DETERMINANTS OF SURGICAL SITE INFECTIONS AMONG POST LAPAROTOMY PATIENTS IN THE SURGICAL UNITS AT THIKA LEVEL 5 HOSPITAL IN KIAMBU COUNTY, KENYA

CATHERINE MUTHONI MWANGI

A RESEARCH THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF SCIENCE IN MEDICAL/SURGICAL NURSING DEGREE OF

MOUNT KENYA UNIVERSITY

MAY 2025

DECLARATION AND APPROVAL

This Research Project has not been submitted for a degree or other academic honor at Mount Kenya institution or any other institution in Kenya, and its authorship is thus acknowledged.

Signature: ..... **Date:** 08/05/2025

CATHERINE MWANGI

MSCN/2021/86906

SUPERVISOR'S APPROVAL

As research supervisors, we approve submission of this research project for examination.

We certify that the candidate while under our supervision completed the work detailed in this project.

Dr. Nilufar Jivraj

Mount Kenya University

Signature: ..... **Date:** 09/05/2025

Dr. Bernard Mbithi

Jomo Kenyatta University of Science and Technology

Signature: ..... **Date:** 09/05/2025

DEDICATION

This thesis is dedicated to my family, whose unwavering support and encouragement have been my constant source of strength throughout this journey.

ACKNOWLEDGMENT

I wish to express my deepest gratitude to all those who supported me in completing this study. First, I extend my heartfelt thanks to my supervisors, Dr. Nilufar Jivraj of Mount Kenya University and Dr. Bernard Mbithi of Jomo Kenyatta University of Science and Technology, for their invaluable guidance, patience, and expertise throughout this research. Their insights and feedback have been instrumental in shaping the direction and outcome of this work.

I also wish to acknowledge the staff and patients at Thika Level 5 Hospital, whose cooperation made data collection possible. Without their willingness to participate, this study would not have been feasible.

Finally, I thank my family and friends for their unwavering encouragement, love, and support, which sustained me throughout this process. Their belief in me has been a constant source of motivation.

ABSTRACT

A surgical site infection (SSI) is a common complication of surgical procedures and represents one form of healthcare-associated infection (HAI) acquired by patients before, during, or after receiving surgical intervention. It is the second most common HAI, and it is responsible for the rise of antibiotic resistance and the deaths of millions of people every year. This research examined patients' performed laparotomy procedure at Thika Level 5 Hospital (TL5H), which forms a good representation of study population to identify risk factors for surgical site infections. The research took the form of analytical cross-sectional study. Post laparotomy Patients at the hospital throughout the research period made up the study's primary population. One hundred and sixty-one patients from the gynecology and surgery departments were selected at random. Quantitative data on patient-related variables and institutional factors as predictors of SSIs was collected using a questionnaire designed in accordance with Centers for Disease Control and prevention (CDC) guidelines and a formulated SSI Surveillance checklist tool. Pretesting of data tools were conducted in Kiambu level 5 hospital in Kiambu County to ensure validity and reliability of data tools. Data was analyzed using the Statistical Program for the Social Sciences (SPSS) computer program, version 25.0 and a chi-square test was used to test for associations between variables with a p-value less than 0.05, and participants' privacy was protected at all times. The study found that factors such as delay in seeking treatment, age, nutritional status, smoking habits, existing medical conditions, transfusion after surgery, and length of hospital stay before surgery were significantly associated with SSIs. Institutional factors such as timing of prophylaxis antibiotics, length of hospital stay after surgery, hand hygiene practices observed by healthcare workers, and the duration of the operation influence the Prevalence of SSIs significantly. The healthcare facilities should implement strict protocols for pre-operative and post-operative care, including timely administration of prophylaxis antibiotics. Healthcare workers should adhere to proper hygiene practices, including hand hygiene and the use of personal protective equipment. Patients should be educated on the importance of seeking timely medical care and adopting healthy lifestyle practices to reduce the risk of SSIs. The results of this research will be published, and utilized to close the knowledge gaps associated with SSIs prevention and management.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

AMR	Antimicrobial resistance
ASA	American Society of Anesthesiologists
CDC	Centre for disease control and prevention
CHMT	County Health Management Team
EAS	Emergency Abdominal Surgery
ERC	Ethical Research Committee
HAI	Healthcare Associated Infection
HIV	Human Immune- Deficient Virus
IAE	Intra-Operative Adverse Events
ICU	Intensive Care Unit
IPC	Infection Prevention Control
KNH	Kenyatta national hospital
LMDC	Lower and Middle-Income Countries
MKU	Mount Kenya University
MOH	Ministry of Health
NACOSTI	National Commission for Science Technology and Innovation.
SPSS	Statistical Package for Social Science
SSI	Surgical Site Infection
TL5H	Thika Level 5 Hospital
UTI	Urinary Tract Infection
VAP	Ventilator-Associated Pneumonia
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1. Background

Surgical site infection (SSI) is a healthcare-associated infection (HAI) that a patient contracts before, during, or after having surgical intervention, as defined by the (Voidazan et al. 2020). Although it is one of the more easily avoidable HAIs, it nonetheless causes a great deal of suffering and economic burden to patients, their loved ones, and healthcare institutions all over the globe. Patient safety is also compromised, leading to more extended hospital stays, permanent impairment, and the development of antibiotic resistance (Medina, Legido-Quigley, and Hsu 2020).

In general, all infections acquired after admission to a hospital are known as healthcare-associated infections (HAIs). These infections are picked up during hospitalization and start showing symptoms after 48 hours of admission or within 30 days. They pose a risk to patient safety and are among the top ten leading causes of mortality in the United States (Sikora A. *et al*,2023).

Healthcare Associated Infections spread rapidly in healthcare facilities due to the high concentration of frail patients whose immune systems have been compromised further by the presence of surgical procedures that circumvent the body's natural protective barriers. Inadequate infection prevention and control (IPC) practices among medical personnel can also contribute to the spread of pathogens because of cross-infections. The most common types of HAIs includes CABSI (central line associated bloodstream infection).,SSI (Surgical site infection at the site of surgery).,CAUTI (Catheter associated urinary tract infection) and VAP (Ventilator associated pneumonia) caused by a mechanical ventilator. Patients' chances of a successful recovery after a laparotomy are significantly decreased, with SSIs constituting 17% of all HAIs (Rickard *et al.* 2020).

The CDC (2025) categorizes SSI as superficial infection when it affects just the skin and severe infection affecting deep tissue including underlying organs or implanted devices. SSIs are the second most common HAIs in regions with more significant per capita income, such as Europe and the United States of America (USA). Antibiotic resistance is a growing problem since the incidence rates in affluent nations range from 1.2% to 5.2%. In LMICs, It is the most common HAI, with incidence rates ranging from 1.2% to 23.6%. Up to 20% of patients in the African context develop postoperative wound infection, making further surgery risky for their health (Keely Boyle, Rachala, and Nodzo 2018).

WHOs guidelines on SSI prevention underpins the IPC program as essential components for the prevention of SSIs. Implementing clinical care practice standards and utilizing a multimodal improvement method may significantly reduce the prevalence of SSIs. However, due to the lack of proper infrastructure and well-established infection prevention and control (IPC) programs, no nation has been able to prevent SSIs successfully (Keely Boyle et al. 2018).

Laparotomy also known as celiotomy, is a surgical operation in which a wide incision is made in the abdomen to provide access to the peritoneal cavity. The procedure has been linked in several studies to an increased risk of surgical site infections (SSIs). Elective laparotomies and emergency laparotomies are the two main categories. In contrast to emergency laparotomies, which occur without warning, elective ones provide the patient time to prepare for the operation (Saklani et al. 2024).

The risk of developing surgical site infection (SSI) is particularly significant during emergency laparotomy (EL) in comparison to elective surgery. Emergency surgery is performed when the patient needs immediate intervention for an acute abdominal ailment. Mortality rates are unfortunately significant for individuals with comorbidities and advanced age after an EL (Levin et al. 2023)

1.2. Problem Statement

According to the CDC (2025) assessment of HAIs, SSIs related to inpatient procedures are 110,800 globally, which raises many health concerns. Despite significant developments in infection control procedures, including improved sterilizing methods, enhanced surgical skills, and the availability of antibiotic prophylaxis, post-laparotomy SSIs continue to be a leading cause of death and extended hospital stays. Twenty percent of all HAIs are SSIs, and these infections carry a mortality risk multiplier of two to eleven, with seventy-five percent of SSI-related fatalities being attributed to the infection itself. It is the most expensive form of HAI, with an annual cost of $3.3 billion, a 9.7-day increase in hospital stays, and an additional $20,000 in costs per admission hence the importance of identifying SSI related factors with the aim of reducing these gaps.

(Strobel *et al*. 2022) performed a randomized controlled experiment to determine the financial effect of SSIs following elective laparotomy. The authors studied 456 patients at a German hospital and compared subcutaneous wound irrigation with polyhexanide and normal saline for 30 days after surgery. The total SSI rate was 28.2%, and the cost of inpatient care was much higher for those with SSIs ($19,703) than those without SSIs ($13,276). The research found that the cost of treating SSIs after elective laparotomy was much higher, which is why prevention is essential in reducing SSI impact.

SSIs have a significant role in the development of both morbidity and mortality. According to (Hendriksen, B,2020), research on the perioperative mortality rate of exploratory laparotomy, including 286 persons in Ghana, found that the total SSI-associated surgical death rate was 12.6%. Intestinal obstruction perforated peptic ulcer disease, severe trauma, and appendicitis accounted for the majority of the cases. The findings of the study therefore can address the challenge of high mortality and morbidity rates.

The pooled prevalence of SSIs among postoperative patients in Ethiopia is 12.3%, according to the results of a recent comprehensive meta-analysis research on SSIs and their related variables in 24 studies comprising 13,136 participants. To lower the number of SSIs, the study authors recommended developing situation-based treatments and regional context-specific preventative methods (Shiferaw *et al.* 2020).

(Aiken et al. 2013) performed research at Thika Hospital in Kenya that included all surgical operations, including cesarean sections. He, however, failed to categorize SSIs using different procedures. Ten years have passed since this research was conducted, and much has changed, including the potential for microbial mutation. This study will therefore have updated findings on SSI related factors, both patient and institutional specifically for post laparotomy surgical outcome of patients

1.3. Purpose of the Study

The purpose of this study was to narrow down the study to post-laparotomy patients in a resource-constrained set up having identified the gaps in existing published studies that have not fully explored SSIs in LMICs. The researcher therefore intended to identify determinants of SSIs post-laparotomy with an interest in liaising with other stakeholders in reducing morbidity and mortality associated with SSIs and bridging the knowledge gap.

1.4. Objectives

1.4.1. Broad Objective

To identify the determinants of surgical site infections among post laparotomy patients in the surgical units at Thika level 5 hospital, Kiambu county, Kenya

1.4.2. Specific Objectives

i. To determine the Prevalence of Surgical Site Infections among post laparotomy patients in the surgical unit at Thika level 5-hospital, Kiambu County

ii. To establish patient-related factors that influence Surgical Site Infections among post laparotomy patients in the surgical unit at Thika level 5 hospital Kiambu County

iii. To determine the institutional-related factors that influence Surgical Site Infections among post laparotomy patients in the surgical unit at Thika level 5 hospital Kiambu County

1.5. Research Questions

i. What are the Prevalence of Surgical Site Infections among post laparotomy patients in the surgical unit at Thika level 5-hospital, Kiambu County?

ii. What are the patient-related factors that influence Surgical Site Infections among post laparotomy patients in the surgical unit at Thika level 5 hospital, Kiambu County?

iii. What are the institutional-related factors that determine Surgical Site Infections among post laparotomy patients in the surgical unit at Thika level 5 hospital, Kiambu County?

1.6. Hypotheses

H_0 There is no statistically significant relationship between patient-related factors and prevalence of SSI among post laparotomy patients

H_1 There is a statistically significant relationship between patient-related factors and prevalence of SSI among post laparotomy patients

H_0 There is no statistically significant relationship between institutional-related factors and prevalence of SSI among post laparotomy patients

H_1 There is a statistically significant relationship between institutional-related factors and Prevalence of SSI among post laparotomy patients

1.7. Justification for the Study

Among the major surgeries performed at Thika level 5 hospital, more than 60% are laparotomy procedures with no published findings to show their SSI-related outcome to support evidence-based practice (EBP), which is a significant concern. This study was timely and hence calls for prevention and assistance in identifying the gaps that lead to high morbidity and mortality attributed to SSI post-laparotomy. It may also guide the application of intervention measures to prevent its occurrences.

The study is important in addressing Infection prevention and control challenges, which is key in SSIs prevention, and is fundamental to achieving sustainable development goal (SDG) number 3 in reducing global morbidity and mortality rates associated with SSIs (Hinson C, 2024). Without strict IPC practices, Healthcare Facilities become breeding grounds for pathogens eventually leading to SSIs, undermining patient safety. The rise in Healthcare-associated infections (HAIs) and antibiotic resistance also highlight the critical need for effective IPC measures in all healthcare settings in preventing of SSIs.

The study may also help nurses in the clinical practice to gain insights on determinants of SSI associated with post-laparotomy procedures for advocacy in advancing policies and guidelines in infection prevention and control practices in the clinical practice settings.

The findings' generalizability will help reduce morbidity and mortality rates globally, hence improving life expectancy as they base their patient care on the findings and may also be instrumental, as future researchers may have a platform to build on their studies as they endeavor to advance evidence-based practice.

Furthermore, many studies have been performed on general SSIs, but existing literature shows few documented findings specifically for post-laparotomy patients and none whatsoever for Thika level 5 hospitals. This study, therefore, is essential in filling the

gaps in the literature related to determinants of post-laparotomy SSIs in this scarcely researched but essential field.

1.8. Scope of Study

The study focused on determinants of SSIs among post-laparotomy patients in TL5H. It is a comprehensive study of patient-related and institutional factors that determine Prevalence of SSI. It involved checking patients' records and follow-up within 14 days post-surgery in the special clinics per the CDC (2017) guidelines to determine if the patients developed SSI after discharge.

According to (Valderas et al. 2019) the typical timeframe for SSI symptoms to manifest is 3-7 days post-procedure. Therefore, the researcher collected data on 161 randomly selected post-laparotomy patients from surgical and gynecology departments during their 14th-day follow-up in the clinic. It also involved checking patients' records per the CDC (2017) guidelines.

1.9. Study Limitations

One limitation of the study was the potential for incomplete questionnaires especially for patients who were still experiencing pain at the surgical site due to SSI and required breaks in between the interview to rest. In this scenario, the researcher did not leave behind the questionnaires with the patients to complete at their convenience. Instead, the researcher opted to wait for the patients to finish their rest period and continue or returned shortly. This approach may have resulted in incomplete data if patients could not resume the session, thereby influencing the comprehensiveness of the collected information.

1.10 Study Delimitation

The study sought data from low-resource facility to help provide credible information regarding determinants of SSIs; however, this was not sufficient for generalizability of the topic especially in different resource settings

The study also involved patient who had undergone surgical emergency or elective laparotomy and no other surgery in the facility where data was collected to ensure uniformity of participants

1.11. Operational Definitions of Key Terms

Co-Morbidity- the existence of more than one disease or condition within the body of a patient at the same time, which can influence the occurrence of SSI

Evidence-based practice - using the finest external clinical data from systematic research along with clinical experience to make choices about patient treatment.

Healthcare-associated infections- These are hospital infections that are acquired after hospitalization and manifest within 48 hours after admission or 30 days after hospital care

Institutional factors -Conditions within the institution that is attributable to SSI occurrence

IPC Practices- Healthcare workers' behaviors on infection prevention and control during patient care delivery.

Laparotomy- A surgical procedure involving a large incision in the abdomen to access the peritoneal cavity

Length of Hospital Stay- duration of admission in the hospital

Levels of SSIs- Numbers of surgical site infections within the study population

Patient-related factors - Conditions within a patient that is associated with SSI occurrence

Prophylaxis Antibiotics medications administered before surgery to prevent SSI occurrence

Surgical site infections- A type of HAI that patients acquire while receiving treatment before, during, or after surgical intervention

Wound classification- classification of wounds based on degree of filthiness. Class 1: no contamination, Class 2: minimal contamination, Class 3: severe contamination. Wound infection, severity level 4.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

A literature review aims to aid a researcher in filling in knowledge gaps and expanding the foundations of a theory by examining many bodies of work in advance of the project at hand. It helps experts in the area learn more about their subject and opens up new avenues for investigation (Kraus *et al.* 2022).

This section provided a comprehensive overview of previous research work conducted by other scholars in the same subject of interest. It provided a framework to further understand the determinants of SSIs and what is known about this study before collecting data. During this period, the researcher was able to note the gaps that were identified earlier by other scholars. The literature review involved extensive search for SSI related factors using online search through applications such as Google scholar, for the information using key words such as SSIs and HAIs .Only credible source sites were used such as WHO and CDC websites. A theoretical and conceptual framework were applied to show the link between the variables under study that underpin the study.

2.1.1. Prevalence of SSI

WHO performed a thorough literature review on SSI in LMICs, analyzing 231 papers written in a variety of languages, and found an SSI incidence of 11.2%. According to the research, cancer patients had the highest incidence rate for laparotomy surgery (17.2%), followed by those undergoing orthopedic procedures (15.1%) and those undergoing general surgery (14.1%) (González S. *et al.* 2020).

In another cross-sectional research, Khan et al. (2022) studied 132 patients who had undergone laparotomy in Pakistan and found that 40 of them (30.3%) had acquired a

surgical site infection. Reducing the number of SSIs can be achieved by the early identification of risk factors and the elimination of needless surgical delays.

According to another study by (Khan *et al*. 2022) in a UK-wide assessment of surgical site infections (SSIs) on 339 women who had laparotomy as part of treatment for gynecological cancer. The results revealed that 54 women (16%) developed Surgical Site Infections, leading to more extended hospitalization and delays in delivering adjuvant medication.

In another Chinese multicenter cross-sectional research on SSI after abdominal surgery, (Pannala *et al.* 2020) analyzed data from 5560 patients who had abdominal surgery at 68 institutions. 163 (2.9% of the total) had SSI, of which 98 (60.1%) had infections in an organ or space, 19 (11.7%) had infections in the deep tissues, and 46 (28.2%) had superficial infections on the incision. The most common infectious agent was Escherichia coli.

Seventy patients were included in a study of Saudi Arabian trauma laparotomy patients to determine the incidence of SSI and evaluate presenting variables associated with the development of SSI at the emergency department (ED). According to the author's findings, SSI is under-diagnosed in trauma laparotomy. (Anon 2023) found no correlation between SSI and patient characteristics, injury features, or acute surgical treatment.

The prevalence of surgical site infections (SSIs) and associated variables were analyzed by (Udayakumaran *et al*. 2021) in a study of patients who had undergone laparotomy in a general surgical hospital in India. Results showed SSI incidence rate of 35.3% which was linked to advanced age, prolonged surgical time, and hospitalization. High blood sugar, tubal drainages, and prior laparotomies were also factors.

Injured service members from Iraq and Afghanistan study was analyzed to determine what causes abdominal SSI. Patients who had exploratory laparotomies performed during

active military activities were included in the research. Eight percent of war victims had organ space SSI, four percent had deep incisional SSI, and four percent had superficial SSI. Compared to other severe traumas, the author finds that the SSI rate for laparotomies performed on war casualties is modest, at 14% (Hopkins 2020).

The prevalence, risk factors, and drug profile of SSI-causing bacteria was evaluated in a prospective research study involving 294 patients at a hospital in Kigali. The incidence rate of SSI was 10.9% among patients who were monitored for 30 days after surgery. Increased age, ASA class, surgical expertise, more than 2 hours of surgery, extended hospitalization, blood transfusion, and emergency procedures were all reported to increase the risk of surgical site infection (SSI). Klebsiella spp. and Escherichia coli were identified as the most common pathogens. The author concludes that regular monitoring and the use of an antibiotic strategy are crucial in the fight against SSIs (Ali, Gebretsadik, and Desta 2023).

(Bunduki et al. 2024) performed a prospective hospital-based investigation on the occurrences, risk factors, causative agents, and susceptibility of SSI among 114 emergency postoperative patients at a Referral Hospital in Uganda. The results showed that SSI was 16.4%, with a distribution of 5.9% superficial infections and 47.1% deep and organ space infections. Klebsiella pneumoniae was the primary cause in 50% of cases and Staphylococcus aureus in 27.8%. Anemia and wound class were the most significant risk factors for SSI.

It was reported in a cross-sectional study of 120 patients scheduled for emergency laparotomy that the incidence rate of SSI was 30.8%. The study was performed at Kenyatta National Hospital (KNH), Kenya. SSI was linked to being male and to alcohol use in patients. Other risk factors for surgical site infections were prolonged preoperative

and intraoperative time, unclean wounds, and perioperative blood transfusion. According to a recent study (Seth *et al.* 2022).

Surgical site infections (SSIs) pose a significant challenge within global healthcare systems, exhibiting varying incidence rates across different regions and types of surgical procedures. A comprehensive literature review by the World Health Organization (WHO) highlighted an overall SSI incidence of 11.2% in low- and middle-income countries (LMICs); underscoring the widespread nature of these, infections and their implications for patient care. SSIs extend hospital stays, increase healthcare costs, and compromise patient recovery and treatment outcomes. The diversity of infection rates is evident in specific studies. For instance, Khan et al.'s research in Pakistan identified a notably higher SSI incidence of 30.3% among patients undergoing laparotomy, emphasizing local healthcare disparities and patient-specific factors. Conversely, a multicenter study in China, as reported by Zhang *et al*, (2020), recorded a lower incidence rate of 2.9% following abdominal surgeries, reflecting regional variations in surgical practices and infection control measures.

This expanded paragraph provides a comprehensive overview of SSIs, their impact, and the regional disparities in infection rates. It offers insights into the broader context of healthcare challenges and strategies for effectively addressing surgical complications of post laparotomy patients.

2.1.2. Patient-Related Factors

2.1.2.1 Patient-Specific Factors and Comorbidities

Patient-specific factors and comorbidities are critical determinants of surgical site infection (SSI) risk. Age is a significant factor, with older patients often experiencing higher rates of SSIs due to age-related immune system decline and slower wound healing processes (Bischoff *et al.* 2023). Advanced age (>55 years) has been consistently linked

to increased susceptibility to infections following surgery, attributed to impaired immune responses and prolonged recovery times (Gustafson *et al.* 2020). Chronic health conditions such as diabetes mellitus significantly increase infection risk by impairing immune function and delaying wound healing (Bischoff *et al*. 2023). Poor glycemic control, a common issue in diabetic patients, contributes to elevated blood glucose levels that promote bacterial growth and compromise immune responses (Al-Sayyar *et al.* 2022). Furthermore, conditions like obesity can contribute to increased tissue trauma during surgery and impair wound healing due to decreased tissue perfusion *(Pierpont et al*. 2014). Obesity-related factors such as reduced oxygen delivery to tissues and impaired immune function further elevate SSI risk (Al-Sayyar *et al.* 2022). Low hemoglobin levels have been associated with poor tissue oxygenation, which can compromise wound healing and increase susceptibility to infections. According to (Maraş and Sürme 2023), financial and social burden by surgical site infections remains a major problem for many countries with approximately half of all surgical site infections being preventable through application of evidence-based practices (EBP). These practices should be integrated into the preoperative, intraoperative, and postoperative periods.

2.1.2.2 Age

(Muchuweti and Jönsson 2015) conducted a prospective analysis on 285 Harare, Zimbabwe patients to assess risk factors for abdominal surgical site infections (SSIs). The study revealed a high SSI rate of 26%, with older age emerging as a significant predictor of infection susceptibility. Among HIV-positive individuals, the SSI rate escalated to 52%, underscoring the heightened vulnerability of immunocompromised older patients to postoperative infections. The findings from Muchuweti and Jönsson's study emphasize the imperative for healthcare providers to adopt age-specific approaches in perioperative care to mitigate SSIs effectively. By addressing age-related vulnerabilities and

implementing targeted interventions, healthcare teams can enhance patient safety, improve recovery outcomes, and reduce healthcare costs associated with postoperative complications

Advanced age is associated with physiological changes that increase the risk of SSIs. Older adults often experience compromised immune responses, reduced skin integrity, and slower wound-healing processes, all contributing to a higher likelihood of infections following surgery. The presence of comorbidities such as diabetes mellitus, hypertension, and cardiovascular disease further exacerbates these risks by affecting overall health and immune function (Bischoff P. *et al*. 2023).

Furthermore, another study by Bella, F, (2023), found that prolonged hospital stays and increased healthcare utilization among older surgical patients highlight the significant economic and resource burden associated with managing SSIs. Effective infection prevention strategies tailored to the unique needs of older adults, including meticulous wound care, antimicrobial stewardship, and enhanced surveillance for early detection of infections, are crucial for optimizing surgical outcomes.

Management of patients with HAIs requires broader-spectrum antibiotic regimen due to possibility of multidrug-resistant organisms, which can promote resistance. It is therefore important to control HAIs spread in healthcare facilities as a way of preventing antimicrobial resistance (Sartelli et al. 2024).

2.1.2.3 Chronic Health Conditions

(Skeie et al. 2018) conducted a comprehensive retrospective examination involving 249 patients at an acute-care surgical hospital in the Ethiopia for a duration of 6 months to investigate how chronic health conditions contribute to surgical site infections (SSIs) risk. Their study highlighted several key findings noting that physiological impairment may exacerbate the risk of infections by impairing local immune responses at the surgical site.

The author recommended that Patients with history of chronic health conditions require special attention to decrease SSI occurrence.

Moreover, the study identified that individuals requiring long-term mechanical ventilation had a significantly elevated SSI risk. This increased risk is likely multifactorial, involving prolonged hospital stays, invasive procedures associated with ventilation support, and the potential introduction of pathogens through ventilator equipment. The immunomodulatory effects of mechanical ventilation may also play a role in predisposing these patients to infections.

Another important finding was the association between blood transfusions and higher rates of SSIs. While the exact mechanism is complex, it is speculated that transfusions may impair immune function or introduce infectious agents, thereby increasing the likelihood of postoperative infections. These findings underscore the critical need for proactive management of chronic conditions preoperatively. Strategies include optimizing respiratory function in COPD patients, minimizing invasive procedures where possible, and implementing rigorous infection control protocols in ICUs. By addressing these factors, healthcare providers can reduce the incidence of SSIs and improve outcomes for surgical patients with chronic health conditions (Mao *et al.* 2024).

2.1.2.4 Nutritional Status

(Skeie et al. 2018), conducted a study on association between nutritional risk and the incidence of SSI among 1194 surgical patients at a hospital in Bergen, Norway. The study specifically examined incidence of SSI within 30 days post-surgery, and the point-prevalence of patients with nutritional risk. The findings showed a significant higher incidence of SSI among patients who had nutritional risk at 11.8% compared to those without risk. The author concluded that SSI is more likely to occur among patients with nutritional risk factors, compared to those who have no risk The study highlights the

importance of preoperative nutritional assessment and intervention strategies in reducing the risk of SSIs. Healthcare providers should prioritize nutritional optimization in surgical candidates, including dietary counseling, supplementation as needed, and addressing underlying nutritional deficiencies. By enhancing nutritional status before surgery, healthcare teams can mitigate the risk of SSIs and improve overall surgical outcomes for patients undergoing elective laparotomies. This proactive approach supports recovery and reduces healthcare costs associated with postoperative complications.

Optimizing nutritional status through targeted interventions is crucial for enhancing immune function, promoting wound healing, and reducing the incidence of SSIs in surgical patients.

Another cohort study by Muhamud and others was conducted on 93 patients undergoing elective laparotomy at a Hospital in Jakarta, among them (48) had adequate protein while another cohort of 45 had inadequate protein. Patient were monitored for 30 days postoperatively to assess SSI complications. The study assessed relationship between pre-operative protein adequacy and post-elective laparotomy SSI occurrence. Findings showed that the pre-operative protein adequacy and pre-operative albumin levels were strongly associated with SSI occurrence. The findings underscored the critical influence of nutritional status on postoperative outcomes. Low levels of total blood proteins, indicative of poor nutritional status, were significantly associated with a higher incidence of SSIs. Adequate protein intake is essential for maintaining immune function, tissue repair, and wound healing. Thus, deficiencies in protein levels can impair these vital functions, compromising the body's ability to combat infections effectively at the surgical site. Moreover, malnutrition, characterized by deficiencies in essential nutrients such as vitamins and minerals, further exacerbates the risk of SSIs. Poor nutritional status can lead to weakened immune defenses, delayed wound healing, and increased infection

susceptibility. This is particularly relevant in surgical patients, where the stress of surgery and the metabolic demands of healing necessitate optimal nutrient intake for optimal recovery (Muhamad, Manikam, and Syaiful 2023).

2.1.3. Institutional Related Factors

2.1.3.1 Surgical Technique and Procedure Characteristics

Duration of Surgery: Prolonged surgical procedures are associated with an increased risk of SSIs. Extended operative times can lead to greater exposure of tissues to potential contaminants, prolonged anesthesia, and increased manipulation of tissues, all of which contribute to higher infection rates. Studies consistently show that shorter surgical durations correlate with lower SSI incidence rates (Bucataru et al. 2024).

Procedure Complexity: The complexity of the surgical procedure itself can influence infection rates. Surgeries that are more intricate often involve extensive tissue manipulation, longer operative times, and greater exposure to foreign materials (such as prosthetics or implants), all of which can increase the likelihood of infections. Surgeons must carefully assess the complexity of each procedure and take appropriate precautions to minimize the risk of SSIs. (WHO, 2016)

Tissue Handling and Contamination Control: How tissues are handled during surgery and the effectiveness of contamination control measures influence SSI risk. Proper aseptic techniques, including strict adherence to sterile protocols, antimicrobial prophylaxis, and maintenance of a clean surgical environment, are crucial in preventing infections. Any breach in these practices can lead to microbial contamination of the surgical site and subsequent infections. (Meyer K. *et al,* 2021)

Evidence-Based Practices: Implementing evidence-based practices such as antibiotic prophylaxis guidelines, surgical checklists, and standardized operating procedures can significantly reduce SSI rates. These practices help ensure consistent adherence to

infection prevention protocols across surgical teams and healthcare facilities. (CDC, 2020)

Patient-Specific Factors: Additionally, patient-specific factors such as age, underlying health conditions (e.g., diabetes, immunosuppression), and preoperative preparation (e.g., optimization of nutritional status smoking cessation) play pivotal roles in determining SSI risk. Tailoring surgical management strategies to address these factors can further mitigate the likelihood of postoperative infections (Bucataru et al. 2024).

Technological Advances: Advances in surgical technologies, such as improved wound closure techniques, antimicrobial-coated sutures, and developing specialized wound dressings (as negative pressure wound therapy); reduce SSIs by promoting optimal wound healing and minimizing microbial colonization. (Hopkins, Brent. 2020.)

2.1.3.2 Intraoperative Events and Complications

Intraoperative adverse events (IAEs) are pivotal moments during surgery where unforeseen complications, such as bowel or vessel injuries, can occur, significantly heightening the risk of surgical site infections (SSIs). These events prolong operative times and introduce contamination risks directly into the surgical site. A study conducted in Massachusetts highlighted that IAEs, particularly injuries to the bowel (44%) and vessels (29%), were strongly associated with an increased overall incidence of SSIs (Dangen 2022).

The occurrence of these complications underscores the critical importance of maintaining meticulous surgical technique, ensuring effective intraoperative monitoring, and promptly managing any adverse events as they arise. To mitigate these risks, healthcare providers should adhere rigorously to established surgical protocols, enhance training for surgical teams to recognize and respond swiftly to complications, and leverage advanced technologies such as intraoperative imaging and monitoring systems. These technologies

enable real-time detection and intervention, reducing the likelihood of complications that could lead to SSIs (Bucataru et al. 2024).

Furthermore, implementing strategies to minimize tissue trauma during surgery, optimize tissue perfusion through adequate hemodynamic management, and employ advanced wound closure techniques can all significantly lower SSI rates associated with intraoperative events. The use of wound protectors and application of negative-pressure wound therapy may be effective in reducing SSIs and it may be an option to take into consideration especially in patients with a high risk of infection. In addition, Intraoperative normothermia is significant in reducing SSIs especially using active warming devices in the operating room. (De Simone, B, 2020)

A study was conducted on financial implications of SSIs on patient outcomes in low- and middle-income countries. The study found that proactive measures not only enhance patient outcomes by reducing the incidence of infections but also yield substantial cost savings by decreasing the length of hospital stays and the need for additional post-operative care. However, the researcher recognized the fact that resource-limited health institutions are not adequately equipped to prevent the occurrence of these infections (Kraus et al. 2022).

In conclusion, addressing intraoperative events and complications with a comprehensive approach that prioritizes preventive measures and rapid response capabilities is paramount in mitigating the risk of SSIs. By continually refining surgical practices and integrating technological advancements, healthcare providers can safeguard patient well-being and optimize the overall quality of surgical care.

2.1.3.3 Postoperative Care and Wound Management

Postoperative care practices and wound management techniques are crucial in determining the incidence of surgical site infections (SSIs) following laparotomy and

other surgical procedures. Proper wound care promotes healing and mitigates the risk of infections, which can significantly affect patient recovery and hospital outcomes (Zabaglo M, 2024)

Various studies have examined different approaches to wound management, highlighting the complexities and challenges in reducing SSI rates. For instance, research from Australia evaluated the use of negative pressure wound therapy, such as PICO dressings, in closed laparotomy incisions. Contrary to expectations, this study did not demonstrate a significant reduction in SSI rates compared to standard dressings (Norman *et al.* 2022). These findings suggest that while advanced wound care technologies like PICO dressings may offer benefits in specific scenarios, their universal application may not uniformly decrease infection risks across all patient populations.

Effective postoperative care strategies encompass various interventions to optimize wound healing and prevent infections. Key components include early mobilization of patients to improve circulation and reduce the risk of complications, vigilant monitoring for signs of infection such as wound erythema or purulent discharge, and strict adherence to evidence-based wound care protocols. These protocols often involve the timely removal of surgical drains and sutures, appropriate use of antimicrobial agents based on susceptibility testing, and patient education on wound hygiene practices. (Zabaglo M, 2024)

Prevention and management of surgical infections should be approached in a collaboration way among all healthcare professionals with diverse knowledge and experience Furthermore, implementing multidisciplinary care teams that coordinate closely with surgeons, infectious disease specialists, and nursing staff is essential for comprehensive postoperative care. Such collaborative efforts facilitate timely

identification and management of potential complications, reducing the incidence of SSIs and improving overall patient outcomes (Sartelli et al. 2024)

In conclusion, while advancements in wound care technology continue to evolve, the effectiveness of postoperative care in preventing SSIs lies in a multifaceted approach that integrates evidence-based practices, patient-centered care, and interdisciplinary collaboration. By prioritizing meticulous wound management and proactive infection prevention strategies, healthcare providers can enhance surgical outcomes and promote faster patient recovery.

2.2. Theoretical Framework

The global demographic landscape is experiencing a significant shift as populations' age at an unprecedented rate. The geriatric population, typically defined as individuals aged 65 and above, is proliferating, bringing unique challenges related to health, social care, and quality of life to the forefront. Enhancing the quality of life for elderly individuals is a pressing concern that necessitates developing and implementing practical service delivery approaches. These approaches encompass a broad spectrum of services, including healthcare, social support, and community-based initiatives, all aimed at addressing the multifaceted needs of older adults.

Numerous factors, including physical health, mental well-being, social engagement, and access to essential services, influence the quality of life in geriatric populations. As individuals age, they often face an increased prevalence of chronic diseases, mobility issues, and cognitive decline, which can significantly affect their daily functioning and overall well-being. Additionally, social isolation and loneliness are shared among the elderly, further exacerbating their health outcomes. Therefore, a holistic approach to service delivery that integrates medical care, psychosocial support, and community

resources is essential to enhance the quality of life for this demographic. (Ellis,*et al* G.2017).

Service delivery approaches play a crucial role in addressing these challenges. Effective healthcare services, including preventive care, chronic disease management, and rehabilitative services, are fundamental to maintaining and improving physical health among the elderly. Moreover, social services that provide opportunities for social interaction, mental stimulation, and emotional support are vital in promoting mental health and preventing social isolation. Community-based programs, such as senior centers, recreational activities, and volunteer opportunities, foster a sense of belonging and purpose, contributing to a higher quality of life.

Despite the recognized importance of these services, there are significant variations in their availability, accessibility, and effectiveness across different regions and populations. Socioeconomic status, geographic location, and cultural background can influence how much elderly individuals benefit from these services. Evaluating the role of various service delivery approaches in enhancing the quality of life among geriatric populations is essential to identify best practices, address gaps in service provision, and inform policy development.

The research centered on the environmental theory developed by Florence Nightingale in the 1860s focused on 13 canons, including proper ventilation and warmth, healthy food, beds and bedding, cleanliness, and observation of the sick.

The patients' internal and external factors influence their health, guiding the nurse's initiative to configure the environment and gradually restore their health.

Applying Nightingales' environmental theory to research may help avoid SSIs and promote a more evidence-based approach to patient care. Florence Nightingale described nursing as "the act of utilizing the patient's environment to assist him in his recovery."

Nurses can identify pathogens within patients' environments through culture swabs and destroy them before they affect the patient.

To promote wound healing and avoid the spread of infection, a patient who has had a laparotomy and is admitted to the hospital must adhere to specific environmental standards, such as infection prevention measures and a safe environment ideal for positive outcomes (Scalise *et al*. 2016).

By applying her theoretical concepts while providing care, such as using an aseptic technique in the operating room during a laparotomy or providing adequate wound care in the ward, nurses significantly contribute to SSI prevention (Rana 2021).

External environmental factors such as prolonged hospital stay and lack of environmental hygiene expose patients to post-laparotomy SSIs. Nightingale states that dirty bed linen and poor hygiene may also promote the growth of pathogens leading to SSIs; hence, nurses must ensure patients' linen is clean, which is a critical factor in infection control. Failure to practice proper IPC, such as hand hygiene, promotes cross-infection from health care workers to patients or from one patient to another through care providers, leading to post-laparotomy SSI. Petty management, in theory, refers to the continuity of care where nurses must closely observe the patient for early recognition of infection and prompt intervention. This is achieved through observation of vital signs such as blood pressure, body temperature, respiration rate, blood sugar and oxygen saturation of the patient.

Internal environmental factors, according to Nightingale's theory, include healthy eating habits such as well-balanced diet. Poor nutrition compromises the patient's immune system, leading to poor healing of wounds. A patient who has undergone laparotomy requires a well-balanced diet to support inflammatory process, promote cellular activity and collagen deposition necessary for wound healing. Elderly patients, especially those

with comorbidities, require good nutrition to promote the body's immune system, as they are prone to post-laparotomy SSIs. Nurses can advocate for proper policies that address good nutrition for hospital patients, liaise with other stakeholders to assess the reason for unhealthy food practices in the community, and institute measures to promote better practices. This can be achieved through collaborative management and engagement through Public Private Partnership (PPP)

2.2.1 Germ Theory of Disease

The Germ Theory of Disease, proposed by Louis Pasteur and Robert Koch, states that microorganisms, such as bacteria, viruses, fungi, and parasites, cause many diseases. In service delivery, this theory underscores the importance of infection control, particularly in healthcare settings frequented by elderly populations and patients with comorbidity who are often more susceptible to infections due to weakened immune systems. (Cavaillon, J.-M., & Legout, S. 2022).

For instance, surgical site infections (SSIs) can occur when pathogens are introduced during surgery if they are not adequately controlled. Factors such as inadequate sterilization of surgical instruments, improper surgical techniques, or contamination of the surgical site can all contribute to the introduction and proliferation of pathogens, leading to SSIs. Understanding and adhering to strict aseptic techniques, proper sterilization of surgical equipment’s and other infection control measures are crucial for preventing SSIs based on this theory

2.2.2 Host-Pathogen Interaction Theory

The Host-Pathogen Interaction Theory focuses on the dynamic relationship between the host (patient) and the pathogen (microorganism). It emphasizes that the host's susceptibility to infection depends not only on the virulence of the pathogen but also on the host's immune response and physiological condition. For SSIs, factors such as the

patient's nutritional status, immune function, comorbidities (e.g., diabetes, obesity), and age can influence their susceptibility to infection. Patients with compromised immune systems or underlying health conditions are more vulnerable to SSIs due to their reduced ability to combat pathogens effectively. This theory underscores the importance of assessing and optimizing patient-specific factors through strengthening their body immune system to minimize infection risks during and after surgery (Jo. K, 2019).

The Host-Pathogen Interaction Theory is pivotal in understanding and preventing surgical site infections (SSIs) among elderly populations. Elderly patients often present unique challenges due to their physiological conditions and comorbidities. For example, poor nutritional status, common in older adults, can impair wound healing and reduce the effectiveness of the immune response. Immune function generally declines with age, making elderly individuals more susceptible to infections. Additionally, conditions such as diabetes, HIV, various types of cancers and obesity can exacerbate these vulnerabilities. Diabetes, for instance, is associated with poor circulation and neuropathy, which can delay wound healing and increase the risk of infection. Obesity can complicate surgical procedures and increase the likelihood of infection due to factors like reduced blood flow to fatty tissues and difficulties in maintaining aseptic conditions during surgery.

2.2.3 Biofilm Theory

Biofilms are communities of bacteria that adhere to surfaces and are embedded in a protective matrix of extracellular polymeric substances (EPS). They can form on medical devices, surgical implants, or tissues, making them highly resistant to antibiotics and immune responses. In the context of SSIs, biofilm formation on surgical wounds or implanted devices can contribute to persistent infections that are difficult to treat. This theory suggests that strategies to prevent biofilm formation, such as proper wound care,

antimicrobial dressings, and timely removal of surgical drains or implants, are essential for reducing the incidence of SSIs. Understanding the role of biofilms in SSIs highlights the need for comprehensive infection prevention protocols that target both planktonic bacteria and biofilm-associated infections (Li, P *et al*, 2023)

This theory emphasizes that a one-size-fits-all approach to infection prevention is inadequate. Instead, a personalized assessment of each patient's risk factors is necessary. This involves preoperative evaluations that consider nutritional supplementation for malnourished patients, strict glycemic control for diabetic patients, and tailored surgical techniques to accommodate obese patients. Moreover, optimizing immune function through strategies such as vaccinations and minimizing immunosuppressive medications can enhance the host's ability to combat infections.

2.3. Conceptual Framework

The conceptual framework helps in integrating different variables and bringing out the aspect of their connections, showing why the study is significant. In this study, level of SSI was the dependent variable whereas patient-related factors and institution-related factors were the independent variables. The conceptual framework helped the researcher in showing how the independent variables can influence the dependent variables.

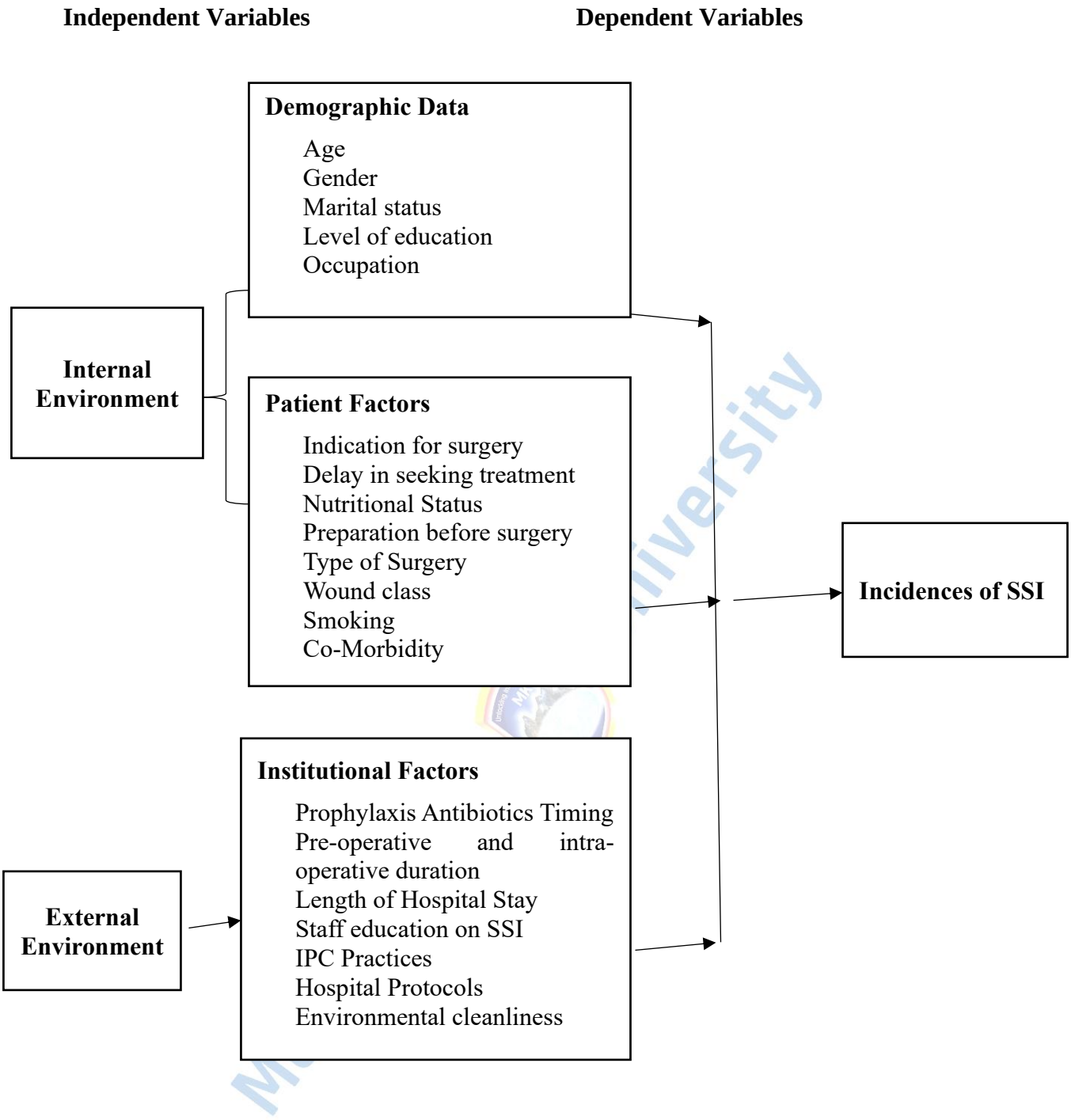


Figure 1:.Conceptual framework (Modified from CDC, 2020 guidelines)

2.4. Summary of Literature Review

There are many published research studies on Surgical Site Infections (SSI) post-laparotomy globally, but the African context, including Kenya, is under-studied. This is a concern because research helps in evidence-based practice, and relying on global findings in prevention and management of surgical wounds in a low economical settings may be misleading as their resource settings differ.

As detailed in the above literature review from different authors globally, regionally, and locally, different studies have different findings on SSI post-laparotomy. However, it is a global concern. Findings from low- and middle-income countries (LMICs) are exciting, as statistics, show SSI incidences are as high as 30%. This eventually translates to a high-cost impact on already economically strained settings. According to one author, SSIs are associated with a 2-to 11-fold increase in the risk of mortality, and 75% of SSI-associated deaths are directly attributable to the SSI. Other authors have also supported this, indicating a retrogression from the Sustainable Development Goal (SDG) 3, which addresses healthy lives and promotes well-being for all.

Based on several findings in this study, the most common isolated pathogens include Escherichia coli, Klebsiella pneumoniae, Staphylococcus aureus, and Enterococcus faecalis. Factors commonly associated with SSI, according to a majority of the findings, include preexisting conditions such as malignancy, diabetes, excess blood loss intraoperatively, hypotension, wound class, prolonged duration of the procedure, low hemoglobin, low albumin, high blood glucose, and emergency surgery. Prolonged operation duration and post-trauma laparotomy are also associated with SSI. Patients with SSI experience prolonged hospitalization and longer ICU occupancy times.

These findings show that post-laparotomy Surgical Site Infections status has not been studied exhaustively, as published literature has yet to reveal the actual situation in

developing countries, such as Kenya. Thika Level 5 Hospital represents a low-resource facility, and study findings on SSIs post-laparotomy are significant for generalizability. This was an essential guide to the researcher's current study.

Additional Insights and Gaps Identified

1. Lack of Context-Specific Data:

There is a clear gap in research specific to the African context, including Kenya. Many global studies do not account for the unique challenges faced by healthcare systems in these regions, such as limited resources, different healthcare practices, and varying patient demographics.

2. Economic Impact

High SSI rates in LMICs lead to increased healthcare costs, which are particularly burdensome to individuals, families and the community including economic strain for already strained healthcare systems. This includes costs related to extended hospital stays, additional treatments, and increased use of ICU facilities. The economic implications of high SSI rates need more focused research in African countries to develop cost-effective strategies for prevention and management. This is the very reason as to why this study is important.

3. Pathogen Variability

The prevalence of certain pathogens such as E. coli, K. pneumoniae, S. aureus, and E. faecalis might differ due to regional variations in microbial flora, antibiotic resistance patterns, and infection control practices. More localized studies can help in tailoring antibiotic stewardship programs and infection control protocols specific to the regional pathogen profiles.

4. Risk Factors

While many studies have identified common risk factors such as diabetes, malignancy, and intraoperative blood loss, the relative contribution of these factors might differ in resource-limited settings. Socioeconomic factors, nutritional status, and access to pre- and post-operative care could also play significant roles and need to be studied in the context of Kenyan healthcare facilities.

5. Impact on Patient Outcomes

The prolonged hospitalization and increased ICU stays associated with SSIs have a profound impact on patient outcomes. Studies focusing on the quality of life, long-term health consequences, and patient satisfaction in the context of post-laparotomy SSIs in Kenya are lacking and could provide valuable insights for healthcare providers and policymakers.

6. Strategies for Improvement

Research is needed to evaluate the effectiveness of different strategies for preventing and managing SSIs in low-resource settings. This includes the feasibility and impact of implementing advanced infection control measures, surgical techniques, and postoperative care protocols tailored to the local context.

Conclusion

The existing literature highlights the global concern of SSIs post-laparotomy but reveals significant gaps in understanding and addressing this issue in the African context, particularly in Kenya. Thika Level 5 Hospital serves as a representative case for studying these gaps and developing context-specific interventions for low resource settings. The current study aims to fill these gaps and provide evidence-based recommendations for improving surgical outcomes and patient care in resource-limited settings.

CHAPTER THREE

MATERIAL AND METHODS

3.1. Introduction

Methodology is the systematic, theoretical analysis of the methods applied to a field of study. It comprises analyzing the methods and principles associated with a branch of knowledge. This section will contain the study design, study location, target population, sampling techniques, sample size determination, data collection procedure, validity and reliability of the study, data management, and ethical consideration.

3.2. Study Design

To investigate the causes and rates of SSIs in patients who have had laparotomies at Thika Level 5 Hospital in Kiambu County, Kenya, researchers used analytical Cross-sectional study design. The study design was used because it is relatively cheaper compared to other study designs bearing in mind that the researcher did not have any financial support and was using out of pocket to support the project. The design was also suitable as it provided timely description of key items being studied in a short period as the researcher was bound to timelines of completing the study within the limited period.

3.2.1. Study Variables

Prevalence of SSI served as the dependent variable in the research, with patient- and hospital-related factors serving as the independent variables.

3.2.2. Independent Variables

Factors unique to the patient and those unique to the institution served as independent variables. A patient's demographics, nutritional status, surgery, comorbidities, smoking habits, and wound classification are all relevant variables.

Timing of prophylactic antibiotics, pre- and intra-operative duration, hospital stays, IPC practices, hospital protocols, staff education on surgical site infections (SSIs), and

environmental cleanliness are all aspects of an institution that might affect the risk of SSIs.

3.2.3. Dependent Variables

The Prevalence of surgical site infections among post laparotomy patients at Thika Level 5 Hospital were the study's dependent variable.

3.3. Location of Study

The hospital chosen for the research was Thika Level 5, which is located in Thika Sub-County of Kiambu County, Kenya. The institution lies approximately 300 meters from Thika's Central Business District (CBD) and is close to Mount Kenya University (MKU). Geographically, the hospital is situated at a latitude of -1.0424429 and a longitude of 37.07744.

Established in 1941 during the colonial era, the facility initially served as a sub-district hospital and has gradually grown to its current status as a Level 5 hospital. It now has a bed capacity of 500, including cots, and a catchment population of approximately 500,000 people. Thika Level 5 Hospital comprises three main sections: out-patient, in-patient, and reproductive health units.

The hospital acts as a referral center for lower-level facilities (Levels 2, 3, and 4), as well as private and faith-based institutions in the surrounding area. Furthermore, it serves as a training hospital for various medical teaching institutions, including medical and nursing students, among other cadres. The hospital offers a wide range of services that include preventive, promotive, curative, and rehabilitative health services.

3.4. Target Population

All hospital patients who underwent laparoscopic procedures throughout the research period were included. Roughly, 60% of all major procedures performed in the surgical

departments are laparotomies, accounting for about 110 cases each month. Total number of nursing staff deployed in the surgical and gynecological wards are sixty-eight nurses. The inclusion criteria is used to identify the research population in a reliable and consistent way. In contrast, the exclusion criteria determine which individuals or groups are not eligible for the study (Garg 2016).

3.4.1. Inclusion Criteria

All patients in surgical and gynecology units of Thika's level 5 hospital who had undergone a laparotomy were included in the research since they had the characteristics required for the study and all the variables of interest were available.

3.4.2. Exclusion Criteria

Patients who underwent laparotomy elsewhere and were referred to Thika Level 5 Hospital for follow-up care were not eligible to participate in the research since some variables that were critical for the study was missing such as preparation of patient before surgery. In addition, those who were critically ill or had unstable medical conditions were excluded because they could not consent due to their unstable health condition.

3.5. Sampling Techniques

Andrade (2020) suggests that researchers use correct sampling techniques before entering a study. Therefore, it is essential that the sample accurately reflect the whole population. The study relied on systematic random sampling to guarantee that the study's sample accurately reflects the population as a whole. The first participant was randomly selected while the other participants were selected at a specified interval of one. The study hence identified the one hundred and sixty one patients using the following sequence 1, 3, 5, 7, 9, 11, etc.

3.6. Sample Size Determination

According to Bhardwaj et *al.* (2024), it is crucial to understand how to calculate a sample size for various research designs. Different sample size calculation methods are significant depending on study design and stated variables of interest that are used in the study.

Since the number of laparotomy patients at TL5H are yet to be discovered, the study relied on Cochran's (1977) calculation for an infinite population.

Given the lack of reported SSI rates in hospitals, the researcher used a value of 0.5 as a proportion of patients affected by SSI.

To determine what constitutes a statistically valid sample size for proportions, Cochran (1977) proposed the following formula:

$$n_o = \frac{Z^2 pq}{e^2}$$

The sample size is denoted by n_o.

At a 95% confidence level, Z = 1.96 is the crucial number that was chosen.

p - Proportion of an attribute that is present in the population, denoted by q = 1-p

e- Permissible threshold of sample error 0.05.

$$n_o = \frac{1.96^2 \times 0.5 \times 0.5}{0.05^2} = 384.16$$

This results is a sample size of 385.

A further formula by Fisher et al. was applied since the population size is smaller than 10,000, to find the optimal sample size.

$$nf = \frac{n}{1+\frac{n}{N}}$$

Where: nf = the target sample size; n = the actual sample size

N - Predicted total number of people.

Approximately 110 laparotomies are performed each month in surgical and gynecology departments. The study lasted for three months, and the researcher had estimated that 330 laparotomies would be performed during that time:

$$nf = \frac{385}{1+\frac{385}{330}}$$

$$nf = 177.4$$

$nf = 178$ Patients

The sample size was increased by 10%, to 196 patients, to account for dropouts and minimize bias.

3.7 Data Collection and Research Instruments

According to Garg (2016), the research team needs study instruments that are understandable and easy to use. They should be appropriate for the study and address the research objectives.

As stated by the CDC (2016), patient-based surveillance is essential for SSI monitoring. Medical records, surgical clinics, patient files, laboratory and imaging, patient questionnaires through mail and telephone, and other post-discharge surveillance measures was used to track down and investigate SSIs after patients have been released from the hospital.

Quantitative data on patient-related variables and institutional factors as SSI predictors were collected using a structured questionnaire designed by CDC guidelines and recommendations. Patients were identified and selected for interview during their follow- up clinic at two weeks. A checklist tool for SSI surveillance, and hospital policies and staff training for preventing and managing SSIs was used to evaluate hospital protocols.

3.8 Pretesting of Data Tools

3.8.1 Validity

To obtain accurate findings, research instruments must be validated to determine how well they measure the construct of interest. The researcher tested the data tool in Kiambu County's level 5 hospital due to its equivalent status in the Kenyan healthcare hierarchy as Thika level 5 hospital. The questionnaires utilized for the pretest were a total of twenty (20), which was 10% of the total number of desired sample size, calculated from a total sample size of. 196. The researcher evaluated data tools to comprehend the intent of the questions and language used and how they relate to study objectives. The errors found were fixed accordingly.

3.8.2 Reliability

An assessment tool's reliability produces stable and consistent results with minimal error. The researcher tested the instruments to ensure they were reliable, sensitive, and specific. The split-half Cronbach's alpha test was used to calculate instrument reliability, and instruments were calibrated to an alpha of 0.7

3.9 Data Management and Analysis

The questionnaire was double-checked for accuracy and completeness before the data was coded and entered into a computer. Statistical Package for the Social Sciences (SPSS) version 25.0 was used for the analysis. The study used descriptive and inferential analysis to analyze the objectives. In descriptive analysis, it provided frequencies and percentages, while inferential analysis was to test the correlation between variables; the researcher utilized the chi-square test for associations, with a p-value less than 0.05.

3.10 Ethical Consideration

Respect for individual autonomy, beneficence, non-maleficence, confidentiality, and justice are fundamental ethical concepts that Bhaskar et al. (2016) identify that must be upheld in any study involving human subjects.

The researcher assured beneficence by checking that the study's outcome benefits the participants directly or indirectly. The results will be sent to the appropriate body to facilitate their implementation.

Accordingly, by the non-maleficence principle, the researcher ensured priority of the well-being of patients and other study participants to minimize their risk of purposeful injury as they participated in the study.

To be just, the researcher made sure that participants in the study were equally distributed and as well, as benefits.

No identifying information, such as names or addresses, was required in the data-collecting tool. Before participating in the research, all respondents were asked to sign an informed consent form to ensure their confidentiality. No one was forced to take part against his or her will.

Mount Kenya University's Ethical Research Committee (ERC), Kenya's National Commission for Science, Technology, and Innovation (NACOSTI), and Kiambu County's Health Management Team (CHMT) granted permission for the study to be conducted. The researcher also applied for permission from the ethical committee at TL5H and notified the unit managers of the study's purpose to solicit their cooperation.

CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION OF FINDINGS

4.1 Introduction

This chapter presents the results to address the research objectives related to the Prevalence of surgical site infections (SSIs) among post laparotomy patients at Thika Level 5 Hospital, Kiambu County. The analysis focuses on three main aspects: the overall Prevalence of SSIs, patient-related factors influencing SSIs, and institutional-related factors influencing SSIs. The study employed descriptive and inferential statistical analysis.

4.2 Response Rate

According to Quiera S *et al*, (2021),tough there's no published cusp for defining adequate rate of response, 80% or higher is an excellent response for ensuring good validity and reliability. The response rate for Thika level 5 study was 161 out of 196, indicating a participation rate of approximately 82%. The response rate reflects a substantial participation rate among post laparotomy patients laparotomy in the surgical and gynecology units of Thika's level 5 hospitals. This high response rate suggests a significant level of engagement and cooperation from the patients included in the study. It indicates a strong willingness among the participants to contribute to the research by providing relevant information about their experiences with laparotomy and any occurrences of surgical site infections (SSIs).

4.3 Reliability Analysis

Reliability analysis was conducted to assess the internal consistency of the research instrument using Cronbach's Alpha. A higher Cronbach's Alpha value (≥ 0.7) indicates good reliability, ensuring that the measurement tool consistently captures the intended data. Table 1 presents the reliability scores for the key variables in this study.

TABLE 1: RELIABILITY ANALYSIS

Test Item	Cronbach's Alpha	N of Items
Determination of the incidence of SSIs among post laparotomy patients in the surgical unit at Thika level 5-hospital	.852	2
Establishment of the patient-related factors that influence SSIs among post laparotomy patients in the surgical unit at Thika level 5 hospital	.932	10
Determination of the institutional-related factors that influence SSIs among post laparotomy patients in the surgical unit at Thika level 5 hospital	.785	6
Total	**.856**	**18**

The reliability analysis revealed that all subscales exceeded the minimum threshold of 0.7, indicating good to excellent internal consistency across the instrument. Notably, the subscale measuring patient-related factors demonstrated the highest reliability with a Cronbach's Alpha of 0.932, reflecting a very high level of internal consistency among its ten items. Despite comprising only two items, the subscale on institutional-related factors also showed a respectable reliability score of 0.785, which is commendable given that reliability often decreases with fewer items. The overall reliability of the entire instrument, measured across 18 items, yielded a Cronbach's Alpha of 0.856, affirming the robustness and consistency of the tool. These findings confirm that the research instrument is both reliable and suitable for measuring factors associated with Surgical Site Infections (SSIs) among post-laparotomy patients at Thika Level 5 Hospital.

4.4 Demographic Data

Surgical Male ward had 72 patients (44.7 of the total). Surgical Female 2 had 41 patients, making up 25.5% of the total, indicating a significant number of female surgical patients. Gynecological Female 6 had 48 patients, representing 29.8% of the total. The gender split was relatively balanced with a slight female majority (52.8%). The patients' education levels varied from primary to tertiary

Table 2: Demographic Data

Test Item	Category	Frequency	Percent
Ward/Unit	Surgical Male	72	44.7
	Surgical Female 2	41	25.5
	Gynecological Female 6	48	29.8
Age	25-34	16	9.9
	35-44	32	19.9
	45-54	64	39.8
	Above 55 years	49	30.4
Gender	Male	76	47.2
	Female	85	52.8
Education	Primary	49	30.4
	Secondary	68	42.2
	Tertiary	44	27.3

Figure 2: Ward/Unit of the respondent

In terms of the age of patients ranged from 25 years to above 55, showing a wide age distribution. This was graphically presented on the column bar below.

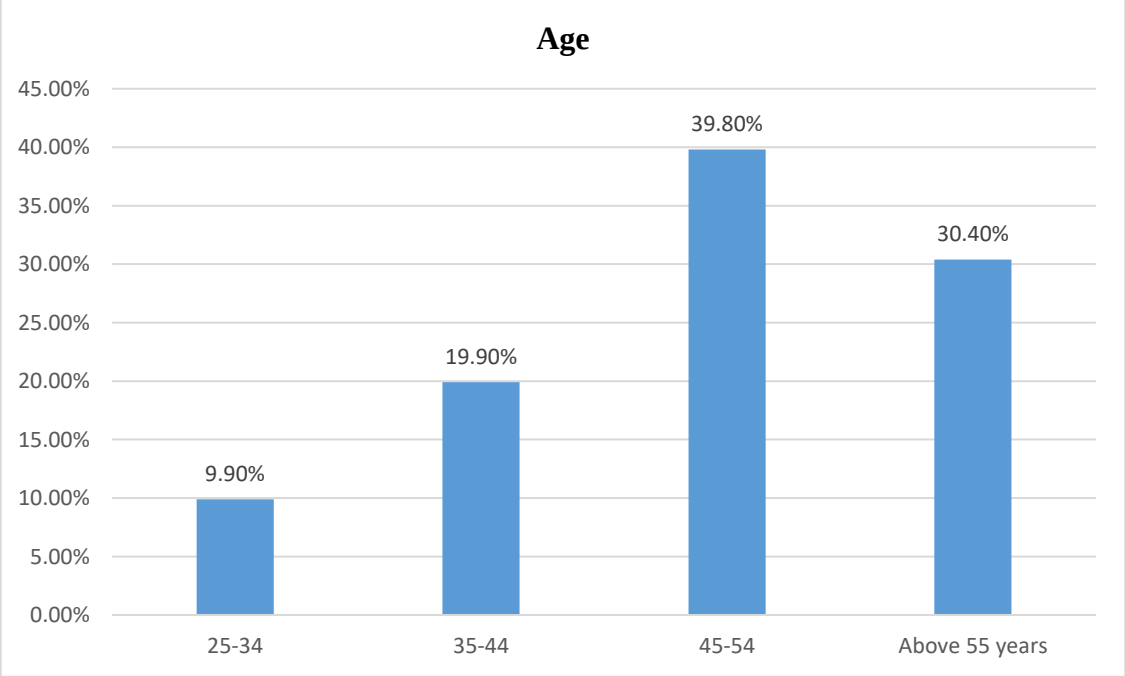


Figure 3: Age of the respondent

4.5 Prevalence of SSIs among Post Laparotomy Patients in the Surgical Unit

4.5.1 Prevalence of SSIs among Post Laparotomy Patients

Of the total 161 patients, 24 developed SSI, which accounts for 14.9% of the total. The majority, 137 patients (85.1%), did not develop SSI. Based on these figures, SSI occurred in a minority of patients in this study or population.

The table below presents data on whether patients developed Surgical Site Infections (SSI) after surgery.

Table 3: Surgical Site Infections development

		Frequency	Percent
Yes		24	14.9
No		137	85.1
Total		161	100.0
IF Yes SSI occurred	0-7 days	19	79.2%
	8-14 days	5	20.8%

Among the patients who developed SSIs, the majority, 19 out of 24 cases (79.2%), experienced infection within the first 0-7 days post-surgery. A smaller proportion, 5 cases (20.8%), developed infections between 8-14 days after surgery.

Below is a graphically represented of Surgical Site Infections development showing minority developed SSI with 14.9%

4.5.2 Symptoms of SSIs among Post Laparotomy Patients in the surgical unit among patients who developed surgical site infections

The symptoms reported among those with SSIs varied. Swelling or inflammation was observed in 8 cases (33.3%), while pain, tenderness, and fever were each reported in 4 cases (16.7%). Notably, there was no redness or erythema at the operation site, abscess formation, wound bursting, or identified pathogens through culture. However, pus

drainage from the surgical site was noted in 8 cases (33.3%). No other symptoms were reported in this group.

Table 3 presents data on the symptoms of surgical site infections (SSIs) observed among patients who underwent laparotomy in the surgical unit, detailing the timing of infection onset and associated symptoms

Table 4: Symptoms of SSIS among Post Laparotomy Patients in the surgical unit among patients who developed surgical site infections

Test Item		F	%
Symptom	Swelling or inflammation	8	33.3%
	Pain or tenderness	4	16.7%
	Fever	4	16.7%
	Redness or Erythema at operation site	0	0.0%
	Pus drainage from the surgical site	8	33.3%
	Abscess	0	0.0%
	Wound burst	0	0.0%
	Identified pathogen through culture	0	0.0%
	Other	0	0.0%

4.6 Patient-related Factors that Influence SSIs among Post Laparotomy Patients. Indication

The second objective was to determine patient-related Factors that Influence SSIs among post Laparotomy Patients and the results were presented as below.

4.6.1 Indication/ surgical diagnosis that led to laparotomy

Cross-tabulation was performed on the data on the indications or surgical diagnoses that led to laparotomy. Their corresponding rates of surgical site infection (SSI) provide a detailed view of how different conditions are associated with SSIs. This information can

be critical for understanding patterns and improving surgical care and infection control practices.

Findings indicated that peritonitis had the highest SSI rate at 25.0%, indicating a significant risk of infection and requiring rigorous infection control measures. Intestinal obstruction also had a high SSI rate of 20.8%, suggesting the need for careful postoperative management. Blunt abdominal trauma, hernia, and uterine fibroids had no SSIs reported, which could reflect effective surgical techniques and perioperative care specific to these conditions. Conditions such as appendicitis (8.3%), benign tumors (4.2%), and ovarian cystic conditions (12.5%) showed moderate SSI rates. Perforated PUD (16.7%) and other conditions (12.5%) had slightly higher SSI rates, though still lower than those for peritonitis. and intestinal obstruction did.

This cross-tabulation highlights the variability in SSI rates depending on the surgical indication for laparotomy and underscores the importance of targeted infection prevention strategies, tailored postoperative care, and continuous monitoring to mitigate the risk of SSIs, thereby improving patient outcomes.

Table 5: Cross tabulation on the Indication/ surgical diagnosis that led to laparotomy

Indicator			SSI Yes	SSI No	Total
Indication	Intestinal obstruction	F	5	9	14
		%	20.8%	6.6%	8.7%
	Brunt abdominal trauma	F	0	12	12
		%	0.0%	8.8%	7.5%
	Appendicitis	F	2	23	25
		%	8.3%	16.8%	15.5%
	Benign Tumors	F	1	12	13
		%	4.2%	8.8%	8.1%
	Peritonitis	F	6	3	9
		%	25.0%	2.2%	5.6%
	Hernia	F	0	28	28

		%	0.0%	20.4%	17.4%
	Perforated PUD	F	4	8	12
		%	16.7%	5.8%	7.5%
	Uterine fibroids	F	0	17	17
		%	0.0%	12.4%	10.6%
	ovarian cystic condition	F	3	18	21
		%	12.5%	13.1%	13.0%
	Others (Cancers of blander, cervix, endometrium and ectopic pregnancy)	F	3	7	10
		%	12.5%	5.1%	6.2%
Total		F	24	137	161
		%	14.9%	85.1%	100.0%

4.6.2 Rating on Patient-related Factors that Influence SSIs among Post Laparotomy Patients.

Table 6 offers valuable insights into the patient-related factors influencing the occurrence of surgical site infections (SSIs) in individuals who underwent laparotomy. Each test item within the table addresses different variables, such as delays in seeking medical attention, blood glucose levels, type of surgery, wound category, smoking status, medical conditions, and transfusions, shedding light on their potential impacts on SSIs.

Delays in seeking medical attention were prevalent among patients, with 87 (54.0%) experiencing delays before undergoing laparotomy, potentially correlating with an increased risk of SSIs, especially among those delaying for more than six weeks, as noted in 36 cases (42.9%). Blood glucose levels were mainly within the normal range for most patients (81, 50.3%), although monitoring gaps were evident in 76 cases (47.2%). Emergency surgeries were more common (85, 52.8%) than elective surgeries (76, 47.2%), possibly indicating higher SSI risks due to the urgency and compromised patient health associated with emergency procedures.

Wound categorization revealed that Class 1 wounds (clean) were predominant (89, 55.3%), followed by Class 2 (clean-contaminated) wounds (52, 32.3%), suggesting

varying degrees of wound contamination that could influence SSI rates. Smoking status, with only a minority of patients being smokers (24, 14.9%), hinted at a potential association between smoking and increased SSI risk, warranting further investigation. The results also indicated that there is a statistically significant relationship between co-morbidity and the Prevalence of SSIs. Moreover, underlying medical conditions were present in a subset of patients (32, 19.9%), with hypertension being the most prevalent (22, 68.8%), followed by diabetes, ulcers, and dysfunctional uterine bleeding (DUB. Similarly, (Mukamuhirwa 2017) performed a prospective analysis, and the results indicated an association between co-morbidity and SSIs.

Finally, a considerable proportion of patients received transfusions (40, 43.0%); possibly indicative of more complex surgical procedures or underlying medical conditions necessitating blood transfusions.

Findings provides a comprehensive overview of patient-related factors and their potential implications for SSI development following laparotomy. Understanding these factors is crucial for identifying high-risk patients, implementing targeted preventive measures, and optimizing postoperative care to reduce SSI occurrences and enhance patient outcomes

Table 6: Rating on Patient-related Factors that Influence SSIs among Post Laparotomy Patients.

Test Item		F	%
Delay	Yes	87	54.0%
	No	74	46.0%
How long if they delayed	Less than a week	20	23.8%
	2- 3 weeks	12	14.3%
	above 6	36	42.9%
	4-6 weeks	8	9.5%
	one-2wks	8	9.5%
Total		**87**	**54.0**
blood Glucose Levels	Normal range	81	50.3%
	Hyperglycemia	4	2.5%
	Hypoglycemia	0	0.0%
	not performed	76	47.2%
Type of Surgery	Emergency	85	52.8%
	Elective	76	47.2%
Wound category	Class 1: Clean	89	55.3%
	Class 2: Clean-contaminated	52	32.3%
	Class 3: Contaminated	12	7.5%
	Class 4: Dirty	8	5.0%
Cigarettes smoking	Yes	24	14.9%
	No	137	85.1%
Medical Condition	Yes	32	19.9%
	No	129	80.1%
Which medical condition if yes	Diabetes	8	25.0%
	Cancer	0	0.0%
	Hypertension	22	68.8%
	HIV	0	0.0%
	Ulcers	1	3.1%
	DUB	1	3.1%
Total		**32**	**100.0%**
Transfused	Yes	40	43.0%
	No	53	57.0%

4.6.3 Inferential Analysis on the patient-related Factors that Influence SSIs among Post Laparotomy Patients.

This section presents the inferential analysis of patient-related factors that influence surgical site infections (SSIs) among patients who have undergone laparotomy, with the

results summarized in Table 7. This table displays the outcomes of Chi-square tests, which help determine whether there are significant associations between various patient-related factors and the Prevalence of SSIs.

The Chi-square test results indicate statistically significant associations between the patient-related factors and the Prevalence of SSIs among patients who underwent laparotomy. The highly significant $\chi 2 = 0.000$ across different tests (Pearson et al. and Linear-by-Linear Association) suggest that the patient-related factors studied substantially influence the likelihood of developing SSIs.

This inferential analysis highlights the importance of considering various patient-related factors in clinical settings to identify and mitigate SSI risks. The significant associations underscore the need for targeted interventions based on these factors to improve surgical outcomes and reduce infection rates.

Table 7: Chi square test on the patient-related Factors that Influence SSIs among Post Laparotomy Patients.

Chi-Square Tests			
	Value	**Df**	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	37.090[a]	10	.000
Likelihood Ratio	31.497	10	.000
Linear-by-Linear Association	12.222	1	.000
N of Valid Cases	161		

The prevalence of delays in seeking medical attention before surgery aligns with findings from studies by (Jack *et al.* 2022), which identified delays as a significant risk factor for postoperative infections.

Furthermore, the association between blood glucose levels and SSI risk corroborates findings from research by (Takesue and Tsuchida 2017), highlighting the importance of glycemic control in reducing postoperative complications. Similarly, the significance of

wound category and type of surgery in influencing SSIs echoes conclusions from studies by (Bucataru *et al*. 2024), emphasizing the need for tailored preventive strategies based on surgical and wound characteristics.

Moreover, recent studies have highlighted the role of other patient-related factors, such as nutritional status, immunocompromised conditions, and antibiotic prophylaxis, in influencing SSI rates. Incorporating insights from these studies into clinical practice can further enhance the understanding of SSI risk factors and inform targeted preventive measures.

By aligning with and expanding upon previous research, this study contributes to a growing body of evidence on patient-related factors influencing SSIs among laparotomy patients, providing valuable insights for clinicians and healthcare professionals to optimize infection prevention strategies and improve surgical outcomes.

4.7 Institutional-related Factors that Influence SSIs among Post Laparotomy Patients.

The third object was to determine the institutional-related Factors that Influence SSIs among Patients undergoing Laparotomy. This section focuses on identifying institutional-related factors that influence the Prevalence of surgical site infections (SSIs) in patients who have undergone laparotomy. The findings are presented through both descriptive analysis and inferential results.

4.7.1 Descriptive analysis on the institutional-related Factors that Influence SSIs among Post Laparotomy Patients

Table 8 below provides a comprehensive breakdown of respondents' ratings on various institutional factors that may influence SSIs among laparotomy patients. These factors include the timing of prophylaxis administration, patient stay duration before and after

surgery, the duration of the operation, and the frequency of nurses' hand hygiene practices observations.

The study examined several institutional factors influencing surgical site infections among post-laparotomy patients at Thika Level 5 Hospital. Regarding the administration of prophylactic antibiotics, 68 patients (42.3%) received them within 30 minutes, 24 patients (14.9%) received them more than an hour before surgery, and 16 patients (9.9%) did not receive any antibiotics. For 53 patients (32.9%), antibiotics were not indicated.

Regarding patient stays before surgery, 145 patients (90.1%) stayed for 0–3 days, 16 patients (9.9%) stayed for 4–7 days, and none stayed for 8–14 days or more than 15 days. The length of the operation also varied, with 20 patients (12.4%) having surgeries lasting 0.5–1 hour, 65 patients (40.4%) having surgeries lasting 1–2 hours, 44 patients (27.3%) having surgeries lasting 2–3 hours, and 32 patients (19.9%) undergoing surgeries that lasted more than 3 hours.

Post-surgery, 61 patients (37.9%) stayed for 1–3 days, 88 patients (54.7%) stayed for 4–7 days, 12 patients (7.5%) stayed for 8–14 days, and no patients stayed for more than 15 days. Regarding hand hygiene observance among nurses, 40 nurses (24.8%) always observed hand hygiene, eight nurses (5.0%) did so rarely, none of the nurses observed hand hygiene, 77 nurses (47.8%) used gloves, and 36 nurses (22.4%) were not sure about their hand hygiene practices. . A majority of patients (73.9%, 119 patients) had a total hospital stay length between 4 to 7 days.

Table 8: Institutional-related Factors that Influence SSIs among Post Laparotomy Patients

Institutional factor		F	%
When was Prophylaxis antibiotics administered	Within 30 minutes	68	42.3%
	More than 1 hour	24	14.9%
	Not administered	16	9.9%
	not indicated	53	32.9%
How long patient stayed before surgery	0 – 3 days	145	90.1%
	4-7	16	9.9%
	8-14	0	0.0%
	More than 15	0	0.0%
How long operation took	0.5-1	20	12.4%
	1-2	65	40.4%
	2-3	44	27.3%
	More than 3	32	19.9%
How long patient stayed after surgery	1-3	61	37.9%
	4-7	88	54.7%
	8-14	12	7.5%
	more 15	0	0.0%
How often do nurses observe hand hygiene	Always	40	24.8%
	Rarely	8	5.0%
	Never	0	0.0%
	used gloves	77	47.8%
	not sure	36	22.4%
Total Length of hospital stay	below 3 days	10	6.2%
	4-7 days	119	73.9%
	Over 7 days	32	19.9%

As identified in this study, the institutional factors influencing SSIs among laparotomy patients resonate with findings from existing research in the field. For instance, the timing of prophylaxis administration, highlighted in Table 8, echoes the significance of timely antibiotic prophylaxis in preventing SSIs, a notion supported by studies such as (Hanfi et al. 2024). Similarly, the duration of patient stay before and after surgery, and the duration of the operation aligns with studies by (Cheng et al. 2017), underscoring the impact of hospital stay duration and operation length on SSI rates.

Evaluation of Protocols and Training for Surgical Site Infections Prevention

Table 9 presents the findings from a checklist evaluating various protocols and training aspects related to SSIs (surgical site infections) in the surgical and gynecology units. Each item was assessed for its presence (Yes) or absence (No) and includes comments where applicable.

The table outlined the adherence to various infection prevention and control (IPC) protocols, environmental cleaning and SSI surveillance protocols across different departments based on a checklist of items. Each row represents a specific protocol or training metric, with columns indicating whether the protocol is followed (Yes or No) and any relevant comments. The numbers under the "Yes" and "No" columns represent the number of wards or departments meeting or not meeting each criterion.

For example, the row for "SSI Surveillance protocols" shows that none of the departments assessed (0) adhered or had these protocols, as indicated by the four departments that failed to meet this criterion (4 under No). This suggests that no nurse had training on SSI (Surgical site infection) surveillance protocols in all four assessed wards. Similarly, "IPC protocols" were adhered to in three departments but not in one (3 Yes, 1 No).

"Environmental Cleaning Protocols" were present in only two departments, with the other two failing to comply (2 Yes, 2 No). No departments had visible protocols for "Surgical Hand Scrub" or "Follow Up" procedures, as indicated by four "No" responses each. Prophylaxis Antibiotics protocols is a key factor in SSI Prevention but was available in only one department (1 Yes, 3 No).

Training logs were also reviewed to assess the number of nurses trained in various IPC and SSI related areas. For SSI, only one nurse in one department was trained across all departments, meaning three departments had no trained nurse on SSI (1 Yes, 3 No, Comment: 1 Nurse). In contrast, all departments had at least one nurse trained in IPC

protocols, totaling five trained nurses (4 Yes, 0 No, Comment: 5 Nurses). Again, only one nurse was trained for wound care, leaving three departments needing trained personnel (1 Yes, 3 No, Comment: 1 Nurse).

The table highlights significant gaps in implementing critical infection control protocols and training across departments. The predominant issue is the lack of adherence to SSI surveillance and prophylaxis antibiotic protocols, alongside a substantial need for more comprehensive training of nursing staff in these essential areas.

Table 9: Evaluation of Protocols and Training for Surgical Site Infections Prevention

Checklist Item per department	Departments with Protocols and Trainings	Departments without Protocols and Trainings	Comment
SSI Surveillance protocols		4	
IPC protocols	3	1	
Environmental Cleaning Protocols	2	2	
Surgical Hand Scrub protocols (check displays)		4	
Prophylaxis Antibiotics protocols	1	3	
SSI Follow Up protocols		4	
Number of Nurses Trained on SSI (check training log)	1	3	1 Nurse
Number of Nurses Trained on IPC (check training log)	4		5 Nurses
Number of Nurses Trained on Wound Care (check training log)	1	3	1 Nurse

4.7.2 Inferential analysis on the institutional-related Factors that Influence SSIs among Post Laparotomy Patients

In this section of the study delves into inferential analysis concerning institutional-related factors that potentially affect the Prevalence of surgical site infections (SSIs) among patients who underwent laparotomy. The findings are elucidated through statistical analysis, particularly utilizing the Chi-square test, as presented in Table 10.

The results of a Chi-square test assessing the relationship between institutional-related factors and surgical site infections (SSIs) among laparotomy patients. The analysis reveals significant associations, as indicated by the calculated Pearson Chi-Square value of 79.298, Likelihood Ratio value of 65.489, and Linear-by-Linear Association value of 50.263, all with corresponding p-values < 0.001. These findings suggest a strong link between institutional factors and SSIs, implying that changes in institutional practices, protocols, and training are likely to influence the occurrence of SSIs among laparotomy patients. The analysis was conducted on a robust sample of 161 valid cases, ensuring the reliability and generalizability of the statistical findings.

Table 10: Chi square test on the institutional-related Factors that Influence SSIs among Post Laparotomy Patients

Chi-Square Tests

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	79.298[a]	5	.000
Likelihood Ratio	65.489	5	.000
Linear-by-Linear Association	50.263	1	.000
N of Valid Cases	161		

The results of the Chi-square test provide compelling evidence of a significant association between institutional-related factors and the Prevalence of SSIs among patients undergoing laparotomy. These findings underscore the importance of addressing institutional factors, such as protocols, training, and practices, to effectively mitigate the risk of SSIs and enhance patient outcomes in surgical settings. Further investigation and targeted interventions based on these results may contribute to improved infection control measures and patient care protocols within healthcare institutions.

By contextualizing the study's findings within the broader research landscape, this study strengthens the understanding of institutional-related factors influencing SSIs among

laparotomy patients. The alignment with previous research underscores the consistency and relevance of the identified factors, emphasizing the imperative for targeted interventions and quality improvement initiatives in healthcare institutions to mitigate the Prevalence of SSIs and enhance patient safety.

4.8 Hypotheses testing

4.8.1 Null Hypothesis 1

Null Hypothesis 1 stated that there is no statistically significant relationship between patient-related factors and Prevalence of SSI among post laparotomy patients. However, the findings showed there was a statistically significant relationship between patient-related factors (nutritional status, smoking, and pre-existing medical condition) and Prevalence of SSI among patients who underwent laparotomy procedures. Therefore, the null hypothesis was rejected.

Alternative hypothesis indicated that there was a statistically significant relationship between patient related factors and prevalence of SSI among post laparotomy patients hence was accepted

4.8.2 Null Hypothesis 2

Null Hypothesis 2 stated that there is no statistically significant relationship between institutional-related factors and Prevalence of SSI among post laparotomy patients. However, the findings shows there was a statistically significant relationship between institutional-related factors (hospital stay, intra-operative period, and hand hygiene) and Prevalence of SSI among patients who underwent laparotomy procedures. Therefore, the null hypothesis was rejected.

Alternative hypothesis indicated that there was a statistically significant relationship between institutional related factors and prevalence of SSI among post laparotomy patients hence was accepted

4.9 Discussion of findings

4.9.1 Prevalence of SSIs among Post Laparotomy Patients

The study conducted at Thika Level 5 Hospital found a Prevalence of surgical site infections (SSIs) among laparotomy patients to be 14.9% (24 out of 161 patients). This finding is consistent with the literature; for instance, the World Health Organization (WHO) conducted a comprehensive literature review on SSI in low- and middle-income countries (LMICs) and found an overall of 11.2% (WHO, 2016). Similarly, (Lubega, Joel, and Justina Lucy 2017) reported an SSI occurrence of 16.4% among emergency postoperative patients in Uganda. These studies demonstrate a comparable range of SSI incidence rates across different regions.

The prevalence rate of 14.9% in this study is also comparable to other findings in the literature. For instance, a study by (De Simone *et al.* 2020) found an SSI incidence of 11.5% among abdominal surgery patients. (Marusic *et al.* 2021) reported rates ranging from 2.6% to 20% depending on the type of surgery and patient risk factors. This consistency across studies strengthens the reliability of the observed incidence rate and suggests that it reflects a genuine representation of SSIs in post-laparotomy patients.

Furthermore, the symptoms and timing of SSIs identified in this study align with other research. Swelling, inflammation, and pus drainage are commonly reported symptoms of SSIs, consistent with findings from (Bucataru *et al*, 2023) and other studies. This convergence of symptoms across studies reinforces the understanding of typical SSI presentations and aids in early detection and intervention.

Regarding the timing of SSI occurrence, the Thika Level 5 Hospital study on determinants of SSI among post laparotomy patients in the surgical department found that 79.2% of SSIs occurred within 0-7 days post-surgery. This observation is consistent with previous literature, indicating that a significant proportion of SSIs occur early after

surgery. (Mukagendaneza *et al.* 2019) reported a similar trend in Rwanda, where most SSIs occurred within the first-week post-surgery. This highlights the critical importance of immediate postoperative surveillance and care to detect and manage SSIs early, thereby minimizing their impact on patient outcomes.

Furthermore, the common symptoms associated with SSIs identified in the Thika level 5-hospital study, such as swelling or inflammation, pain or tenderness, fever, and pus drainage from the surgical site, align with findings from previous research. For example, (Mahajan et al. 2020) reported similar symptoms among patients who developed SSIs in India. These symptoms serve as important indicators of postoperative complications, emphasize the need for vigilant monitoring, and prompt intervention to address SSIs effectively.

4.9.2 Patient-Related Factors that Influence SSIs among Post laparotomy Patients

The Thika Level 5 Hospital study revealed several patient-related factors that influence surgical site infections (SSIs) among post laparotomy patients. For instance, the study indicated that delays in seeking treatment before hospital admission were prevalent, with over half of the patients (54%) experiencing such delays. Statistical analysis confirmed a significant relationship between delay and the Prevalence of SSIs ($p < .001$). Among those experiencing delays, a substantial portion waited more than six weeks (41.3%) before seeking treatment. This finding resonates with existing literature. Isbell *et al.* (2021) investigated emergency laparotomy patients and found that delays in treatment were associated with an increased risk of SSIs, consistent with the Thika study's results. Similarly, the study highlighted the impact of delays in seeking treatment on SSIs among laparotomy patients, emphasizing the importance of prompt medical intervention to mitigate SSIs.

Additionally, the study identified the significance of wound classification in influencing SSIs among laparotomy patients. Most wounds were classified as clean (55.3%), and statistical analysis confirmed a significant relationship between wound category and the Prevalence of SSIs ($p < .001$). This finding aligns with (Utsumi et al. 2022), who reported that wound class was a risk factor for SSIs in both open laparotomy and laparoscopic procedures. They emphasized the need for vigilant wound management to reduce the risk of SSIs, which is consistent with the implications of wound classification observed in the Thika study.

Moreover, the study highlighted the association between specific patient characteristics, such as nutritional status and existing medical conditions, and the Prevalence of SSIs. The study found a significant relationship between nutritional status and SSIs ($p = .006$), as well as between existing medical conditions and SSIs ($p < .001$). This finding is supported by (Tabiri et al. 2018), who identified patient characteristics such as sex and ASA score as predictors of SSIs among abdominal surgery patients. They emphasized the importance of considering patient-specific factors in SSI prevention strategies, reflecting the implications of nutritional status and existing medical conditions observed in the Thika study.

The significant associations found through Chi-square tests in this study highlight the importance of timing and symptoms, paralleling conclusions from studies by (Hou *et al.* 2023) which emphasize early postoperative monitoring and intervention to prevent SSIs. By corroborating these findings, this study underscores the importance of vigilant postoperative care and tailored interventions to mitigate the risk of SSIs effectively.

Moreover, it is worth noting that while the Prevalence rates may vary slightly across studies, the consistent identification of critical symptoms and risk factors underscores their importance in SSI prevention. For example, this study's absence of redness or

erythema aligns with previous research emphasizing the importance of considering multiple symptoms rather than relying solely on visual cues for SSI diagnosis.

Additionally, studies such as that by (Dhole et al. 2023) have highlighted the role of microbial colonization in SSIs and the significance of intraoperative and postoperative antimicrobial prophylaxis in reducing SSI rates. Incorporating these insights into clinical practice can further enhance SSI prevention strategies.

4.9.3 Institutional-Related Factors that Influence SSIs among Post Laparotomy Patients

The study highlighted institutional-related factors, including emergency surgeries and prolonged operation duration, as significant predictors of SSI Prevalence at Thika Level 5 Hospital. The study revealed that the timing of prophylaxis antibiotics administration significantly affected the Prevalence of SSIs, with administration within 30 minutes before surgery associated with a lower risk of infection. This finding aligns with previous research conducted in Saudi Arabia, which identified an open surgical technique, emergency surgeries, and prolonged operation duration as primary predictors of SSIs (Bucataru *et al*, 2023). Both studies emphasize optimizing perioperative antibiotic protocols to reduce infection risk and improve patient outcomes.

Furthermore, there was a strong correlation between the length of stay before surgery and the risk of developing SSIs. Patients with a longer preoperative stay (4-7 days) were at a much higher risk of SSIs compared to those with a shorter stay (0-3 days). The study found that the length of hospital stay before and after surgery was significantly associated with SSIs, with shorter stays correlating with lower infection rates. This corroborates findings from a Brazilian retrospective analysis, which identified prolonged hospital stays as a risk factor for SSIs (Hou *et al.* 2023). These findings underscore the importance of

streamlining preoperative and postoperative care processes to minimize the duration of hospitalization and reduce the risk of nosocomial infections.

Moreover, the duration of the operation intra-operatively was found to significantly influence the Prevalence of SSIs, with longer surgeries associated with higher infection rates. This aligns with existing literature emphasizing the impact of surgical complexity and prolonged surgery time on SSI risk (Cheng *et al*. 2017). The current study underscores the importance of efficient surgical techniques and meticulous intraoperative management in mitigating infection risk.

The study highlighted the importance of nurses' hand hygiene practices during patient care, with proper hygiene protocols significantly associated with lower SSI rates. This finding underscores the crucial role of healthcare workers in infection prevention and control, echoing recommendations from previous studies (AlJohani et al. 2021). The current study underscores the importance of comprehensive infection control measures in reducing SSIs among laparotomy patients by emphasizing the significance of adherence to hand hygiene guidelines.

The findings significantly affect the hospital's management of Surgical Site Infections (SSIs) among patients. The lack of adherence to SSI surveillance protocols in all assessed wards indicates a critical gap in monitoring and preventing SSIs. This non-compliance can lead to increased infection rates, prolonged hospital stays, and higher healthcare costs (Calderwood *et al*, 2023)

Moreover, the inadequate training of nurses in SSI surveillance and wound care exacerbates the risk of SSIs. With only one nurse trained in these areas in the three departments, the hospital needs help ensuring that best practices are consistently applied (Friedman *et al*., 2017). This situation reflect the hospital's overall quality of care and can affect its reputation and accreditation status.

Comparing these findings with other studies, the importance of strict adherence to SSI protocols and comprehensive staff training is well documented. For instance, a study by (Mehtar et al. 2020) found that hospitals with robust SSI surveillance and well-trained staff had significantly lower SSI rates. The study emphasized that continuous education and adherence to standardized protocols are crucial in reducing the Prevalence of SSIs.

In conclusion, addressing the identified gaps in SSI management is crucial for the hospital to reduce infection rates, improve patient outcomes, and maintain high standards of healthcare delivery. Implementing these changes will require a concerted effort from hospital administration, continuous education for healthcare providers, and adherence to established infection control guidelines.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a comprehensive overview of the key findings from the study on the Prevalence of surgical site infections (SSIs) among post laparotomy patients at Thika Level 5 Hospital, Kiambu County. It presents a summary of the research outcomes, followed by conclusion of the findings. Additionally, recommendations based on the study findings are provided to guide future actions and interventions aimed at reducing the Prevalence of SSIs in the hospital setting.

5.2 Summary of the Result Findings

5.2.1 Prevalence of SSIs among Post Laparotomy Patients

The study provides valuable insights into the Prevalence and characteristics of surgical site infections (SSIs) among laparotomy patients, highlighting factors influencing infection rates and postoperative outcomes. Among the 161 patients studied, 24 developed SSIs, resulting in an Prevalence rate of 14.9%. Most SSIs (79.2%) occurred within the first 0-7 days post-surgery, with fewer infections occurring between 8-14 days. This finding aligns with existing literature, which reports SSI rates ranging from 2.6% to 20% depending on surgical procedures and patient risk factors. Identified symptoms such as swelling, inflammation, and pus drainage were consistent with typical presentations, facilitating early detection and intervention.

The timing of SSIs, predominantly within the first-week post-surgery, underscores the importance of vigilant postoperative monitoring and early intervention to prevent infections. This temporal pattern emphasizes the critical window for early intervention to prevent SSIs and underscores the need for comprehensive perioperative care protocols.

The study's Chi-square tests revealed statistically significant associations between various factors and SSI Prevalence, emphasizing the need for tailored preventive measures and early intervention strategies based on identified risk factors.

The consistent identification of critical symptoms and risk factors across studies highlights their significance in SSI prevention and management. Recognizing common symptoms like swelling and pus drainage reinforces the necessity for a comprehensive SSI surveillance and diagnosis approach. Incorporating recent advances in surgical techniques, such as minimally invasive procedures, and implementing perioperative care bundles can enhance SSI prevention efforts. The role of microbial colonization and the efficacy of antimicrobial prophylaxis emphasizes the importance of evidence-based interventions in reducing SSI rates and improving patient outcomes.

This study contributes to ongoing efforts to enhance SSI prevention strategies and optimize surgical outcomes in clinical practice by aligning with previous research and emphasizing comprehensive perioperative care.

5.2.2 Patient-Related Factors that Influence SSIs among Post Laparotomy Patients

The study comprehensively investigates patient-related factors influencing surgical site infections (SSIs) among laparotomy patients. It identifies several key variables contributing to SSI risk. The most common indications for laparotomy were hernia (17.4%), appendicitis (15.5%), and ovarian cystic conditions (13%). Preoperative preparations included vital sign observation (95.7%), prophylactic antibiotics (87.6%), and blood glucose monitoring.

Delays in seeking medical attention were prevalent, with over half of the patients experiencing delays before laparotomy. A significant relationship was found between delays and SSIs, with 41.3% of patients waiting more than six weeks before treatment, which was associated with higher SSI risk. Blood glucose levels a critical indicator of

metabolic status and immune function were generally within normal ranges, but monitoring gaps in nearly half the cases suggested opportunities for better perioperative glycemic control. The significant association between blood glucose levels and SSI risk corroborates findings from previous studies, emphasizing the pivotal role of glycemic management in postoperative outcomes

The predominance of emergency surgeries over elective ones highlighted increased SSI risks due to compromised health status and systemic inflammation in urgent cases, predisposing them to higher SSI rates. This underscores the importance of tailored perioperative management strategies to address the unique needs and vulnerabilities of these patients Wound categorization revealed that while most wounds were clean, clean-contaminated wounds indicated potential microbial exposure. Smoking, status, although relatively low rates among the cohort hinted at its possible association with increased SSI risk, corroborating previous research linking tobacco use to impaired wound healing.

Comorbidities like hypertension and diabetes were notable, as they influence immune responses and tissue healing, increasing SSI susceptibility. Transfusions, necessary in specific scenarios, indicated more extensive surgical procedures or underlying pathologies, contributing to infection risks. The inferential analysis in Table 7 emphasizes the importance of considering these factors in risk stratification and preventive interventions. The robust statistical associations identified reaffirm the need for individualized approaches to infection prevention and perioperative care, tailored to address the unique risk profiles of laparotomy patients.

This study enhances understanding of the complex interplay between patient factors and SSI outcomes, supporting the need for individualized infection prevention and perioperative care. The insights can inform evidence-based practices to optimize surgical care, reduce SSI Prevalence, and improve patient outcomes.

5.2.3 Institutional-Related Factors that Influence SSIs among post Laparotomy Patients

The study explores the institutional factors influencing surgical site infections (SSIs) among laparotomy patients. It examines aspects such as the timing of prophylaxis administration, the duration of patient stays before and after surgery, the length of operations, and the frequency of nurse observations. The findings indicate that 42.2% of patients received prophylaxis within 30 minutes before surgery, aligning with the optimal window for preventing SSIs. However, 9.9% did not receive prophylaxis, revealing a gap in preventive measures. Regarding patient stay duration before surgery, 90.1% of patients stayed for 0-3 days, reflecting potentially lower preoperative complications and SSI risks. The duration of operations showed that 40.4% lasted 1-2 hours, while 19.9% lasted more than 3 hours, which is associated with a higher risk of SSIs due to prolonged exposure to contaminants. Statistical analysis confirmed a significant relationship between operation duration and the Prevalence of SSIs, highlighting the importance of efficient surgical practices to minimize postoperative complications. Post-surgery, the majority of patients (54.7%) stayed for 4-7 days, indicating a typical recovery period, while longer stays suggested complications that could contribute to SSIs. This underscores the importance of early discharge planning and effective postoperative care protocols.

The study also assessed nurses' hand hygiene practices, finding that while there was some compliance with hand hygiene and glove use, inconsistencies and uncertainties persisted, indicating areas for improvement in infection control practices. Additionally, a checklist evaluation of SSI protocols and training revealed significant gaps in surveillance, infection prevention, environmental cleaning, hand hygiene, prophylaxis antibiotics, and follow-up protocols. There also needed to be more SSI-related training among nurses,

with only one nurse trained specifically on SSIs and wound care, underscoring the need for enhanced training programs.

A Chi-square test showed a significant association between institutional factors and SSIs among laparotomy patients, suggesting that changes in institutional practices, protocols, and training could influence SSI occurrence. The robust sample size of 161 valid cases ensures the reliability and generalizability of these findings. The study emphasizes the importance of targeted interventions and quality improvement initiatives to mitigate SSIs and enhance patient safety in surgical settings, providing valuable insights into the complex interplay of institutional factors contributing to SSIs.

5.3 Conclusion

The overall Prevalence of SSIs among patients undergoing laparotomy was thus 14.9%. Most SSIs occurred within 0-7 days post-operation, with symptoms including swelling/inflammation, pain/tenderness, fever, and pus drainage. The findings suggest that both patient-related and institutional-related factors play crucial roles in the occurrence of SSIs among patients undergoing laparotomy. Factors such as delay in seeking treatment, age, nutritional status, smoking habits, existing medical conditions, transfusion after surgery, and length of hospital stay before surgery were significantly associated with SSIs. Institutional factors such as the timing of prophylaxis antibiotics, length of hospital stay after surgery, hygiene practices observed by healthcare workers, and the duration of the operation influence the Prevalence of SSIs significantly. Strategies to address these factors can potentially reduce the Prevalence of SSIs and improve patient outcomes.

5.4 Recommendations

Based on the findings, the following recommendations are suggested:

i. Thika level 5 hospital should implement strict protocols for pre-operative and post-operative care, including timely administration of prophylaxis antibiotics. Given that only the gynecological ward had prophylaxis antibiotics protocols, it is necessary to standardize these protocols across all surgical units. Clear guidelines should be established regarding the appropriate use of prophylactic antibiotics to prevent surgical site infections. This can also be achieved through regular training sessions, audits, and supervision to ensure that all staff members understand and follow IPC guidelines.

ii. Healthcare workers should adhere to proper hygiene practices, including hand hygiene and the use of personal protective equipment. Given the deficiencies in environmental cleaning protocols observed in two wards and since all wards did not adhere to surgical hand scrub protocols, efforts should be made to reinforce the importance of proper hand hygiene among healthcare workers. Training sessions and reminders should be provided to ensure consistent adherence to hand hygiene protocols before surgical procedures. Regular monitoring and feedback mechanisms should be established to maintain cleanliness and prevent the spread of infections.

iii. The management of Thika level 5 hospital should increase training on SSI surveillance and wound care. Since only the gynecological ward had one trained nurse on SSI, and only the male surgical ward had one nurse trained on wound care, efforts should be made to provide training to nurses in all surgical units. Training programs should focus on SSI surveillance, wound care management, and infection prevention practices to improve patient outcomes. While most wards had one nurse trained on IPC, additional training should be provided to ensure sufficient coverage and expertise in infection prevention and control measures.

iv. Patients should be educated on the importance of seeking timely medical care and adopting healthy lifestyle practices to reduce the risk of SSIs.

v. The study suggests further studies that incorporates qualitative data to understand the perspectives of patients, healthcare providers, and policymakers regarding Surgical Site infection prevention and barriers to their implementation. Further studies can include a wider patient population from various demographics and socioeconomic backgrounds to assess the generalizability of the initial findings.

REFERENCES

Aiken, Alexander M., Anthony K. Wanyoro, Jonah Mwangi, Francis Juma, Isaac K. Mugoya, and J. Anthony G. Scott. 2013. "Changing Use of Surgical Antibiotic Prophylaxis in Thika Hospital, Kenya: A Quality Improvement Intervention with an Interrupted Time Series Design." *PLOS ONE* 8(11):e78942. doi: 10.1371/JOURNAL.PONE.0078942.

Al-Sayyar, Amnah, Katina D. Hulme, Ronan Thibaut, Jagadeesh Bayry, Frederick J. Sheedy, Kirsty R. Short, and Fawaz Alzaid. 2022. "Respiratory Tract Infections in Diabetes – Lessons From Tuberculosis and Influenza to Guide Understanding of COVID-19 Severity." *Frontiers in Endocrinology* 13. doi: 10.3389/FENDO.2022.919223.

Ali, Abdurrahman, Daniel Gebretsadik, and Kassu Desta. 2023. "Incidence of Surgical Site Infection, Bacterial Isolate, and Their Antimicrobial Susceptibility Pattern among Patients Who Underwent Surgery at Dessie Comprehensive Specialized Hospital, Northeast Ethiopia." *SAGE Open Medicine* 11. doi: 10.1177/20503121231172345/ASSET/IMAGES/LARGE/10.1177_20503121231172345-FIG2.JPEG.

AlJohani, Abdurahman, Karmegam Karuppiah, Alya Al Mutairi, and Abbas Al Mutair. 2021. "Narrative Review of Infection Control Knowledge and Attitude among Healthcare Workers." *Journal of Epidemiology and Global Health* 11(1):20. doi: 10.2991/JEGH.K.201101.001.

America, The Research Committee of the Society of Healthcare Epidemiology of. 2010. "Enhancing Patient Safety by Reducing Healthcare-Associated Infections: The Role of Discovery and Dissemination." *Infection Control and Hospital Epidemiology : The Official Journal of the Society of Hospital Epidemiologists of America* 31(2):118. doi: 10.1086/650198.

Anderson, Deverick J., Kelly Podgorny, Sandra I. Berríos-Torres, Dale W. Bratzler, E. Patchen Dellinger, Linda Greene, Ann-Christine Nyquist, Lisa Saiman, Deborah S. Yokoe, Lisa L. Maragakis, and Keith S. Kaye. 2014. "Strategies to Prevent Surgical Site Infections in Acute Care Hospitals: 2014 Update." *Infection Control & Hospital Epidemiology* 35(S2):S66–88. doi: 10.1017/S0899823X00193869.

Anon. 2023. "Podium Presentations." *Journal of Indian Association of Pediatric Surgeons* 28(7):1. doi: 10.4103/0971-9261.382858.

Anon. n.d. "Morbidity and Mortality Weekly Report." doi: 10.1056/NEJMoa2002032.

Bischoff, Peter, Tobias Siegfried Kramer, Christin Schröder, Michael Behnke, Frank Schwab, Christine Geffers, Petra Gastmeier, and Seven Johannes Sam Aghdassi. 2023. "Age as a Risk Factor for Surgical Site Infections: German Surveillance Data on Total Hip Replacement and Total Knee Replacement Procedures 2009 to 2018." *Eurosurveillance* 28(9):1. doi: 10.2807/1560-7917.ES.2023.28.9.2200535.

Bucataru, Alexandra, Maria Balasoiu, Alice Elena Ghenea, Ovidiu Mircea Zlatian, Dan Dumitru Vulcanescu, Florin George Horhat, Iulia Cristina Bagiu, Virgiliu Bogdan Sorop, Madalina Ioana Sorop, Andrada Oprisoni, Estera Boeriu, and Stelian Stefanita Mogoanta. 2024. "Factors Contributing to Surgical Site Infections: A Comprehensive Systematic Review of Etiology and Risk Factors." *Clinics and Practice* 14(1):52. doi: 10.3390/CLINPRACT14010006.

Bunduki, Gabriel Kambale, Effita Masoamphambe, Tilly Fox, Janelisa Musaya, Patrick Musicha, and Nicholas Feasey. 2024. "Prevalence, Risk Factors, and Antimicrobial Resistance of Endemic Healthcare-Associated Infections in Africa: A Systematic Review and Meta-Analysis." *BMC Infectious Diseases 2024 24:1* 24(1):1–18. doi:

10.1186/S12879-024-09038-0.
Cheng, Hang, Brian Po Han Chen, Ireena M. Soleas, Nicole C. Ferko, Chris G. Cameron, and Piet Hinoul. 2017. “Prolonged Operative Duration Increases Risk of Surgical Site Infections: A Systematic Review.” *Surgical Infections* 18(6):722–35. doi: 10.1089/SUR.2017.089.
Dangen, Jordyn Kate. 2022. “Effectiveness of Preoperative Nutritional Supplementation on Postoperative Outcomes for Patients Undergoing Pancreaticoduodenectomy for Cancer.”
Dhole, Simran, Chandrashekhar Mahakalkar, Shivani Kshirsagar, and Abhilasha Bhargava. 2023. “Antibiotic Prophylaxis in Surgery: Current Insights and Future Directions for Surgical Site Infection Prevention.” *Cureus* 15(10). doi: 10.7759/CUREUS.47858.
Garg, Rakesh. 2016. “Methodology for Research I.” *Indian Journal of Anaesthesia* 60(9):640. doi: 10.4103/0019-5049.190619.
Gustafson, Claire E., Chulwoo Kim, Cornelia M. Weyand, and Jörg J. Goronzy. 2020. “Influence of Immune Aging on Vaccine Responses.” *The Journal of Allergy and Clinical Immunology* 145(5):1309. doi: 10.1016/J.JACI.2020.03.017.
Hanfi, Hanifullah, Waqas Ahmad, Arjun Singh, Muhammad Ibrahim, Aamna Ilyaseen, Naveed Iqbal, Ashraf Ali, Abdul Basit, and Shahkar Ali Khan. 2024. “Antibiotic Prophylaxis for Preventing Surgical Site Infections after Abdominal Surgery.” *International Journal of Health Sciences* 8(S1):705–16. doi: 10.53730/IJHS.V8NS1.14902.
Holzheimer, René G. 2001. “Antibiotic Prophylaxis.”
Hopkins, Brent. 2020. “THE EVALUATION OF INCISIONAL NEGATIVE PRESSURE WOUND THERAPY FOR THE PREVENTION OF SURGICAL SITE INFECTION AFTER COMPLEX INCISIONAL HERNIA REPAIR.”
Hou, Yuefeng, Ashley Collinsworth, Flutura Hasa, and Leah Griffin. 2023. “Incidence and Impact of Surgical Site Infections on Length of Stay and Cost of Care for Patients Undergoing Open Procedures.” *Surgery Open Science* 11:1. doi: 10.1016/J.SOPEN.2022.10.004.
Jack, Kathryn, Catrin Evans, Louise Bramley, Joanne Cooper, Tracy Keane, Marie Cope, and Elizabeth Hendron. 2022. “Identifying and Understanding the Non-Clinical Impacts of Delayed or Cancelled Surgery in Order to Inform Prioritisation Processes: A Scoping Review.” *International Journal of Environmental Research and Public Health* 19(9). doi: 10.3390/IJERPH19095542/S1.
Keely Boyle, K., Sridhar Rachala, and Scott R. Nodzo. 2018. “Centers for Disease Control and Prevention 2017 Guidelines for Prevention of Surgical Site Infections: Review and Relevant Recommendations.” *Current Reviews in Musculoskeletal Medicine* 11(3):357–69. doi: 10.1007/S12178-018-9498-8/METRICS.
Khan, Kazim Raza, Jaya Kumari, Syed Muhammad Waqar Haider, Shaikh Basiq Ul Fawwad, Narindar Kumar, Rukhsar Nizar, Deepak Kumar, . Sangam, Mohammad Hasan, and Hassan Mumtaz. 2022. “The Prevalence and Etiology of Surgical Site Infections Following Gastrointestinal Tract Surgery: A Cross-Sectional Study From a Tertiary Care Hospital.” *Cureus* 14(7). doi: 10.7759/CUREUS.27320.
Kraus, Sascha, Matthias Breier, Weng Marc Lim, Marina Dabić, Satish Kumar, Dominik Kanbach, Debmalya Mukherjee, Vincenzo Corvello, Juan Piñeiro-Chousa, Eric Liguori, Daniel Palacios-Marqués, Francesco Schiavone, Alberto Ferraris, Cristina Fernandes, and João J. Ferreira. 2022. “Literature Reviews as Independent Studies: Guidelines for Academic Practice.” *Review of Managerial Science* 16(8):2577–95. doi: 10.1007/S11846-022-00588-8/FIGURES/3.

Levin, Johannes, Alkomiet Hasan, Irene Alba Alejandre, Irene Lorenzi, Volker Mall, and Tilman R. Rohrer. 2023. "Diseases Affecting Middle-Aged and Elderly Individuals With Trisomy 21." *Deutsches Ärzteblatt International* 120(1–2):14. doi: 10.3238/ARZTEBL.M2022.0371.

Lubega, Abubaker, Bazira Joel, and Najjuka Justina Lucy. 2017. "Incidence and Etiology of Surgical Site Infections among Emergency Postoperative Patients in Mbarara Regional Referral Hospital, South Western Uganda." *Surgery Research and Practice* 2017(1):6365172. doi: 10.1155/2017/6365172.

Mahajan, Nilesh S., Johnson Pvt Ltd, India Hitesh Chopra Regional Sales Manager, Ethicon Sales, Marketing team, Ajay Grover Director, Ashish Kohli, Reshmi Pillai, Hitesh Chopra, and Ajay Grover. 2020. "An Economic Model to Assess the Value of Triclosan-Coated Sutures in Reducing the Risk of Surgical Site Infection in General Surgery in India." *~ 142 ~ International Journal of Surgery Science* 4(4):142–48. doi: 10.33545/surgery.2020.v4.i4c.550.

Mao, Rui Min D., Taylor P. Williams, V. Suzanne Klimberg, Ravi S. Radhakrishnan, Abe DeAnda, Alexander Perez, John P. Walker, William J. Mileski, and Douglas S. Tyler. 2024. "Quality of Surgical Care Within the Criminal Justice Health Care System." *JAMA Surgery* 159(2):179–84. doi: 10.1001/JAMASURG.2023.6236.

Maraş, Gülseren, and Yeliz Sürme. 2023. "Surgical Site Infections: Prevalence, Economic Burden, and New Preventive Recommendations." *Http://Www.Xiahepublishing.Com/* 8(4):366–71. doi: 10.14218/ERHM.2023.00010.

Marusic, Vuk, Ljiljana Markovic-Denic, Olivera Djuric, Andja Cirkovic, Vladimir Nikolic, Emilija Dubljanin-Raspopovic, and Marko Kadija. 2021. "Incidence and Risk Factors of 30-Day Surgical Site Infection after Primary Total Joint Arthroplasty in a Middle-Income Country: A Single-Center Experience." *International Journal of Environmental Research and Public Health 2021, Vol. 18, Page 863* 18(3):863. doi: 10.3390/IJERPH18030863.

Medina, Marie Jo, Helena Legido-Quigley, and Li Yang Hsu. 2020. "Antimicrobial Resistance in One Health." *Advanced Sciences and Technologies for Security Applications* 209–29. doi: 10.1007/978-3-030-23491-1_10.

Mehtar, Shaheen, Anthony Wanyoro, Folasade Ogunsola, Emmanuel A. Ameh, Peter Nthumba, Claire Kilpatrick, Gunturu Revathi, Anastasia Antoniadou, Helen Giamarelou, Anucha Apisarnthanarak, John W. Ramatowski, Victor D. Rosenthal, Julie Storr, Tamer Saied Osman, and Joseph S. Solomkin. 2020. "Implementation of Surgical Site Infection Surveillance in Low- and Middle-Income Countries: A Position Statement for the International Society for Infectious Diseases." *International Journal of Infectious Diseases* 100:123. doi: 10.1016/J.IJID.2020.07.021.

Muchuweti, David, and Kent U. G. Jönsson. 2015. "Abdominal Surgical Site Infections: A Prospective Study of Determinant Factors in Harare, Zimbabwe." *International Wound Journal* 12(5):517–22. doi: 10.1111/IWJ.12145.

Muhamad, Davie, Nurul Ratna Mutu Manikam, and Ridho Ardhi Syaiful. 2023. "Association Preoperative Protein Adequacy and Post Elective Laparotomy Surgical Site Infection." *The Korean Journal of Gastroenterology = Taehan Sohwagi Hakhoe Chi* 82(6):282–87. doi: 10.4166/KJG.2023.103,.

Mukagendaneza, Marie Josée, Emmanuel Munyaneza, Esperance Muhawenayo, Dancilla Nyirasebura, Egide Abahuje, John Nyirigira, Jean De Dieu Harelimana, Thierry Zawadi Muvunyi, Florence Masaisa, Jean Claude Byiringiro, Théobald Hategekimana, and Claude Mambo Muvunyi. 2019. "Incidence, Root Causes, and

Outcomes of Surgical Site Infections in a Tertiary Care Hospital in Rwanda: A Prospective Observational Cohort Study." *Patient Safety in Surgery* 13(1). doi: 10.1186/S13037-019-0190-8.

Mukamuhirwa, Deborah. 2017. "Risk Factors Predisposing Adult Patients to Postoperative Infection at a Rural District Hospital in Southern Province/Rwanda."

Norman, Gill, Chunhu Shi, En Lin Goh, Elizabeth M. A. Murphy, Adam Reid, Laura Chiverton, Monica Stankiewicz, and Jo C. Dumville. 2022. "Negative Pressure Wound Therapy for Surgical Wounds Healing by Primary Closure." *The Cochrane Database of Systematic Reviews* 2022(4). doi: 10.1002/14651858.CD009261.PUB7.

Pannala, Rahul, Kumar Krishnan, Joshua Melson, Mansour A. Parsi, Allison R. Schulman, Shelby Sullivan, Guru Trikudanathan, Arvind J. Trindade, Rabindra R. Watson, John T. Maple, and David R. Lichtenstein. 2020. "Artificial Intelligence in Gastrointestinal Endoscopy." *VideoGIE* 5(12):598–613. doi: 10.1016/J.VGIE.2020.08.013.

Rana, Anna. 2021. "Health in Environment: Reduce Surgical Site Infections by Applying Health in Environment: Reduce Surgical Site Infections by Applying Florence Nightingale's Environmental Theory Florence Nightingale's Environmental Theory." 71(A). doi: 10.47391/JPMA.896.

Rawabdeh, Ali Ahmad Awad, Abdul Rahman Saleh Al Mulhim, and Zahid Khan. 2016. "Surgical Site Infections Incidence, Their Predictors and Causative Organisms in a Teaching Hospital." *International Journal of Community & Family Medicine* 1(1). doi: 10.15344/2456-3498/2016/104.

Rickard, Jennifer, Gregory Beilman, Joseph Forrester, Robert Sawyer, Andrew Stephen, Thomas G. Weiser, and Julie Valenzuela. 2020. "Surgical Infections in Low- and Middle-Income Countries: A Global Assessment of the Burden and Management Needs." *Https://Home.Liebertpub.Com/Sur* 21(6):478–94. doi: 10.1089/SUR.2019.142.

Saklani, Avanish, Mufaddal Kazi, Ashwin Desouza, Ankit Sharma, Reena Engineer, Rahul Krishnatry, Shivkumar Gudi, Vikas Ostwal, Anant Ramaswamy, Aditya Dhanwat, Prabhat Bhargava, Shaesta Mehta, Sridhar Sundaram, Aditya Kale, Mahesh Goel, Shraddha Patkar, Gurudutt Vartey, Suyash Kulkarni, Akshay Baheti, Suman Ankathi, Purvi Haria, Aparna Katdare, Amit Choudhari, Mukta Ramadwar, Munita Menon, and Prachi Patil. 2024. "Tata Memorial Centre Evidence Based Management of Colorectal Cancer." *Indian Journal of Cancer* 61:S29–51. doi: 10.4103/IJC.IJC_66_24.

Sartelli, Massimo, Corrado P. Marini, John McNelis, Federico Coccolini, Caterina Rizzo, Francesco M. Labricciosa, and Patrizio Petrone. 2024. "Preventing and Controlling Healthcare-Associated Infections: The First Principle of Every Antimicrobial Stewardship Program in Hospital Settings." *Antibiotics* 13(9). doi: 10.3390/ANTIBIOTICS13090896,.

Scalise, Alessandro, Roberto Calamita, Caterina Tartaglione, Marina Pierangeli, Elisa Bolletta, Matteo Gioacchini, Rosaria Gesuita, and Giovanni Di Benedetto. 2016. "Improving Wound Healing and Preventing Surgical Site Complications of Closed Surgical Incisions: A Possible Role of Incisional Negative Pressure Wound Therapy. A Systematic Review of the Literature." *International Wound Journal* 13(6):1260. doi: 10.1111/IWJ.12492.

Serna González, Carol Viviana, Viviane Fernandes De Carvalho, See Hee Park Kim, Cinthia Viana Bandeira Da Silva, Ana Flávia Dos Santos Amaral, Diana Lima Villela De Castro, Paula Cristina Nogueira, and Vera Lúcia Conceiçaõ De Gouveia Santos. 2020. "Complicated Surgical Wounds and Associated Factors in Oncology

Patients.” *Plastic Surgical Nursing* 40(2):91–99. doi: 10.1097/PSN.0000000000000307.

Seth, Abhinav, Ashish Sharma, Ashwinin B. Gadde, Milind Mandwar, and Shyam Bihari Bansal. 2022. “Surgical Site Infections in Solid Organ Transplant Recipients: Expert Group Opinion for Prophylaxis and Management in South Asia.” *Indian Journal of Transplantation* 16(5):89–97. doi: 10.4103/IJOT.IJOT_98_21.

Shiferaw, Wondimeneh Shibabaw, Yared Asmare Aynalem, Tadesse Yirga Akalu, and Pammla Margaret Petrucka. 2020. “Surgical Site Infection and Its Associated Factors in Ethiopia: A Systematic Review and Meta-Analysis.” *BMC Surgery* 20(1):1–15. doi: 10.1186/S12893-020-00764-1/FIGURES/13.

De Simone, Belinda, Massimo Sartelli, Federico Coccolini, Chad G. Ball, Pietro Brambillasca, Massimo Chiarugi, Fabio Cesare Campanile, Gabriela Nita, Davide Corbella, Ari Leppaniemi, Elena Boschini, Ernest E. Moore, Walter Biffl, Andrew Peitzmann, Yoram Kluger, Michael Sugrue, Gustavo Fraga, Salomone Di Saverio, Dieter Weber, Boris Sakakushev, Osvaldo Chiara, Fikri M. Abu-Zidan, Richard Ten Broek, Andrew W. Kirkpatrick, Imtiaz Wani, Raul Coimbra, Gian Luca Baiocchi, Micheal D. Kelly, Luca Ansaloni, and Fausto Catena. 2020. “Intraoperative Surgical Site Infection Control and Prevention: A Position Paper and Future Addendum to WSES Intra-Abdominal Infections Guidelines.” *World Journal of Emergency Surgery* 15(1):1–23. doi: 10.1186/S13017-020-0288-4/TABLES/4.

Skeie, Eli, Anne Mette Koch, Stig Harthug, Unni Fosse, Kari Sygnestveit, Roy Miodini Nilsen, and Randi J. Tangvik. 2018. “A Positive Association between Nutritional Risk and the Incidence of Surgical Site Infections: A Hospital-Based Register Study.” *PLoS ONE* 13(5). doi: 10.1371/JOURNAL.PONE.0197344,.

Strobel, Rahel M., Rasmus Leistner, Marja Leonhardt, Konrad Neumann, Sophie M. Eschlböck, Lucas D. G. Lee, Claudia Seifarth, Christian H. W. Schineis, Carsten Kamphues, Benjamin Weixler, Katharina Beyer, and Johannes C. Lauscher. 2022. “Is There an Association between Intra-Operative Detection of Pathogens in Subcutaneous Tissue and Surgical Site Infections? Results from a Prospective Study.” *Https://Home.Liebertpub.Com/Sur* 23(4):372–79. doi: 10.1089/SUR.2021.154.

Tabiri, Stephen, Edwin Yenli, Martin Kyere, and Theophilus T. K. Anyomih. 2018. “Surgical Site Infections in Emergency Abdominal Surgery at Tamale Teaching Hospital, Ghana.” *World Journal of Surgery* 42(4):916–22. doi: 10.1007/S00268-017-4241-Y.

Takesue, Yoshio, and Toshie Tsuchida. 2017. “Strict Glycemic Control to Prevent Surgical Site Infections in Gastroenterological Surgery.” *Annals of Gastroenterological Surgery* 1(1):52. doi: 10.1002/AGS3.12006.

Udayakumaran, Suhas, Shibu Pillai, Srinivas Dwarakanath, Suchanda Bhattacharjee, Naveen Mehrotra, Subodh Raju, Deepak Gupta, Manas Panigrahi, Neelam Venkataramana, Vedantam Rajshekhar, and Suresh Sankhla. 2021. “Indian Society of Pediatric Neurosurgery Consensus Guidelines on Preventing and Managing Shunt Infection: Version 2020-21.” *Neurology India* 69(8):S483–512. doi: 10.4103/0028-3886.332268.

Utsumi, Momoe, Terumasa Yamada, Kazuo Yamabe, Yoshiteru Katsura, Nariaki Fukuchi, Hiroki Fukunaga, Masahiro Tanemura, Junzo Shimizu, Yoshinori Kagawa, Shogo Kobayashi, Hidekazu Takahashi, Koji Tanaka, Tsunekazu Mizushima, Hidetoshi Eguchi, Nana Nakayama, Kiyoko Makimoto, and Yuichiro Doki. 2022. “Differences in Risk Factors for Surgical Site Infection between Laparotomy and Laparoscopy in Gastrointestinal Surgery.” *PLOS ONE* 17(9):e0274887. doi:

10.1371/JOURNAL.PONE.0274887.
Valderas, Jose M., Barbara Starfield, Bonnie Sibbald, Chris Salisbury, and Martin Roland. 2009. “Defining Comorbidity: Implications for Understanding Health and Health Services.” *Annals of Family Medicine* 7(4):357–63. doi: 10.1370/AFM.983.
Voidazan, Septimiu, Sorin Albu, Réka Toth, Bianca Grigorescu, Anca Rachita, and Iuliu Moldovan. 2020. “Healthcare Associated Infections—A New Pathology in Medical Practice?” *International Journal of Environmental Research and Public Health 2020, Vol. 17, Page 760* 17(3):760. doi: 10.3390/IJERPH17030760.

APPENDICES

Appendix I: Consent Form

Greetings, Morning/Afternoon

Hello, I am Catherine Mwangi, and I am a nurse in Kiambu County. At now, I am a student at Mount Kenya University working for a **Master of Science in Medical-Surgical Nursing**.

My research focuses on the causes of surgical site infections in patients who have had laparotomies at Thika Level 5 Hospital in Kiambu County.

The study's goal is to identify the variables that contribute to SSI rates in surgical and gynecological wards. The results of this study will be utilized to promote policies that reduce SSI at the institution and direct future studies on the same area.

The collected information will remain private and confidential during and after the research. No identifying information will be included in the questionnaire, ensuring the confidentiality of both the respondents and the reviewed records. Except for the aforementioned advantages, participants in this research will not be compensated in any way.

I'd appreciate it if you could voluntarily take part. You are allowed to discontinue participation in the research at any time and for any reason.

I agree to take part in this research willingly. I attest that all my questions and concerns about the study have been thoroughly addressed by the researcher.

Respondent’s Signature: ……

Date: …… Time: …….

Researcher's Name : Catherine Mwangi

Address : P.O Box 2112-01000, Thika

Phone No. : 0721250978

School Contact : Mt. Kenya University; Department of Nursing

P.O Box 342 – 00100, Thika.

Appendix II: Questionnaire

DETERMINANTS OF SURGICAL SITE INFECTIONS AMONG POST LAPAROTOMY PATIENTS IN THE SURGICAL UNITS AT THIKA LEVEL 5 HOSPITAL, KIAMBU COUNTY, KENYA.

DEMOGRAPHIC DATA

i. Ward/Unit the patient was admitted (tick one)

Surgical Male1A	[ ]	Surgical Female 2	[ ]
Surgical Male 1B	[ ]	Gynecological Female 6	[ ]

1) Age of patient in years

18 – 24	[ ]	25 – 34	[ ]
35 – 44	[ ]	45 - 54	[ ]
Above 55	[ ]		

2) The gender of the respondent

Male	[ ]	Female	[ ]
Others specify	[ ]		

3) Level of Education

Primary	[ ]	Secondary	[ ]
Tertiary	[ ]		

4) Length of hospital stay

PREVALENCE OF SSI

6) a). Did the patient develop SSI?

Yes	[ ]	No	[ ]
Not Sure	[ ]		

b). If Yes, When did the SSI occur?

0 – 7 days	[ ]	8 – 14 days	[ ]

7). What Symptoms of SSI were observed?

Swelling or inflammation [ ]

Pain or tenderness [ ]

Fever [ ]

Redness or Erythema at operation site [ ]

Pus drainage from the surgical site [ ]

Abscess [ ]

Wound burst [ ]

Identified pathogen through culture [ ]

Others specify [ ]

PATIENT-RELATED FACTORS

8) What was the indication/ surgical diagnosis that led to laparotomy?

Intestinal obstruction	[ ]	Brunt abdominal trauma	[ ]
Appendicitis	[ ]	Tumors	[ ]
Stab wound	[ ]	Peritonitis	[ ]
Hernia	[ ]	Perforated PUD	[ ]
Cancers cervix	[ ]	Uterine fibroids	[ ]
Others specify	[ ]		

9) Was there a delay in the patient seeking treatment before coming to the hospital?

Yes	[ ]	No	[ ]

10) If yes to the above question, how long did the patient take before coming to the hospital?

Less than a week	[ ]	1 – 2 weeks	[ ]
3- 4 weeks	[ ]	5-6 weeks	[ ]
Above 6 weeks	[ ]		

11) What preparations were perfomed to patients before being taken to the theatre (tick all that apply)

Shaving	[ ]	Blood glucose check	[ ]
Enema	[ ]	Prophylaxis antibiotics	[ ]
Morning bathing	[ ]	Observation of vital signs	[ ]
Others specify	[ ]		

12) What is the nutritional Status of the patient? (Fill all)

i. Weight _____

ii. Height _____

iii. BMI _____

13) What was the blood Glucose Levels before Surgery? (Indicate levels next to the tick)

Normal range	[ ]	Hyperglycemia	[ ]
Hypoglycemia	[ ]	Not performed	[ ]

14) What Type of Surgery was performed?

Emergency	[ ]	Elective	[ ]

15) What was the patients' wound category using the wound classification method? (Tick one)

Class 1: Clean	[ ]	Class 2: Clean contaminated	[ ]
Class 3: Contaminated	[ ]	Class 4: Dirty	[ ]

16). Does the patient smoke cigarettes?

Yes	[ ]	No	[ ]

17) Does the patient have any existing medical condition?

Yes	[ ]	No	[ ]

18) If yes in (17), which medical condition (tick all that applies)

Diabetes	[ ]	Cancer	[ ]

Hypertension	[ ]	HIV	[ ]
Others Specify	[ ]		

b). was the patient transfused after surgery?

Yes	[ ]	No	[ ]

INSTITUTIONAL RELATED FACTORS

19) When was Prophylaxis Antibiotics Administered before surgery?

30 minutes	[ ]	More than 1 hour	[ ]
Not administered	[ ]	others specify	[ ]

20) How long did the patient stay in hospital before surgery?

0 – 3 days	[ ]	4 - 7 days	[ ]
8 - 14 days	[ ]	More than 15 days	[ ]
Others specify	[ ]		

21) How long did the operation take intra-operatively?

0.5 - 1 hour	[ ]	1.5 - 2 hours	[ ]
2.5 - 3 hours	[ ]	More than 3 hours	[ ]

22) How long did the patient stay in hospital after surgery?

1 - 3 days	[ ]	4 - 7 days	[ ]
8 - 14 days	[ ]	More than 15 days	[ ]
Others specify	[ ]		

23) How often do nurses observe hand hygiene Practices while handling you during care?

(Ask the patient)

Always	[ ]	Rarely	[ ]
Never	[ ]		

24) Checklist on SSI supportive documents

WARD/UNIT

S/NO	CHECKLIST ITEM	YES	NO	COMMENT
1	SSI Surveillance protocols			
2	IPC protocols			
3	Environmental Cleaning Protocols			
4	Surgical Hand Scrub protocols**(check displays**			
5	Prophylaxis Antibiotics protocols			
6	Follow Up protocols			
7	Number of Nurses Trained On SSI (**check training log)**			
8	Number of Nurses Trained On IPC(**check training log)**			
9	Number of Nurses Trained On Wound Care **(check training log)**			

Appendix III: SSI Surveillance Form

NHSN
NATIONAL HEALTHCARE SAFETY NETWORK

Form Approved
OMB No. 0920-0666
Exp. Date: 01/31/24
www.cdc.gov/nhsn

Outpatient Procedure Component
Surgical Site Infection (SSI) Event

This form is used for reporting data on each patient having a SSI event related to one of the NHSN operative procedures selected for monitoring.

Instructions for this form are available at: https://www.cdc.gov/nhsn/forms/instr/57_405-toi.pdf.

Page 1 of 2 *required for saving

Facility ID:	Event #:	
*Patient ID:	Social Security #:	
Secondary ID #:	Medicare #:	
Patient Name, Last:	First:	Middle:
*Gender: F M Other	*Date of Birth:	
Ethnicity (Specify):	Race (Specify):	
*Date of Encounter (MM/DD/YYYY):		

Surgical Site Infection (SSI)

*Event Type: SSI

*Date of Event: ___/___/____ *Primary CPT Code:_____ *NHSN Procedure Code: _____

*SSI Level:

☐ Superficial Incisional Primary (SIP) ☐ Deep Incisional Primary (DIP) ☐ Organ/Space

☐ Superficial Incisional Secondary (SIS) ☐ Deep Incisional Secondary (DIS)

*Specify SSI Criteria Used (check all that apply):

Signs & Symptoms

☐ Abscess ☐ Localized swelling

☐ Erythema or redness ☐ Pain or tenderness

☐ Fever (>38°C) ☐ Purulent drainage

☐ Heat ☐ Wound spontaneously dehisced

☐ Incision deliberately opened/drained

☐ Other evidence of infection found on invasive procedure, gross anatomic exam, or histopathologic exam

Laboratory

☐ Organism(s) identified

☐ Culture or non-culture based testing not performed

☐ Imaging test evidence of infection

Clinical Diagnosis

☐ Diagnosis of superficial SSI by surgeon or physician

*Pathogens Identified: ☐ Yes ☐ No

If Yes, indicate up to 3 pathogens: _____ _____ _____

Continue>>>

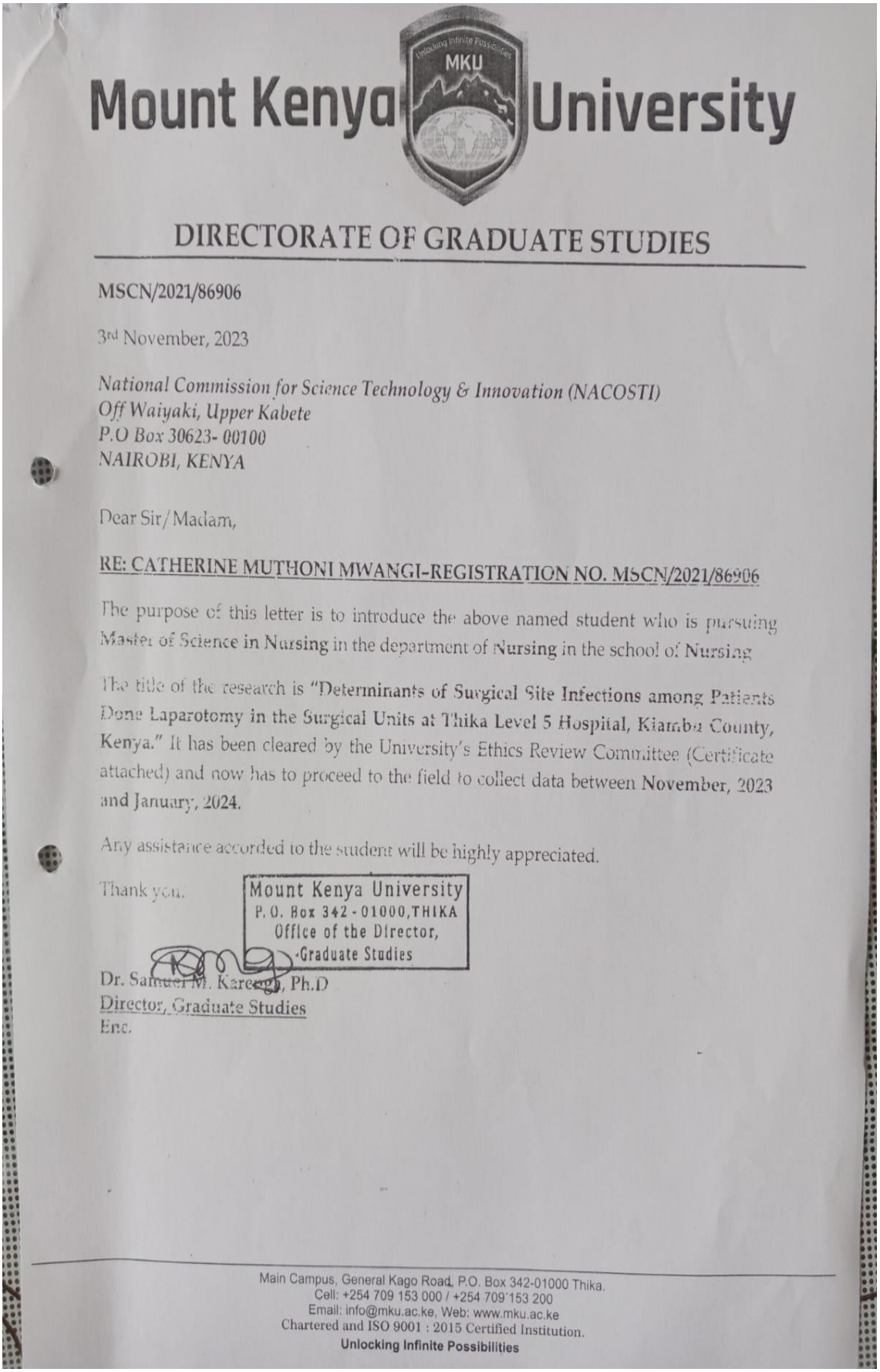
Assurance of Confidentiality: The information obtained in this surveillance system that would permit identification of any individual or institution is collected with a guarantee that it will be held in strict confidence, will be used only for the purposes stated, and will not otherwise be disclosed or released without the consent of the individual, or the institution in accordance with Sections 304, 306 and 308(d) of the Public Health Service Act (42 USC 242b, 242k, and 242m(d)).

Public reporting burden of this collection of information is estimated to average 8 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. An agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to CDC, Reports Clearance Officer, 1600 Clifton Rd., MS D-74, Atlanta, GA 30333, ATTN: PRA (0920-0666).

CDC 57.405 (Front), v8.0

January 2021

Appendix IV: Introductory letter



Mount Kenya University

DIRECTORATE OF GRADUATE STUDIES

MSCN/2021/86906

3rd November, 2023

National Commission for Science Technology & Innovation (NACOSTI)
Off Waiyaki, Upper Kabete
P.O Box 30623- 00100
NAIROBI, KENYA

Dear Sir/Madam,

RE: CATHERINE MUTHONI MWANGI-REGISTRATION NO. MSCN/2021/86906

The purpose of this letter is to introduce the above named student who is pursuing Master of Science in Nursing in the department of Nursing in the school of Nursing

The title of the research is "Determinants of Surgical Site Infections among Patients Done Laparotomy in the Surgical Units at Thika Level 5 Hospital, Kiambu County, Kenya." It has been cleared by the University's Ethics Review Committee (Certificate attached) and now has to proceed to the field to collect data between November, 2023 and January, 2024.

Any assistance accorded to the student will be highly appreciated.

Thank you.

Mount Kenya University
P. O. Box 342 - 01000, THIKA
Office of the Director,
Graduate Studies

Dr. Samuel M. Kareenga, Ph.D
Director, Graduate Studies
Enc.

Main Campus, General Kago Road, P.O. Box 342-01000 Thika.
Cell: +254 709 153 000 / +254 709 153 200
Email: info@mku.ac.ke, Web: www.mku.ac.ke
Chartered and ISO 9001 : 2015 Certified Institution.
Unlocking Infinite Possibilities

Appendix V: ERC Approval

Mount Kenya University

REF: MKU/ISERC/3323 Date: 03 November 2023
TO: CATHERINE M. MWANGI
REG: MSCN/2021/86906

Dear Sir/Madam,

RE: DETERMINANTS OF SURGICAL SITE INFECTIONS AMONG PATIENTS DONE LAPAROTOMY IN THE SURGICAL UNITS AT THIKA LEVEL 5 HOSPITAL, KIAMBU COUNTY, KENYA

This is to inform you that **Mount Kenya University** has reviewed and approved your above research proposal. Your application approval number is **2367.** The approval period is **03/11/2023 - 02/11/2024.**

This approval is subject to compliance with the following requirements:

i. Only approved documents including informed consents, study instruments, MTA will be used
ii. All changes including amendments, deviations and violations are submitted for review and approval by **Mount Kenya University**
iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to **Mount Kenya University** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affect the safety or welfare of study participants and others or affect the integrity of the research must be reported to **Mount Kenya University** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal
vii. Submission of an executive summary report within 90 days upon completion of the study to **Mount Kenya University**

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://research-portal.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely,

The Chairman
Mount Kenya University
Ethics Review Committee
P. O. Box 342 - 0100, Thika

Dr. Alfred Owino, PhD
Chairman, Mount Kenya University ISERC

Main Campus, General Kago Road, P.O. Box 342-01000 Thika.
Cell: +254 709 153 000 / +254 709 153 200
Email: info@mku.ac.ke, Web: www.mku.ac.ke
Chartered and ISO 9001 : 2015 Certified Institution.
Unlocking Infinite Possibilities

Appendix VI: NACOSTI Approval

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **373471**

Date of Issue: **10/November/2023**

RESEARCH LICENSE

This is to Certify that Ms.. CATHERINE MUTHONI MWANGI of Mount Kenya University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Kiambu on the topic: DETERMINANTS OF SURGICAL SITE INFECTIONS AMONG PATIENTS UNDERGONE LAPAROTOMY IN THE SURGICAL UNITS AT THIKA LEVEL 5 HOSPITAL, KIAMBU COUNTY, KENYA for the period ending : 10/November/2024.

License No: **NACOSTI/P/23/31340**

373471

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

Appendix VII: Data Collection Approval

COUNTY GOVERNMENT OF KIAMBU

DEPARTMENT OF HEALTH SERVICES

Telephone: +254722106797
Email address: thikal5hospital@gmail.com

When replying please quote:

THE MEDICAL
SUPERINTENDENT,
P. O. BOX 227 – 01000,
THIKA

Ref: CGK/TL5H/07/30/2023 **Date: 11th December, 2023**

APPROVAL TO CARRY OUT RESEARCH

PRINCIPAL INVESTIGATOR: CATHERINE MUTHONI MWANGI

RE: A STUDY ON DETERMINATION OF SSI AMONG PATIENTS DONE LAPAROTOMY IN THE SURGICAL UNITS AT THIKA LEVEL 5 HOSPITAL.

Following deliberations by Thika Level 5 Hospital's Training, Research and Ethics Committee (TREC), and subject to provision of all the necessary licenses and ethical approvals, your proposal to carry out the above referenced research, at this facility, has been approved.

This approval is subject to the following mandatory conditions:

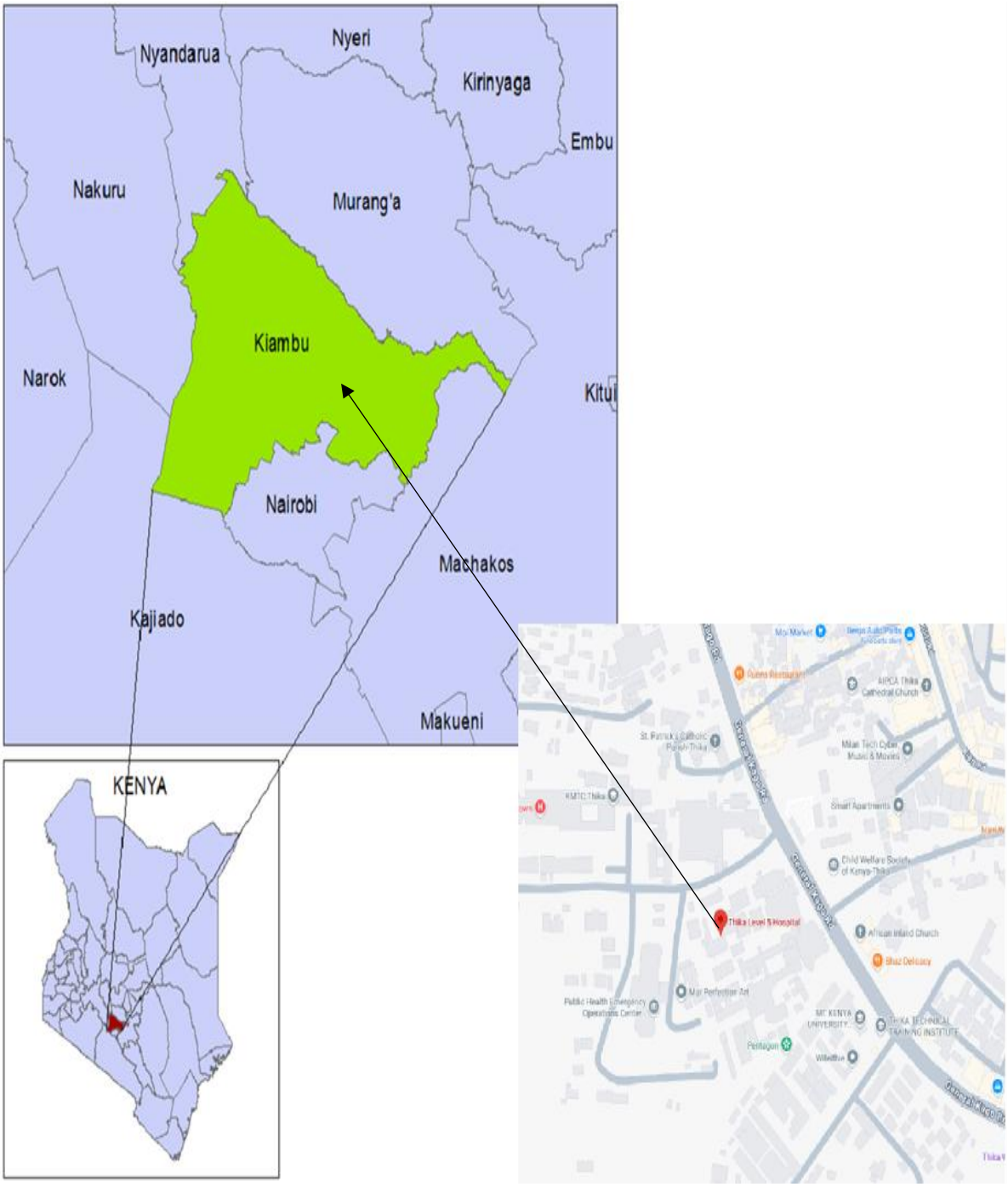
1. You shall submit a copy of the abstract of the final report, through the above contact details.
2. Where called upon, you shall be expected to make a feedback presentation to the hospital's Training, Research and Ethics Committee.
3. You shall maintain ethical consideration and the research subjects' confidentiality as outlined in your proposal.
4. Any patient confidential information that you may access during your research should not be used without consent.
5. You shall make payments of applicable research fees to the hospital before commencing research activities.

This letter is valid up to 15th April 2024. For any queries feel free to contact the committee chair through the Medical Superintendent's office or Training, Research and Ethics Committee Office.

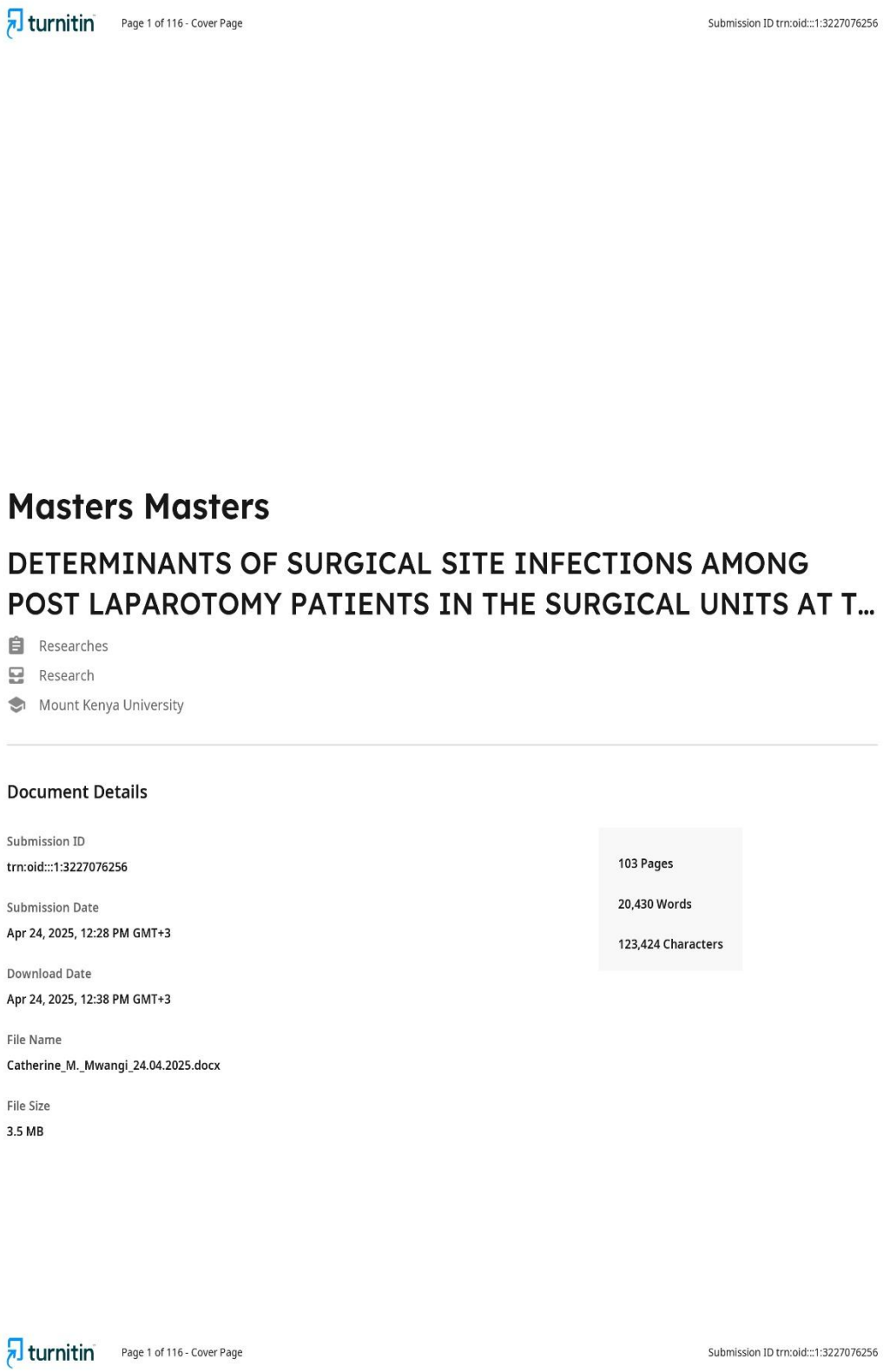
Thank you and all the best.

SUSAN GATEI
FOR: CHAIRPERSON, TRAINING RESEARCH & ETHICS COMMITTEE,
THIKA LEVEL 5 HOSPITAL

Appendix VIII: Study Area



Appendix IX: Similarity Index



15% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

Filtered from the Report

- Bibliography

Exclusions

- 1 Excluded Source

Match Groups

- **246** Not Cited or Quoted 14%
  Matches with neither in-text citation nor quotation marks
- **20** Missing Quotations 1%
  Matches that are still very similar to source material
- **1** Missing Citation 0%
  Matches that have quotation marks, but no in-text citation
- **0** Cited and Quoted 0%
  Matches with in-text citation present, but no quotation marks

Top Sources

13% Internet sources
8% Publications
5% Submitted works (Student Papers)

Integrity Flags

1 Integrity Flag for Review

Hidden Text
17 suspect characters on 1 page
Text is altered to blend into the white background of the document.

Our system's algorithms look deeply at a document for any inconsistencies that would set it apart from a normal submission. If we notice something strange, we flag it for you to review.

A Flag is not necessarily an indicator of a problem. However, we'd recommend you focus your attention there for further review.

Match Groups

- 246 Not Cited or Quoted 14%
  Matches with neither in-text citation nor quotation marks
- 20 Missing Quotations 1%
  Matches that are still very similar to source material
- 1 Missing Citation 0%
  Matches that have quotation marks, but no in-text citation
- 0 Cited and Quoted 0%
  Matches with in-text citation present, but no quotation marks

Top Sources

13% Internet sources
8% Publications
5% Submitted works (Student Papers)

Top Sources

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

1	Internet	
ir-library.ku.ac.ke		1%
2	Internet	
www.coursehero.com		<1%
3	Internet	
erepository.mku.ac.ke		<1%
4	Internet	
erepository.uonbi.ac.ke		<1%
5	Internet	
www.researchgate.net		<1%
6	Internet	
erepository.uonbi.ac.ke:8080		<1%
7	Internet	
ir.jkuat.ac.ke		<1%
8	Internet	
www.mdpi.com		<1%
9	Internet	
ugspace.ug.edu.gh		<1%
10	Internet	
www.frontiersin.org		<1%