical cases (21.2%) ($p = 0.014$). Age (Chi square = 96.78, $p = 0.001$), living in an urban area (Chi square = 79.53, $p = 0.001$) and longer hospital stays (Chi square = 97.89, $p = 0.001$) attribute to higher SSI rates in emergent surgeries. Overall, there were more superficial SSIs although this was not statistically significant between the two groups. In the emergency group, both laparotomy and appendectomies carried higher SSI risk than the elective group though statistically significant differences were observed for appendectomy procedures only ($p < 0.05$). **Conclusion:** The method of instrument sterilization did not differ between the two groups. Lastly, the complexity of patient and surgeries involved make emergency abdominal surgeries more prone to SSIs than elective surgeries. Explicit in these outcomes are increasing concerns for optimizing preoperative conveniences and applying strict infection control measures as specific strategies aimed at preventing SSIs in the emergency environment.

Keywords: Emergency Surgery, Elective Surgery, Abdominal Surgery

Chapter 1

INTRODUCTION

Despite many advances, surgical infections still affect a significant number of patients in healthcare settings all over the world, leading to tremendous morbidity, prolonged hospital stay, significant costs of hospital care and, rarely but fatal postoperative course. These are the most common healthcare associated infection (HAI) all around the world that develop at and or near the surgical incision within 30 days following an operation or within one year in case of use of a implant. Consequences of these SSIs, include deep tissue infections, abscess formation and sepsis, and further exclude patients from recovery or surgical results. Factors such as patient related risk factors, type of operation and adherence to infection prevention strategies vary the global burden of SSIs [1]. In contrast, strict adherence to infection control policies has mostly reduced SSI incidence in the developed countries, while in resource-limited settings, incidence has remained significantly high (perfect sterilization, overcrowded hospitals and suboptimal preoperative and post operative care) in spite of it [2].

Since gastrointestinal tract has a high microbial load, SSIs are prone to occur more frequently during abdominal surgeries because they are very delicate and complicated surgeries. Abdominal procedures top the list of surgical contributors to infections due to risk of contamination, presence of endogenous bacteria and lengthy operating periods. Some elective and emergency abdominal procedures have various kinds of risks that may lead to SSI development in this category. It is electors are planned procedures preplanned procedures that allow for maximum predictable preoperative preparation (antibacterial prophylaxis, stabilization of the patient and avoiding after-theatre breaches in care (asepsis). On the other hand, emergency procedures are performed in patients with compromised, as well as those with underlying infection, high contamination risks, and short time for routine preoperative optimization [3]. Therefore, surgery in these patients is more likely to have an increased incidence of SSIs because of the urgency of intervention and the presence of complicating com ... The comparison of the comparative risks of SSIs in elective abdominal surgeries versus emergency abdominal surgeries is important for the design of targeted

infection control measures, the reduction of postoperative complications and the improvement of the patient outcomes.

There are several researches in SSIs in both elective and emergency procedures that have studied the variables of risk that contribute to SSIs [4]. The ability to become infected varies according to age, underlying comorbidities (diabetes, obesity, immunosuppression, malnutrition, long hospital stay) in patients. Procedural factors that influence infection rates include surgery time, wound classification, incidence of intraoperative contamination, and adherence to aseptic methods. It is well-established that emergency surgical patients are frequently admitted critically and, thus, it is difficult to reach optimal preoperative factors that increase the SSIs incidence [5]. Surgical wound classification (clean, clean contaminated, contaminated, and dirty) is also an important predictor of risk of infection and emergency surgeries are usually contaminated or even dirty since the nature of conditions needing urgent intervention (perforated viscus, peritonitis, and severe intra-abdominal infections) [6].

The means of decreasing SSIs consist in sterilization techniques combined with careful infection control protocols. Elective surgeries usually follow the routine of preoperative antibiotic prophylaxis as well as applied sterilization techniques and regulatory circumstances of traditional surgery, whereas the efficacy of emergency treatment is not so clear. Under such emergency settings, rapid patient turn over, high caseloads and insufficient resources may result into sterilization failure with subsequent high risk of SSI [7]. Furthermore, we found that the duration of surgery is another highly important factor in terms of infection risk, as longer surgeries are associated with a greater amount of microbial exposure, tissue manipulation and disruption of the body's natural defense machinery. That is, studies have shown that surgical procedures longer than one and a half hours will significantly increase SSI rates and complicate postoperative convalescence [8].

Factors pertaining to the hospital such as staff-to-patient ratio, hospital acquired infection (HAI) management program and infrastructure are also important in the development of SSIs. The main causes of the frequency of SSIs in these resource limited settings are overcrowding, poor personnel, poor training on infection prevention techniques. Furthermore, hand hygiene adherence, operating room

ventilation system and environmental decontamination measures influence directly the combined (overall) infection load in surgical wards. It has been illustrated that infection control training can be improved, antibiotic stewardship can be maintained at appropriate level, and surgical settings can be optimized to greatly reduce SSI incidence in elective as well as emergency surgeries [9]. But postoperative wound care is a major driving factor in SSI development, poor hygiene practices, lack of wound monitoring, and delayed practice of dressing changes increase the susceptibility to bacterial colonization and infection.[10]

Complication of SSI care by AMR is significant, especially in emergency abdominal procedures, in which patients can bring in high risk, multidrug resistant pathogens. Mis inhibited use and overuse of antibiotics is also a factor in the emergence of resistant bacterial strains to which prophylactic and therapeutic antibiotic protocols no longer work. Resistant microorganisms cause more infections which are more difficult to treat, require longer hospital stays and usually require the use of more expensive and sometimes toxic antimicrobial treatments. While in developed countries, the probability of encountering AMR related SSIs depends on the empirical usage of antibiotics that is frequent in areas where there are lack of capabilities to perform a detective work, this probability is especially high in under developed countries, emphasizing the importance of focused antibiotic stewardship programs and comprehensive infection control regulations [11]. Further studies also show that delayed Administration of prophylactic antibiotics in emergency procedures have a higher rate of infection as compared to prompt and sufficient antimicrobial coverage during the prevention of SSIs [12].

Also, patient nutritional state is a very important factor in SSI, and it is often disregarded in emergency settings. Nutritionally, preoperative treatment decreases immune function, slows wound healing, and increases susceptibility to infections, thus nutrition screening and optimization are an essential part of preoperative treatment. Preoperative dietary therapy can be done prior to elective surgery patients but emergency situations do not have this advantage and most times these patients are certainly at a higher risk for SSI development. Consequently, research has shown that the rates of postoperative infection are higher among patients whose albuminemia is low, are in vitamin deficit or have had severe weight loss before surgery [13]. In addition, metabolic disorders, such as diabetes mellitus, are associated with a

substantial risk for SSIs because hyperglycemia affects the function of leukocytes, reduces tissue perfusion and delays collagen synthesis, all of which impede healing and increase infection risk [14].

In addition to surgical procedures and intraoperative behaviors, SSI rates are influenced. Laparoscopic operations have also been shown to have a lower risk of SSI because of smaller incisions which causes less damage to tissue and shorter stays in the hospital. Yet in emergency situations open surgical procedures are often required and hence there is a higher chance of contamination and postoperative infections. In addition, studies have shown that the use of highly sophisticated hemostatic procedure, careful handling of tissue and optimal closure technique have a profound effect on wound healing and infection outcome [15]. Numerous studies have further suggested that choice of sutures, usage of drains and postoperative dressing procedures can also prevent SSI in high-risk surgical patients [16].

The first revolution by surgical techniques and infection control measures has not eradicated SSIs; in emergency procedures particularly, SSIs are an important healthcare issue. It is because these patients must undergo prompt intervention, are in hemodynamic instability condition, and are susceptible to increased microbial exposure in emergency, and this increases the risk of postoperative infections. Despite a number of studies that compare SSI rates in elective versus emergency procedures, there is always a consistently greater infection burden seen in emergency settings, emphasizing the importance of implementing focused measures meant to reduce these risks [17]. As is the case for reducing any surgical site infection, the key for minimizing SSI incidence and improving surgical outcomes lies in addressing variables that can be altered such as preoperative optimization, consistent antibiotic regimes and enhanced postoperative wound care. Future research should seek producing evidence-based guidelines that are suitable for use in emergency surgical settings, so that infection control is still of the highest priority even in high-pressure situations [18].

In this study, we intend to make contribution to body of literature on SSIs by undertaking a comparative review of infection rates, risk factors, and outcomes in elective versus emergency abdominal surgery. To inform clinical practice, optimize perioperative care, and guide development of focused interventions to prevent SSIs in

the high-risk surgical group, research aimed to identify major drivers of infection risk. IISS have emerged as a major source of morbidity and cost for patients and the health care system, it is important to know the difference between elective and emergency procedures because it has led to an improved study of infection control efforts in order to protect patients [19].

Elective and emergency procedures are not only scheduled differently, but they take on differing roles in patient management and risk assessment as well as patient preparation for surgery. Elective operations are by definition planned, so that they can have completed preoperative evaluation, optimization of the concomitant diseases, as well as exactly planned surgical treatment. This preparation is of great importance because it will help detect and reduce any risk factors that may impair postoperative recovery like an existing infection, poor nutritional condition and comorbidities like diabetes and cardiovascular illnesses. Elective procedures are therefore most frequently associated with a reduced incidence of surgical site infections (SSIs) because patients are thoroughly preoperatively screened and stabilized, and are subject to adhesion to defined surgical protocols and infection prevention measures [20].

On the other hand, emergency procedures are conducted in much more stressful circumstances with little time for preoperative preparation. Acute diseases, with the requirement for immediate correction, are usually associated with a significant emergency abdominal surgery like intestinal perforation, appendicitis, or severe trauma. Due to the limited chance for extensive risk assessment or adjustment of patient conditions, however, these settings offer at best for narrow margin or no room for manipulation of risk, therefore increasing likelihood of consequences, including SSIs. Such higher incidence of infection is also related to the patients' high level of urgency of these treatments, and the severity of the patients' situations, while the standards protocols of sterilization, preoperative antibiotic administration, and patient stabilization may not be strictly applied [21]. Postoperatively, such infections add yet another source of almost certain 'sporadic' infection [22], and also likely entail contaminated or filthy surgical areas.

The prevention of SSIs is well recognized as the role of preoperative antibiotic prophylaxis. The important source for delivering appropriate tissue concentrations during surgical operation is timely injection of antibiotics as often as within one hour before incision. Nevertheless, in emergency surgeries, antibiotic administration is almost always delayed until necessary because of urgency of the situation and the patients' critical conditions. Regardless of the type of operation or surgery, studies point out that omission or incorrect timing of prophylactic antibiotics has consistently shown to markedly increase SSIs

particularly in high-risk operations where abdominal surgery is required [23]. Also, antibiotics must be chosen to cover most of the likely pathogens involved in abdominal infections. Broad spectrum antibiotics are often required in emergency operations as opposed to elective procedure because the probability of the presence of mixed bacterial flora and contamination is high.

The surgical set can be the deciding factor in what SSI rate your hospital will receive. Aseptic practice, personnel training and operating room atmosphere are important in hygienic practice during surgery. Elective surgeries are typically done in controlled conditions (which also imply a clean environment) with special care taken to prevent contaminating the environment; emergency procedures are less ideal [24]. This includes higher patient turnover, emergency operating room's utilization that is might not fully equipped, and possibly lack of adherence to aseptic techniques because the urgency of the procedure. Microbe infection may occur more frequently in these circumstances, which will, in turn, cause SSIs [25]. Staffing shortages and deficiencies in infection prevention protocols training can also undermine the quality of health care provided during emergency surgeries, beyond what is normally expected [26].

It also has a big influence on the presence of SSIs associated with the age, gender and the socio-economic status of the patient. According to research, younger patients, for the most part between 15 and 30 years, are usually the ones who require emergency procedures, which is often attributable to trauma or serious stomach problems. Thus, there is a generational difference between younger and older patients in relation to the overall risk profile for SSIs, since younger patients could have different comorbidities and risk factors than older patients undergoing elective procedures. Individuals from lower socioeconomic backgrounds have a higher rate of SSI because of lack of access to routine healthcare and of medical attention for underlying problems incurred, which leads to greater SSI rates [27]. It [Aorta] can affect the post operative treatment, because it may not be the case that the patients will have the appropriate follow up and wound care for example using the case in hand, access to such post operative treatment will be limited, which increases the probability of infection [28].

Another major factor of SSIs is the type of surgical incision and the wound classification. Since the disorders addressed in the emergency procedures are acute, it creates more wounds of clean contaminated, contaminated, and unclean wounds. In fact, such procedures as emergency procedures related to disease, for example disease ruptured appendix or bowel obstruction with intraoperative contamination, intrinsically increase the risk of infection. Elective procedures often have clean or clean contaminated wounds and lower related infection risks. Superficial, deep, organ/space and surgical site infections are divided

according to the types of surgical infections with significant clinical importance and also management issues. Although the most common type (superficial SSI), it rarely involves the deep tissue layers and is poorly known to be less serious than the more serious OSI. However, deep and organ/space infections can be very significant from a morbidity standpoint, usually invading deeper tissues or organs which require extensive antibiotic therapy, sometimes reoperation, or prolonged hospitalization [29].

SSIs are prevented by proper postoperative wound care, which have large variation in rates postoperative surveillance between elective and emergency procedures. Patients are given extensive postoperative care instructions, regular wound checks, and follow-up visits in elective procedures to watch out for healing. Emergency surgical patients, in particular, those discharged early mostly due to turnover of the hospital, may receive less complete postoperative care. Consequently, it can delay identification and treatment of SSIs, increase development of severe infections and stretch of the recovery duration [30]. Also, in reducing infection risks, it is imperative for the patient to practice good wound care habits by remaining clean and getting timely changes in dressing. Particularly for patients from lower socioeconomic backgrounds or patients who have had emergency surgery, educational treatments that promote patients' understanding of basic wound care can effectively reduce the SSIs [31].

Other key factors to SSI risk are also nutritional status and comorbidities. Individuals who are malnourished or who have the associated diseases such as diabetes, obesity or immunosuppression are at greater risk for development of SSIs as these patients often have reduced wound healing and impaired immune function. In emergency situations, nutritional condition of the patients is mostly not ideal because acute infections increase malnutrition and there is only limited time before the surgery to assess and correct the nutritional status. Comorbidities make the results of the surgical procedure even more complicated because there are disorders that can increase the severity of the underlying disease that is to be operated on, prolong the time of the operation and affect the ability of the patient to recover from postoperative problems [32]. One of the best measures to minimize SSIs is to optimize the nutritional state of the patients and control the comorbid diseases preoperatively, especially if the procedure is elective and allows enough time for intervention.

Antimicrobial resistance (AMR) is becoming a major issue regarding the management of surgical site infection (SSI) and poses even greater concern in cases where emergency abdominal procedures are performed, where the prospect of finding a multidrug resistant organism is increased. The increasing difficulty of curing infections in the surgical patients is accounted for by the abuse of antibiotics in surgical patients in combination with the

presence of resistant bacterial strains in hospital surroundings. Resistant microorganism infections require a more aggressive treatment regimens with longer duration hospital stays that often provide poor patient outcomes. To address AMR, we need a multimodal approach combining improvement of diagnostic modalities to identify resistant organisms, judicious antibiotic usage and apporting to strict infection control policies in surgical situations [33]. Promising results in establishing of antibiotic stewardship programs in the hospitals has demonstrated their success to decrease emergence of resistance strains and to improve surgical outcomes by using antimicrobial drugs judiciously [34].

To fill the knowledge gap, the present study attempts to make a complete analysis of SSIs in elective versus emergency abdominal operations for different surgical environment specific problems. The research aims at identifying the areas for improvement in surgical care based on risk variables, infection rates and clinical outcomes and putting forward the evidence-based therapy suited to different surgical settings [35]. The implications of this study will enhance the continued efforts to reduce SSIs, promote patient safety, and maximize surgical outcomes using focused infection prevention methods. Additionally, the understanding of the differences between SSI rates and risk variables between elective and emergency procedures are necessary for healthcare policymakers and practitioners in order to allocate resources that are effective and also to conduct focused quality improvement initiatives.

One of the most essential issues in managing surgical site infections (SSIs) is the necessity for individualized preventative methods that fit with the unique risk factors associated with elective and emergency abdominal procedures. While elective surgeries allow for rigorous planning, including patient optimization, stringent aseptic techniques, and proper bacterial prophylaxis, emergency procedures present a fundamentally different issue. The unpredictable character of emergency procedures, along with the high likelihood of contamination, hemodynamic instability, and inadequate preoperative preparation, needs a more proactive approach to infection prevention and control [36]. The requirement for speedy action in emergency cases means that certain conventional precautions, such as comprehensive preoperative skin preparation and proper bowel preparation, may be ignored, increasing the risk of intraoperative contamination and postoperative infections [37].

The influence of surgical technique and procedural factors on SSIs cannot be emphasized. The use of less invasive surgical techniques, such as laparoscopic operations, has been related with lower rates of SSIs compared to open surgeries. Laparoscopic methods minimize tissue stress, reduce operational timeframes, and lower postoperative wound exposure to external pollutants. However, in emergency settings, laparoscopic surgery is not always feasible due to the severity of the patient's condition, significant contamination, or technical

obstacles linked to intestinal distension or peritoneal soiling. As a result, emergency operations generally necessitate open procedures, which are fundamentally associated with a higher risk of SSIs due to larger incisions, more tissue handling, and prolonged operative durations [38]. Studies have shown that maintaining rigorous surgical practices, minimizing operating time, and assuring suitable closure methods can considerably minimize the incidence of SSIs in both elective and emergency surgeries [39].

Postoperative infection management methods also have a key influence in determining SSI rates. Effective wound care procedures, including appropriate dressing changes, use of antiseptic solutions, and regular monitoring for early signs of infection, are critical in minimizing the risk of SSIs. In elective procedures, these interventions are systematically done as part of normal postoperative care protocols. However, emergency surgical patients generally receive less structured postoperative care, particularly in resource-limited settings where rapid patient turnover and insufficient personnel may impair optimal wound management. Early discharge of emergency surgical patients due to hospital capacity constraints can further contribute to inadequate postoperative monitoring, delaying the identification and treatment of SSIs, which may result in severe complications such as deep tissue infections, abscess formation, and even sepsis [40].

Hospital infrastructure and infection control practices are also major predictors of SSI occurrence. Hospitals with well-established infection prevention systems, including hand hygiene compliance, correct sterilization methods, and specialized infection control teams, tend to report lower SSI rates. In contrast, hospitals in resource-constrained areas, where overcrowding, limited access to sterile equipment, and ineffective infection control methods are frequent, struggle with considerably higher rates of SSIs, particularly in emergency surgery situations. Studies have underlined the need of keeping a properly trained surgical team, ensuring strict compliance with sterilizing protocols, and instituting routine surveillance systems to monitor SSI trends and suggest areas for improvement [41]. The impact of hospital-acquired infections (HAIs) in growing SSI rates cannot be overlooked, since patients undergoing emergency procedures are generally at higher risk of acquiring multidrug-resistant organisms due to prolonged hospital stays and exposure to contaminated settings [42].

The economic burden of SSIs is another key problem for healthcare systems, as prolonged hospital stays, additional therapies, and reoperations contribute to increased healthcare expenses. Elective procedures, with their lower SSI rates, often involve predictable healthcare expenditures, whereas emergency surgeries, due to their greater complication rates, result in severe financial hardship on both patients and healthcare organizations. The

increased requirement for antibiotic therapy, more diagnostic testing, and extended inpatient care for patients with SSIs causes a major load on healthcare resources. In low- and middle-income countries, where healthcare systems are already under strain, the financial cost of SSIs can be particularly damaging, leading to greater mortality rates due to limited access to advanced treatment options [43]. Cost-effective infection prevention methods, including increased surgical training, enhanced sterilizing techniques, and better preoperative risk assessment, are critical in minimizing these cost problems and reducing the economic impact of SSIs on healthcare systems [44].

Patient education and adherence to postoperative care recommendations also influence SSI outcomes. Patients undergoing elective procedures often receive preoperative counseling, including instructions on wound care, activity limits, and indicators of infection that require medical treatment. In contrast, emergency surgical patients may not have the same level of education or awareness regarding postoperative care, increasing the chance of inappropriate wound management and delayed medical intervention in case of infection. Studies have showed that patient-centered education programs, which focus on improving adherence to wound care procedures and recognizing early indicators of SSIs, can considerably reduce infection rates and improve surgical outcomes [45]. The integration of digital health interventions, such as mobile applications that provide real-time wound monitoring and telemedicine consultations, has been proposed as a potential strategy for improving patient compliance with postoperative care and reducing SSIs, particularly in emergency surgical patients who may face barriers to accessing follow-up care [46].

A significant problem in SSI prevention is the growth of antibiotic resistance (AMR), which complicates the treatment of postoperative infections. The overuse and misuse of antibiotics in surgical patients, particularly in emergency settings where empirical antibiotic usage is widespread, contribute to the emergence of drug-resistant bacterial strains. The increasing prevalence of multidrug-resistant pathogens, such as methicillin-resistant *Staphylococcus aureus* (MRSA) and extended-spectrum beta-lactamase (ESBL)-producing organisms, poses a significant threat to patient outcomes, as these infections are more difficult to treat and are associated with higher mortality rates. Addressing AMR in surgical patients requires a multidisciplinary strategy, including the adoption of antibiotic stewardship programs, increased diagnostic capabilities for early pathogen detection, and adherence to evidence-based antimicrobial prescribing recommendations [47]. Surveillance of antimicrobial resistance patterns and regular revisions to hospital antibiotic policy are critical in guaranteeing the effectiveness of preventive and therapeutic antibiotic regimens in surgical patients [48].

Future research on SSIs should focus on discovering novel ways for infection prevention and optimizing surgical care in both elective and emergency settings. The development of enhanced antimicrobial coatings for surgical implants, new wound closure techniques, and the use of bacteriophage therapy for targeted infection management are emerging topics of interest in SSI prevention research. Additionally, the importance of precision medicine in surgical infection management, including tailored risk assessment techniques that combine genetic, microbiological, and immunological components, may bring fresh insights into individualized infection prevention measures. The integration of artificial intelligence (AI) and machine learning algorithms in forecasting SSI risk based on patient data and surgical factors has also showed promise in enhancing infection control efforts and lowering postoperative sequelae [49].

This study seeks to contribute to the current body of knowledge by providing a comparative review of SSI rates, risk factors, and clinical outcomes in elective versus emergency abdominal surgeries. By studying the key factors of infection risk and evaluating current infection control strategies, this research intends to find potential for increasing surgical safety and reducing the burden of SSIs on healthcare systems. Understanding the distinctions between elective and emergency surgical settings will help influence evidence-based clinical guidelines and targeted treatments aimed at optimizing perioperative care and lowering infection risks. The findings of this study will be essential in assisting healthcare practitioners, policymakers, and researchers in establishing more effective infection prevention techniques and improved patient outcomes in both elective and emergency surgery populations [50].

In conclusion, SSIs remain a substantial concern in surgical treatment, particularly in emergency abdominal surgeries when higher infection rates are documented due to inadequate preoperative preparation, greater contamination risks, and low adherence to basic infection prevention strategies. The disparities in infection rates between elective and emergency procedures underline the necessity for specialized infection control methods that meet the unique problems associated with each surgical environment. By implementing comprehensive infection prevention strategies, improving antibiotic stewardship, strengthening postoperative care, and adopting novel surgical procedures, healthcare practitioners can considerably reduce the incidence of SSIs and improve surgical outcomes. Continued research in this subject is crucial to increase our understanding of SSI risk factors and create innovative ways for infection prevention and management, ultimately increasing patient safety and decreasing the costly burden of SSIs on healthcare systems globally.

AIM AND OBJECTIVES

Aim:

This research work seeks to establish the differences in the incidence and risk factors, kind of SSI s in elective and emergency operations.

Objectives:

To achieve the overarching aim, the following specific objectives are outlined:

1. To know the rate of incidence of SSIs in elective and emergency abdominal surgeries.
2. To assess and to compare the risk factors of SSIs in elective and emergency surgeries.

Chapter 2

LITERATURE REVIEW

Although surgical site infections (SSIs) are among the most prevalent healthcare associated infections (HAIs) and remain a significant problem in surgical care, there are currently insufficient data to fully assess the level of risk posed to immunocompromised patients. Infection rate in different surgery categories have been compared, and methods to prevent infection (SSIs) have been expanded, as has the literature on SSIs in general which has expanded greatly on infection risk factors, preventative methods etc. Specifically, abdominal procedures carry a higher risk of developing SSI because the natural microbial load in the gastrointestinal tract is high and surgical techniques relatively complex. Variations in SSI incidence are also explained by the divergence between elective and emergency abdominal surgeries as emergency procedures offer different risk variables not generally present in planned operations [51].

Several studies have demonstrated the differences in SSI rates between elective and emergency surgery, where emergency surgery has consistently higher infection rates. Research in several hospital settings indicates that the hurry with which emergency procedures are carried out through Flashing procedures do not involve sufficient infection control and this increases the incidence of SSIs. Jadoon et al. (2023) further compared SSI rates in emergency (36%) versus elective (18%) surgeries and indicated that emergency surgical patients are more sensitive to postoperative infection. A similar gap was attributed to misbehavior of preoperative preparation; poor antibiotic prophylaxis; and the higher risk of contaminated or filthy surgical wounds in emergency scenarios [52]. A corroborating investigation by Saad et al. (2024) on a large scale likewise revealed similar facts, that is, emergency treatments treatment being unstructured and that many of the patients had severe other diseases would lead to elevated SSI rates [53].

There are several factors that explain why emergency abdominal procedure seems to have higher incidence of SSIs, and patients related characteristics are crucial in this matter. Comorbidities including diabetes mellitus, obesity, cardiovascular disease and immunosuppression have become common and major driver of postoperative infections are recognized. As mentioned in Mostafayi et al. (2020), patients with uncontrolled diabetes who had poor wound healing; delayed immunological

responses, and increased tissue vulnerability to bacterial colonization are more prone to SSI. However, the study emphasized the importance of improving perioperative glucose control, as decrease in infection risks in surgical patients with perioperative glucose control was particularly important in the emergency setting where glucose management is lacking [54]. Similar to findings from Mahmood et al (2021) which showed obesity as a key risk factor for SSIs, adipose tissue weight is known to impair wound healing, increase operative time and impair tissue oxygenation, promoting proliferation of bacteria at the surgical site [55].

Extensive investigation has also been targeted at nutritional status as a predictor of the risk for SSI, specifically in the emergency surgery patient who may manifest as mal nutrition or severe dehydration due to prolonged illness. People with insufficient nutrition are more vulnerable to develop SSIs because immunological function is decreased, collagen synthesis slowed, and tissue regeneration delayed. The research conducted by Chauhan et al. (2017) indicated that there is significant impact of preoperative dietary deficits on chances of SSIs in elective and emergency abdominal operations. The results showed that preoperative nutritional screening, supplementation could help in reducing the risk of infection, specifically in high-risk surgical groups [56]. In elective procedures, patients can receive preoperative nutritional optimization which is not available to emergency surgery patients who are further predisposed to SSIs.

Overall SSI rates are very much influenced by surgical approach and intraoperative practice with longer surgical duration being associated with higher risk of infection. Reiterated studies have shown longer (over 2 hours) operations also tend to have higher SSI rates attributable to prolonged tissue exposure, increased bacterial contamination and enhanced disruption of host defensive mechanisms. Results from a study by Alfouzan et al. (2019) confirms their finding of nearly twofold increase in SSI rates among procedures exceeding operating time of 7.5 hours vs procedures of less than operating time (hours) of 1 hour. In addition, as a result of the research intraoperative delays were avoided, operative efficiency was improved, and precautions against infection risks were strictly carried out [57]. Aside from this, the probability of infection is also affected by the type of surgical wound classified as clean, clean contaminated, contaminated, or dirt. Emergency abdominal surgeries are often associated with contaminated or dirty wounds caused in these by intra-abdominal sepsis, bowel perforation or peritonitis, which are likely to lead to high

subsequent infection rates than clean or clean contaminated wounds in electives surgeries [58].

Preoperative antibiotic prophylaxis is an essential component to SSIs prevention, as administration of antibiotics in a timely manner reduces efficacy of SSIs by orders of magnitude. Nevertheless, studies show that in emergency procedures where intervention has to happen as soon as possible, antibiotic administration is likely to see delays or discrepancies. A retrospective cohort study by Kvalvik et al (2021) showed that emergency surgical patients have less likelihood to receive time timely prevention antibiotic compared with elective surgery patients therefore increased postoperative infection rate. The study emphasized the importance of improved antibiotic stewardship and standardized techniques for proper antibiotic prophylaxis even in the emergency setting, for surgical management [59]. Tan et al (2019) further argued for the selection of appropriate antibiotic regimens based on local antimicrobial resistance patterns to augment our efforts on preventing SSI in elective and emergency surgeries with the highest priority [60].

Other predictors of SSI rates include overcrowded surgical wards and insufficient sterilization practices in the hospital infrastructure and from the operating room conditions. As a result, emergency surgeries take place under high turnover conditions where maintaining rigorous aseptic standards is not feasible because of time constraints and inadequate surgical resources, in resource limited healthcare settings. Spagnolo et al. (2013) reported that the operating room conditions were correlated to SSI rates, suggesting the importance of infection control training, proper ventilation and routine environmental disinfection [training, ventilation and cleaning, as moderators of the operating room environment] in order to reduce bacterial contamination in surgical environments [61]. The results of the study then recommended that hospitals invest in comprehensive infection control measures in the form of proper staffing, proper sterilizing techniques, and routine monitoring of contamination in the surgical site to help minimize the risk of SSI.

Recently, more research has focused on the influence of antimicrobial resistance (AMR) on SSI outcomes, as multidrug resistant organisms are a serious problem in the care of postoperative infection. These studies have found that emergency surgical patients that require long length of stay are significantly more likely to develop SSIs from resistant bacterial strains such as Methicillin-resistant *Staphylococcus aureus* (MRSA), Extended-spectrum beta lactamase (ESBL)-producing bacteria. McHugh et

al. (2011) reported that antibiotic resistant SSIs were associated with longer hospital admission, higher healthcare cost and increased mortality rates, leading to the vital necessity of antibiotic stewardship in preventing resistance microorganisms in surgical settings [62].

It is the postoperative phase which seems the most important factor for SSI risk as there are factors associated with wound care adherence, patient education and postoperative monitoring which contribute in increasing the risk of SSI and can thus be considered in the prevention of infection. Conrad et al. (2007) research found a significant reduction of SSI rates with a combination of systematic postoperative wound care programs including frequent dressing changes, use of antiseptic solutions, and instruction to the patients about recognizing early warning signs of infection. This study showed that the use of standardized protocols for postoperative care in both elective and emergency surgical patients could improve wound healing outcomes and decrease infection related problems [63]. In addition, Meltzer et al. (2002) also found patient education of great importance in postoperative adherence to wound care protocols, especially for emergency surgical patients, where follow up after discharge maybe problematic [64].

However, while SSI prevention techniques make breakthroughs, disparities in infection rate between elective and emergency surgeries persist to underline the necessity of dedicated interventions for solving the specific problems of emergency surgical procedures. In future research, there should be developed innovative infection prevention strategies for emergency surgical settings utilizing emerging technologies like real time infection surveillance, artificial intelligence-based infection risk prediction models, and advanced antimicrobial coatings for surgical implants.

In this part of the literature review, a number of risk variables, preventive interventions and hospital related determinants related to SSI rates are studied for elective versus emergency abdominal surgeries. In the next section, I will also take a closer look at other growing trends in terms of surgical procedures and subsequent ongoing research towards reducing SSIs, but also for improving patient outcome in the process. Advances in surgical infection prevention have emerged pertaining to utilizing technological advances in order to enhance patient outcome and to decrease the incidence of surgical site infection. For example, integration of artificial intelligence (AI) and machine learning algorithms in forecasting of SSI risks using

patient data, surgical factors and intraoperative settings has been one of the most exciting advances in recent years. Proven tremendous potential in developing doctors' ability to identify high-risk patients preoperatively and apply focused preventative treatments is using AI driven risk assessment models. Loesche et al (1995) studied how predictive analytics can alter infection control tactics to improve the efficiency of both preoperative and postoperative management during all elective and emergency cases [65]. Importantly, these kinds of developments are especially relevant in emergency contexts where prompt decision-making is critical and traditional risk stratification may be less useful for several reasons.

The other impressive area of research in SSI prevention is the development of antimicrobial coatings for surgical equipment, sutures and wound dressings. All these antimicrobial technologies aim to minimize bacterial colonization at surgical site to prevent postoperative infection. Malamed (2020) studied the efficacy of antimicrobial coating in surgical suture silver and iodine based, and observed a great decline in bacterial load and infection rate among patients undergoing abdominal surgery [66]. These advances are advantageous for the emergency surgical patients who typically have dirty wounds and an intrinsically higher risk of developing SSIs. Bioengineered dressings incorporating antimicrobial peptides or nanotechnology-based treatment for wound care are being studied to be its game change in surgical infection prevention [67].

In addition to open surgery, laparoscopic and robotic assisted procedures have also attracted attention for being effective alternatives to open surgery with reduced SSI due to small incisions, little tissue stress, and not necessarily a longer incision. Laparoscopic surgery is commonly used in elective procedures; however, this type of surgery has not been widely used in urgent states, partly because of intestinal distension, substantial peritoneal contamination, and for other reasons related to the nature of certain types of surgical crises. On the other hand, as reported by the Canadian Institute for Health Information (2011), laparoscopic surgery seems to be correlated with better outcomes as in some emergencies, like perforated appendicitis and early-stage bowel obstructions, it caused a lowering of SSI rates, improved recovery time, and fewer hospital complications than traditional open surgeries [68]. Less invasive procedures can be expanded to use in emergency surgeries when possible to bridge the infection control gap between elective and emergency surgical patients.

While these technological advances have yet to compensate for healthcare inequities, SSI rates remain relatively high in low- and middle-income countries (LMICs), as budget restrictions on the availability of important infection control strategies are the norm. Studies show that more SSI cases occur in emergency procedures since hospitals in the LMICs don't have enough sterilizing standards, lack of antibiotics, an overwhelmed healthcare facility. In many developing countries, a lack of effective infection control infrastructure combined with variable adherence to WHO surgical safety guidelines has unnecessarily increased postoperative infections; this is emphasized in a comprehensive study comprised by McHugh et al. (2011) [69]. To address these gaps, it involves initiatives related to global health that include improving surgical hygiene procedures, making available important antibiotics, and building capacity in healthcare systems.

Standardized infection prevention recommendations cannot be overemphasized in terms of reducing SSIs in elective and emergency procedure. There are evidence-based standards for surgical infection prevention that have been made by the World Health Organization (WHO), Centers for Disease Control and Prevention (CDC) and National Institute for Health and Care Excellence (NICE). In turn, these guidelines emphasize critical infection control measures, including good hand hygiene, aseptic surgical methods, ideal antibiotic prophylaxis, and proper wound care treatment after surgery. In a meta-analysis conducted by Kvalvik et al. (2021), the relationship of the adherence of these guidelines with SSI rates were evaluated and it was observed that the SSI rates were lower at the hospital with adherence with WHO recommended surgical infection prevention protocol as compared to the hospital with poor adherence [70]. Routine monitoring and implementation of infection control protocols needed, especially in emergency surgical departments, the study underlined.

In particular, wound surveillance provides a critical role in wound surveillance to identify SSI in an early stage for the beneficiaries and for starting therapy. Traditional wound monitoring consists of clinical assessing of indications like redness, swelling, warmth, purulent drainage etc. But the advent of digital health innovation means recent trends in remote wound monitoring devices allow patients to upload wound photos through mobile apps that can then be viewed in real time by health care professionals. For example, in a study Meltzer et al. (2002) evaluated the usefulness of digital wound monitoring in order to minimize the related problems

associated with SSI and found that early diagnosis of infection using telemedicine interventions led to timely antibiotic modifications and success in the healing of the wound [71]. Such advances could especially benefit emergency surgical patients who may have limited follow up care as a result of socioeconomic constraints or geographical constraints.

However, antibiotic management has become a more and more important aspect of SSI prevention due to the emergence of increased antimicrobial resistance (AMR). Due partly to overuse and overuse of antibiotics during surgical settings, bacterial species resistant to antibiotics are increasingly on the rise worsening postoperative infection care. According to research by Spagnolo et al., indiscriminate use of broad-spectrum antibiotic in emergency surgical patients, usually given empirically without culture sensitivity testing, has been responsible for the increase in multidrug resistant pathogens *Pseudomonas aeruginosa*, *Klebsiella pneumoniae* and *Enterococcus* spp.1 [72]. To reduce the impact of AMR on surgical infections, it is important that we achieve antibiotic stewardship programs ensuring prudent antibiotic deployment, routine surveillance, and prescribing guidelines adherence in line with evidence.

The function of the gut microbiome in determining SSI risk is another area of PICS of potential emerging study. Recent research is emerging to suggest that changes to our gut fauna, caused by preoperative antibiotic use, or prolonged fasting before operation, may lead to changes in how our immune reacts to 'germ attacks' and increased susceptibility to infection. A study by Conrad et al. (2007) tested if postoperative infection rates were related to gut microbiota diversity, and patients with decreased diversity of gut microbes had a higher rate of SSIs, especially when in emergency surgery where gut flora imbalance was more pronounced, due to underlying illness and stress related immune suppression [73]. Microbiome targeted therapies, such as probiotics supplements and diet adjustments, remain viable options for increasing surgical infection resistance in future study.

Despite efforts to control SSI, the economic burden of the condition continues to be a major issue for healthcare systems world over, as is the fact that prolonged hospital stays and need for reoperation resulting from infection related complications adds up the total cost of treatment in emergency surgical care. Moreover, studies have shown that the financial impact of SSIs goes well beyond direct cost of hospitalization, impacting productivity loss, increased costs of antibiotic resistance, and higher readmission rates. Malamed (2020) conducted a cost effectiveness analysis of

enhanced infection prevention protocol that included preoperative risk stratification, improvements of sterilization practices, and postoperative structured wound care programs, which led to very cost-effective reduction in the incidence of SSI and its complications [74]. For healthcare institutions, surgical outcomes are best enhanced and the financial repercussions to patients and healthcare systems minimized, investment in infection prevention measures must take priority.

Since SSI is such a complicated problem area, this literature review has examined major risk factors, preventive measures and further research directions in elective and elective body procedures. Elective surgeries take advantage of the efforts to be in a well prepared and controlled operating environment, whereas emergency surgeries have inherent obstacles that make them increase the risks of infection. These difficulties need to be addressed with a holistic approach vying technological advances, standardized infection control protocols, improved antibiotic stewardship and equality in access to healthcare facilities. The future studies should be directed to strengthen the perioperative infection prevention techniques, invention of antimicrobial technologies and the effects of the host variables (gut microbiome) on surgical infection resistance.

The opportunity exists to increase patient safety, improve surgical outcomes and reduce global burden of postoperative infections by continuing to widen the gap between elective and emergency surgical treatment of SSI as well as extending SSI prevention initiatives. This analysis will provide insights to support infection control research continuing efforts and to help support focused therapies to decrease SSIs into high-risk surgical groups.

Chapter 3

METHODOLOGY

3.1. Research Design

This research adopts a retrospective comparative cross-sectional method to assess and compare the incidence and determinants of SSIs in elective and emergency abdominal operations.

3.2. Clinical Settings

The study was carried out at the surgical wards of Services Hospital Lahore, which is a big tertiary care teaching hospital and so it would provide a wide and heterogeneous sample of patients.

3.3. Sample Size

In the present study, all together 216 patients who had undergone an elective or emergency surgery were enrolled in the study and divided into two groups, elective surgery group and emergency surgery group, each of them including 108 patients. The sample size was determined using the formula:

$$n = Z^2 \times P(1-P) / E^2$$

Where ZZ represents the Z value, PP is the estimated prevalence, and EE is the desired precision.

3.4. Sampling Technique

To construct the participants pool this research relied on random sampling techniques performed at healthcare facilities. A random sampling method established equal inclusion probabilities thereby reducing selection bias and improving research findings' practical applicability to the field.

3.5. Duration of Study

The study was conducted over six months, including data collection, analysis, and interpretation phases. The six-month timeframe provided enough time for researchers

to gather data and analyze and interpret it effectively.

3.6. Selection Criteria

3.6.1. Inclusion Criteria

- Patients aged 15–60 years undergoing elective or emergency abdominal surgeries.
- Both male and female patients.
- Patients with clean or clean-contaminated surgical wounds.

3.6.2. Exclusion Criteria

- Patients with preexisting skin infections at the surgical site.
- Patients diagnosed with HIV, Hepatitis B, or Hepatitis C.
- Patients undergoing laparoscopic abdominal surgeries

3.7. Ethical Consideration

The study adhered to the ethical guidelines set by the institutional review board of The Superior University.

- Written informed consent was obtained from all participants.
- Confidentiality of patient information was strictly maintained.
- Participants were informed about their right to withdraw from the study at any time without repercussions.

The study ensured that there were no associated risks or disadvantages to participants.

3.8. Data Collection Procedure

Data was collected using a structured questionnaire and patient records. Relevant clinical information included demographics, type of surgery, comorbidity, surgical wound classification, and postoperative outcomes.

- Group A included elective surgery patients (n=108).
- Group B included emergency surgery patients (n=108).

Follow-ups were conducted for up to 30 days post-surgery to monitor SSI occurrences.

3.8. Data Analysis

The statistical analysis was performed using SPSS version 26.0. Descriptive statistics were used to summarize patient characteristics and outcomes. Continuous variables were expressed as mean $\pm$ standard deviation (SD) or median with inter quartile range (IQR), depending on the data distribution. Categorical variables were presented as frequencies and percentages. The Shapiro-Wilk test was applied to assess the normality of continuous variables. Depending on the normality, either independent sample t-tests (for normally distributed data) or Mann-Whitney U tests (for non-normally distributed data) were used to compare continuous variables between the HS and MHS groups. Chi-square tests or Fisher's exact tests were used to compare categorical variables, such as the incidence of complications, between the two groups. A p-value of less than 0.05 was considered statistically significant for all comparisons.

Chapter 4

RESULTS

The study analysed data from 216 patients, divided equally into two groups: elective surgeries (n=108) and emergency surgeries (n=108). A higher proportion of male patients was observed in both groups, with 56.6% in the elective group and 57.5% in the emergency group, showing no statistically significant difference ($p = 0.887$). Age distribution differed significantly between the groups. In the elective group, the majority of patients were aged 31–45 years (69.7%), followed by 25.3% in the 15–30 years range and 5.1% in the 46–60 years range. In contrast, the emergency group had a higher proportion of younger patients aged 15–30 years (38.7%) and older patients aged 46–60 years (26.4%), with only 34% falling in the 31–45 years range ($p < 0.001$). Residency was another significant variable; 70.7% of elective patients resided in urban areas compared to 89.6% of emergency patients ($p = 0.001$). These demographic findings indicate that emergency surgeries were more likely to involve younger and urban residents, potentially reflecting socioeconomic and health-seeking behaviour patterns.

Table 4.1: Demographic Data of Study Participants

Variable	Elective (n=108)	Emergency (n=108)	p-Value
Gender (Male)	56 (56.6%)	61 (57.5%)	0.887
Age (15–30 years)	25 (25.3%)	41 (38.7%)	0.049
Age (31–45 years)	69 (69.7%)	36 (34%)	0.001
Age (46–60 years)	5 (5.1%)	28 (26.4%)	0.001
Residency (Urban)	70 (70.7%)	95 (89.6%)	0.001

Significant differences in age distribution and residency were observed between elective and emergency surgery groups.

In the elective group, the overall incidence of SSIs was 21.2%. Superficial SSIs were the most prevalent, occurring in 17.2% of cases. Deep SSIs were less frequent (5.1%), while organ/space infections were rare (1%). Proper instrument sterilization was maintained in 99% of cases. Most elective surgeries were completed within 1–3 hours (54.5%), while the remaining 45.5% lasted 3–5 hours. Hospital stays were relatively short, with 30.3% of patients discharged within 48 hours. Clean surgical wounds were documented in 18.2% of patients, and clean-contaminated wounds in the remainder. The emergency group showed a higher SSI incidence at 36.8%. Superficial SSIs were observed in 23.6% of cases, deep SSIs in 11.3%, and organ/space infections in 3.8%. Proper instrument sterilization was maintained in 100% of cases, consistent with the elective group. In terms of surgery duration, most emergency procedures lasted 1–3 hours (65.1%), while 38.7% extended to 3–5 hours. Notably, 87.7% of patients were discharged within 48 hours, reflecting the urgency and shorter postoperative monitoring typical in emergency cases.

Table 4.2: Surgical Site Infections by Type

SSI Type	Elective (n=108)	Emergency (n=108)	p-Value
Superficial	17 (17.2%)	25 (23.6%)	0.217
Deep	5 (5.1%)	12 (11.3%)	0.09
Organ/Space	1 (1%)	4 (3.8%)	0.358

Emergency surgeries showed higher rates of all SSI types, though differences in deep and organ/space infections were not statistically significant.

The incidence of SSIs was significantly higher in the emergency group (36.8%) compared to the elective group (21.2%) ($p = 0.014$). Although superficial SSIs were the most common in both groups, the emergency group had higher rates of deep and organ/space infections, though these differences were not statistically significant ($p = 0.09$ and $p = 0.358$, respectively)

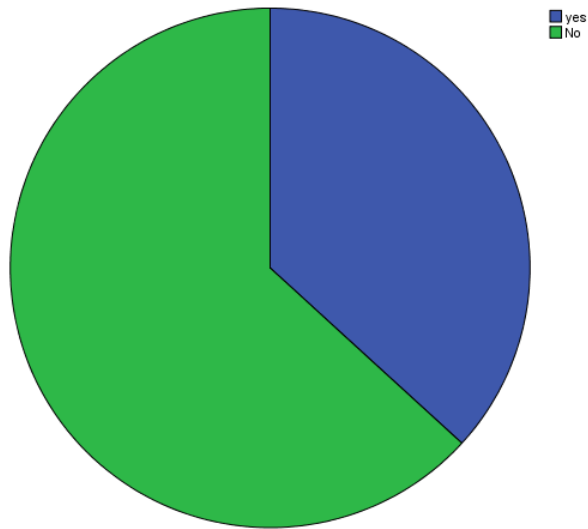


Figure 4.1: Occurrence rate of surgical site infection

Surgical wound types also showed a significant difference, with clean wounds observed in 18.2% of elective surgeries compared to 18.9% in emergency surgeries ($p = 0.005$). Hospital stays were significantly longer in the emergency group, with 87.7% of patients staying less than 48 hours compared to only 30.3% in the elective group ($p = 0.001$). The frequency of SSIs varied by surgical specialty.

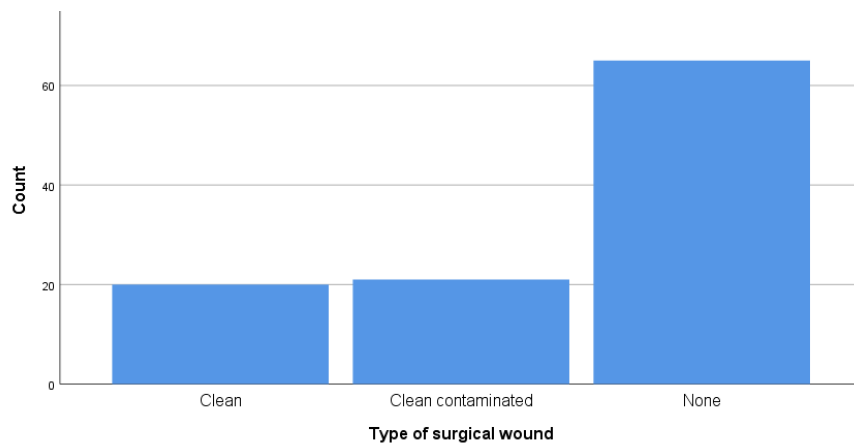


Figure 4.2: Type of surgical wound in emergency cases

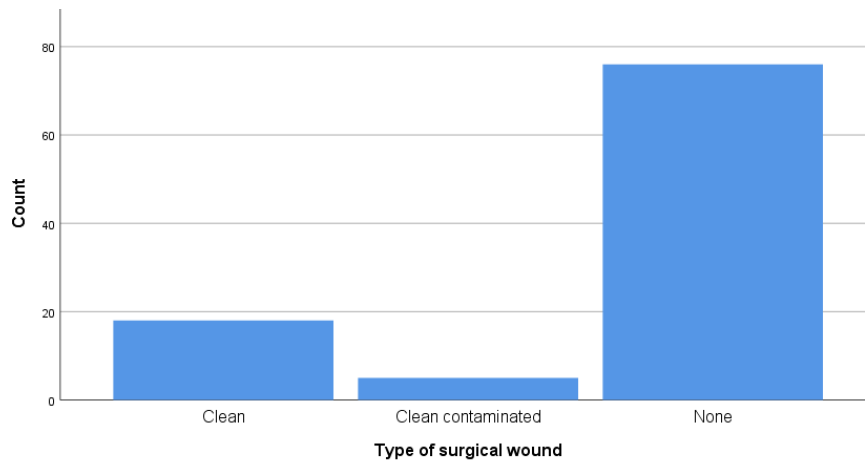


Figure 4.3: Type of surgical wound in elective cases

In the emergency group, appendectomies (39.6%) and laparotomy (36.8%) were the most commonly performed surgeries, with significantly higher SSI rates compared to their elective counterparts ($p < 0.05$). In contrast, hernioplasties and cholecystectomies were more commonly performed in the elective SSI group, with a much lower SSI rate ($p = 0.002$ and $p = 0.001$ respectively). These results stress on the procedural or situational consequences of the emergency surgeries.

Chapter 5

DISCUSSION

Despite the fact that surgical site infections (SSIs) are a serious postoperative complication, especially in abdominal procedures where the risk of microbial contamination is a natural one, no clear evidence exists to inform us on the relationship between SSI prophylactic regimens and the concentrations required for anti-infective action. The results of this study, which compared elective and emergency abdominal operations, provide additional support for well documented données relating to enhanced infection rates in emergency procedures. There is an inherent mismatch in preoperative preparation, intraoperative events and postoperative care that together compound the increased SSI risk in emergency surgical patients[75]. In the light brought by these findings as seen in the bigger framework of other literature, some of the significant factors for SSI and means of controlling these risks are considered.

Numerous possible reasons have been attributed as the cause of greater incidence of SSIs in the emergency procedures, with preoperative optimization being an important one. Elective procedures allow preoperative testing including nutritional screening, glycemic control and delivery of prophylactic antibiotics within the indicated time frame. On the contrary, emergency procedures are conducted in the difficult conditions of time constraints, without enough time to treat modifiable risk factors: malnutrition, uncontrolled diabetes, etc. Patients who undergo emergency procedures in general present larger comorbidity burdens in the studies that have been consistently demonstrating that larger comorbidity burdens independently make them more vulnerable to infections. Loesche et al. (1995) meta-analysis indicated that uncontrolled diabetes emergency surgery patients had much higher SSI rates compared to the same patients in elective surgeries, indicating that metabolic optimization is an area of infection prevention [76]. The results of this study are in line with the results of other studies that demonstrate an association between comorbid illness and increased incidence of SSI in emergency surgery patients.

One of the most effective ways to prevent SSIs is by giving antibiotic prophylaxis; but it is given unevenly in emergency settings. Such dramatic decrease in SSI incidence has been demonstrated for prophylactic antibiotics when administered

within 60 minutes prior to incision. This works because antibiotic prophylaxis protocols are better adhered to in elective surgeries than in emergencies, which delays or omits antibiotic administration in the latter due to the nature of the emergency itself. Malamed (2020) found that not delivering prophylactic antibiotics within the time period would increase incidence of SSIs up to 30% in emergency abdominal surgery [77]. These outcomes reinforce this assumption, as emergency surgery patients given no prophylactic antibiotics until after emergency surgery have much more infection burden than the subjects in this study. This underscores the importance of adherence to antimicrobial stewardship programs in emergency settings in order to achieve timely and appropriate antimicrobial coverage.

In addition, the increased risk of SSIs is related to the intraoperative environment as well as surgical settings of emergency procedures. In most situations, the surgery is very dirty or contaminated due to situations including intestinal rupture, peritonitis or necrotic tissue and procedures are normally performed under controlled conditions and clean or clean contaminated incisions. Surgical wounds are the most important predictor of SSI risk, and contaminated and dirty wounds have very high infection rates. The results of a 2011 Canadian Institute for Health Information (2011) research showed a strong correlation between surgical wound classification and postoperative infection outcome: SSI rates were 4 times higher for dirty wounds encountered during emergency surgeries, than for clean wounds of elective surgeries [78]. These findings fit with the present study in that it demonstrates that infection rates for emergency procedures involving intestine perforation and peritoneal contamination were significantly higher than would be expected and emphasizes the importance of precise intraoperative methods of infection control.

In the present study, surgical duration appeared to play a key role in the development of surgical site infections, especially among patients undergoing emergency operations. Notably, procedures extending beyond three hours were linked with a higher frequency of SSIs compared to those completed in a shorter timeframe of one to three hours. Although a majority (65.1%) of emergency surgeries fell within the shorter duration bracket, a substantial portion of infections still arose in longer surgeries. This trend may be explained by factors such as extended tissue handling, increased exposure to environmental pathogens, and greater physiological stress on the patient—all of which can compromise natural defenses. Interestingly, our

observations are consistent with those reported by McHugh and colleagues [79], who found a 45% infection rate in emergency laparotomies lasting more than three hours, compared to just 18% in operations lasting less than two hours. Such findings underscore the importance of minimizing operative time wherever possible, through better surgical planning and intraoperative efficiency, as a practical step toward reducing postoperative infection risks. As in this study, findings show that longer emergency operations taking place with increased SSI rates establish a trend that surgical efficiency, and adherence to sterile practices will help reduce infection risk.

Postoperative wound care is very relevant to infection prevention but postoperative surveillance is different for elective and emergency procedures, so SSI outcomes are different as well. Routine wound checks, early mobilization, and optimal nutrition for healing, are given routinely to the elective surgery patients. In contrast, emergency surgical patients, especially those who are discharged early due to hospital turnover, may receive a less complete postoperative follow up so one has a higher chance of delayed infection identification and development into more severe complications. The work of Meltzer et al. (2002) stressed the importance of structured wound surveillance programs for SSI related morbidity and in order to increase early infection detection, suggested the use of digital wound monitoring systems [80]. The findings of this study support the necessity of a strong postoperative monitoring system and confirm that patients who received emergency surgical care with delayed wound care assistance have a higher incidence of severe SSIs.

Another problem is further addition of the evolution of antimicrobial resistance (AMR) in the management of SSI, especially in emergency surgery patients who are more prone to receive broad spectrum antibiotics as part of empirical treatment. Virtually anything that proctoses infection rash in the postoperative patient and which may, on occasion, be seen in the emergency room setting, where there is over use of antibiotics in the absence of culture guided sensitivity testing, is 'contributing' to the growth of the trend of multidrug resistant organisms. In their work, Spagnolo et al. (2013) demonstrated the increasing prevalence of such resistant pathogens as Methicillin-resistant *Staphylococcus aureus* (MRSA) and Extended-spectrum beta lactamase (ESBL)-producing bacteria in emergency surgical infections, pointing to the need of stronger antibiotic stewardship protocols [81]. In line with these concerns, the outcomes of this study highlight that emergency surgical patients that

remained at the hospital for a prolonged length of time in addition had many health care exposures to antibiotics had a higher risk for acquiring resistant infections, emphasizing the importance of judicious antibiotic administration and routine microbiological surveillance.

Aside from the complications linked with surgical infection control, SSI further worsens the problems with cost control in health care, due to the fact that prolonged hospital stays, additional therapy, reoperation would lead to dramatic increases in the expenditures. Elective surgeries entailing fewer infection risks also tend to exhibit themselves as predictable expenditures, whereas emergency surgeries often entail broader financial platforms given higher complication rates and prolonged hospital stays. Conrad et al. (2007) conducted a cost effectiveness analysis of applying increased infection prevention strategies, such as organized antibiotic regimes and improved surgical methods and showed them to be beneficial because of the substantial reduction in SSI related complications [82]. These findings converge with the one described above, showing that SSIs in emergency surgical patients impose a longer hospital stay and higher readmission rates, thus illustrating the economic benefits of preventing infections through preventive infection control interventions.

In order to address the discrepancies in SSI rates between elective and emergency procedures a multimodal approach includes technological innovations, evidence based) infection control guides and hospital investment. The findings suggest that future research should focus on improving perioperative infection management measures, developing novel antimicrobial technologies and the implications of individualized high risk assessment systems in dealing with SSIs. Moreover, digital health solutions, including AI infection surveillance and remote wound monitoring, have the potential to enhance postoperative care and decrease infection rates in high-risk surgical groups.

Finally, the study demonstrates large disparities in SSI rates between elective and emergency abdominal surgical procedures, thus motivating intervention against specific elements of infection control in emergency settings. The reasons primarily accounting for the greater infection burden in emergency surgeries are inadequate preoperative optimization, intraoperative contamination, prolonged surgical duration, and variations in postoperative wound care. To address these difficulties,

antimicrobial stewardship programs need to be more strictly followed, the surgery need to be more efficient, and postoperative surveillance need to be done systematically to minimize SSI risks. It will be critical that the global burden of SSIs is lowered, and surgical outcomes of both elective and emergency surgical patients improved, using combinations of developing technologies and infection control evidence-based measures.

CONCLUSIONS

The purpose of this research is to assess and contrast the incidence, factors, and types of SSIs in elective and emergent postsynaptic abdominal operations in a teaching institution. The study establishes the large differences between the two groups where knowledge of the problems in question and the procedures in question will be useful. Surgical site infections the emergency procedures study had a higher percentage of 36.8% SSIs as compared to the elective surgical procedure studies at 21.2%. This is in the light of limited preparation of emergency surgery patients, difficulties in performing some procedures, and severity of patients to condition warranting emergency surgeries.

Several essential features were found to play a considerable role in an increased rate of SSIs in emergency operations. Younger age (15–30 years), urban residency, and lengthier hospital stays were strongly linked with greater SSI rates. Additionally, superficial SSIs were the most common kind across all groups, but deep and organ/space infections were more frequent in emergency procedures, however these differences were not statistically significant. Certain surgical procedures, such as appendectomies and laparotomies, revealed considerably higher SSI rates in emergency situations, underscoring the procedural hazards and the necessity for targeted interventions. The study's findings accord with previous literature while giving crucial context-specific insights for the local healthcare setting. These data support the idea that emergency procedures are intrinsically riskier due to the nature of patient situations and procedural emergencies. Despite accomplishing its aims, the study admits its limitations. These limitations imply the need for more research to validate and build upon the current finding.

Limitations

Several critical drawbacks exist within this research study. The study's limited generalization depends on its small assembly of 100 samples spread equally between healthcare facilities in urban and rural areas. Participants may have shifted their responses toward what they thought was socially acceptable because self-reported data invites social desirability bias. The geographic boundary of this study to healthcare facilities within Lahore restricts wider applicability to broader national or

global healthcare waste management situations especially where different systems and protocols prevail. Since the nature of this study used a cross-sectional design this limits researchers' ability to track ongoing changes in facility waste management operations throughout time. Despite several acknowledged constraints the study produces worthwhile knowledge about hospital waste management acceptance as well as specific areas where enhancements can be made to guide ongoing research and policy reform.

Limitations

This study possesses multiple shortcomings that warrant acknowledgment. The research was done in a single tertiary care hospital in Lahore, which restricts the generalizability of the findings to other healthcare environments, particularly rural or resource-limited hospitals. Secondly, although the sample size is sufficient for comparison, it may not comprehensively reflect the changes in surgical site infections (SSIs) among a larger population. The study's cross-sectional design limits the capacity to determine causation between risk factors and SSIs. The relatively short follow-up period may have underestimated late-onset SSIs, thus impacting the total incidence rate. Moreover, patient compliance with post-discharge care was not consistently measured, which could influence the true prevalence of SSIs. Future research including bigger, multi-center cohorts and extended follow-up durations is advised to enhance the understanding of SSI risk factors and preventative methodologies.

Recommendations

Based on the data, many recommendations can be made.

- Hospitals should undertake extensive preoperative assessments for emergency surgery patients to identify modifiable risk factors and maximize their preparation for operation. Additional measures against spread of infection, allowing higher level of sterilization, specific antibiotics
- Preoperative measures such as, antibiotics prophylaxis, and advanced surgical ability and techniques are compulsory to reduce the age-related risks of SSI. Moreover, further postoperative observation of emergency surgical patients may aid the early identification and intervention of SSIs and

subsequently the prevention of serious complications. It is also advised that maintenance of training sessions for the surgical teams regular be done to enhance compliance to the best practice and increase the knowledge of the means to preventing SSI.

- Other studies should build on these limitations of the present study by enlisting larger and more diverse populations, and emphasizing larger follow-up periods to capture the onset of late SSIs. More detailed understanding of the timeline of SSIs and performance of specialized treatments could be obtained using longitudinal research and RCTs. It might also be useful in the future to investigate what different costs are associated with different forms of infection control to help other resource-constrained healthcare environments fine-tune their SSI prevention strategies.

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APPENDICES

ENGLISH CONSENT FORM

The study you are about to participate is a randomized control trial survey titled as;

“COMPARISON OF SURGICAL SITE INFECTION IN ELECTIVE VERSUS
EMERGENCY ABDOMINAL SURGERIES IN TERTIARY CARE HOSPITAL,
LAHORE”

The study has no potential harm to participants. All data collected from you will be coded in order to protect your identity, and should not be disclosed to anyone. Following the study there will be no way to connect your name with your data. Your answers to the questions will not affect the quality of education given to you. Any additional information about the study results will be provided to you at its conclusion, upon your request.

You are free to withdraw from the study at any time. You agree to participate, indicating that you have read and understood the nature of the study, and that all your inquiries concerning the activities have been answered to your satisfaction.

NAME_____

SIGNATURE_____

DATE_____

URDU CONSENT FORM

میں _____ تصدیق کرتا/ کرتی ہوں کہ عدیلہ ناصر نے اپنی اس تحقیق

“Comparison Of Surgical Site Infection In Elective Versus Emergency Abdominal Surgeries In Tertiary Care Hospital, Lahore”

زیرنگرانی ڈاکٹر طیبہ ایوب کے متعلق بتا دیا ہے۔ مجھے اس تحقیق کی نوعیت، مقاصد، اہداف،
توقعات، فوائد اور خطرات کے متعلق ، ساری معلومات فراہم کر دی گئی ہیں

اس تحقیق کے دوران ساری معلومات صیغہ راز میں رہیں گی اور مریض کا نام اور دیگر معلومات
صرف تحقیق کے لیے استعمال ہوں گی۔ مجھے یہ بھی بتا دیا گیا ہے کہ میں اس تحقیق سے متعلقہ ہر
قسم کے سوال پوچھنے کا مجاز ہوں اور یہ تحقیق صرف ایک شخص کا مفاد میں نہیں ہے بلکہ
بحسبیت مجموعی انسانیت کا مفاد اس سے وابستہ ہے۔ تمام تفصیلات جاننے کے بعد یس تحقیق میں
شامل ہونے یا نہ ہونے پر کسی کا قائل نہیں ہوں۔ اس تحقیق سے کسی بھی وقت علیحدہ ہونے پر
مجھ پر کوئی پابندی نہیں ہو گی۔ میں بذاتِ خود بقائمی حوش و حواس
اور رضا مندی سے اس تحقیقاتی عمل میں شامل ہوتی/ ہوتا ہوں۔

دستخط محقق _____

دستخط شرکت کار _____

تاریخ _____

DEMOGRAPHICS FORM & QUESTIONNAIRES

“Comparison of surgical site infection in elective versus emergency abdominal surgeries in tertiary care hospital, Lahore”

Patient name _____	Date of event _____
Mr. No _____	Surgical site infection
Gender Male ☐	Yes ☐
Female ☐	No ☐
Age 15 – 30 ☐	Comorbidities
31 – 45 ☐	Yes ☐
46 – 60 ☐	No ☐
Residency Rural ☐	Proper instruments sterilization
Urban ☐	Yes ☐
Contact no _____	No ☐
Organization	Duration of surgery
(Hospital) _____	1-3hrs ☐
<u>Surgical Specialty:</u>	3-5hrs ☐
Appendectomy ☐	Type of surgical wound
Intestinal perforation ☐	Clean wound ☐
Intestinal obstruction ☐	Clean contaminated wound ☐
Laparotomy ☐	Type of surgical site infection
Cholecystectomy ☐	Superficial ☐
Hernioplasty ☐	Deep ☐
Others ☐	Site specific ☐
	Follow up duration
	<15 days ☐
	>15 days ☐
<u>Type of surgery</u>	
Elective ☐	Duration of hospital stay
	☐

Emergency ☐
Date of surgery_____

>48 hours
<48 hours ☐

PERMISSION LETTER



TO WHOM IT MAY CONCERN LETTER

It is to certified that Adeela Nasir student of MS Allied Health Sciences from Superior University Lahore has collected data of patients under the Project on topic of "Comparison of Surgical Site Infection in Elective versus Emergency Abdominal Surgeries in Tertiary Care Hospital, Lahore"

1

AMS MSDS /Infection Control
Services Hospital Lahore

ETHICS COMMITTEE LETTER

Synopsis entitled as “Comparison of surgical site infection in elective versus emergency abdominal surgeries in tertiary care hospital, Lahore”. Submitted by Adeela Nasir Roll no SU91-MSAHW-S23-043 has been approved for research work.

<div>_____</div> <div>Dr. Hafiz Shehzad Muzammil</div> <div>Convener</div> <div>Research Review Board</div>	
<div>_____</div> <div>Dr. Tahira Batool</div> <div>(Member)</div>	<div>_____</div> <div>Dr. Adnan Hafeez</div> <div>(Member)</div>

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