"ASSOCIATION OF STERILE GLOVES AND INSTRUMENTS CHANGE AT THE TIME OF ABDOMINAL WOUND CLOSURE TO PREVENT SURGICAL SITE INFECTIONS – ONE YEAR DESCRIPTIVE CROSS SECTIONAL STUDY AT A TERTIARY CARE HOSPITAL"

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List of Abbreviations

SSI - Surgical Site Infection

LMICs - Low- and Middle-Income Countries

HICs - High-Income Countries

WHO - World Health Organization

CDC - Centers for Disease Control and Prevention

HAIs - Healthcare-Associated Infections

MRSA - Methicillin-Resistant Staphylococcus Aureus

E. coli - Escherichia coli

SPSS - Statistical Package for the Social Sciences

GA - General Anesthesia

SA - Spinal Anesthesia

RBS - Random Blood Sugar

WBC - White Blood Cell

POD - Postoperative Day

HBsAg - Hepatitis B Surface Antigen

CVA - Cerebrovascular Accident

LSCS - Lower Segment Cesarean Section

HDI - Human Development Index

CFR - Case Fatality Rate

SF-12 - Medical Outcomes Study 12-Item Short-Form Health Survey

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ABSTRACT

Background: Surgical Site Infections (SSIs) are a significant cause of morbidity, mortality, and economic burden in healthcare, particularly in low- and middle-income countries (LMICs). While aseptic techniques are fundamental to infection prevention, the impact of routine changes of sterile gloves and instruments before abdominal wound closure remains inconclusive.

Objective: This study evaluates the association between the routine changing of sterile gloves and instruments before abdominal wound closure and the incidence of SSIs in patients undergoing elective surgeries at a tertiary care hospital.

Methods: A descriptive cross-sectional study was conducted at KLE'S Dr. Prabhakar Kore hospital and Medical Research Centre, Belagavi, India, over a one-year period. A total of 105 patients undergoing elective laparotomies, open cholecystectomies, open appendicectomies, or hysterectomies were included. Patients were divided into two groups: those with routine changes of sterile gloves and instruments before wound closure and those without this intervention. SSI incidence was assessed using the Southampton Wound Grading System, and microbiological cultures were analyzed to determine bacterial contamination. Data analysis was performed using SPSS version 25.0, with chi-square tests and logistic regression applied for statistical assessment.

Results: The incidence of SSIs was significantly lower in the intervention group (routine change of gloves and instruments) compared to the control group. Microbiological analysis revealed a substantial reduction in bacterial contamination, particularly for *E. coli*, in the intervention group. Improved wound healing outcomes were observed in the intervention group based on the Southampton Wound Grading

System. No significant differences were noted in hospital stay duration or surgery length between the groups.

<u>Conclusion</u>: Routine changes of sterile gloves and instruments before abdominal wound closure were associated with a lower incidence of SSIs and improved wound healing. These findings suggest a cost-effective infection control strategy that can be particularly beneficial in LMICs. Further large-scale, multicenter trials are recommended to validate these results and inform surgical protocols.

INTRODUCTION

Surgical site infections (SSIs) are among the most common healthcare-associated infections (HAIs) and represent a significant burden on healthcare systems worldwide. Despite advances in surgical techniques, sterilization protocols, and antibiotic prophylaxis, SSIs remain a persistent challenge, particularly in low- and middle-income countries (LMICs).[1] SSIs are defined as infections that occur at or near the surgical incision within 30 days of the procedure or within 90 days if an implant is involved.[2] These infections can lead to prolonged hospital stays, increased healthcare costs, and significant morbidity and mortality. In some cases, SSIs can result in life-threatening complications such as sepsis, organ failure, and even death.[3,4]

The global burden of SSIs is substantial. According to the World Health Organization (WHO), SSIs affect up to 10% of patients undergoing surgical procedures in high-income countries (HICs) and up to 30% in LMICs. The disparity in SSI rates between HICs and LMICs can be attributed to differences in healthcare infrastructure, access to sterile equipment, and adherence to infection control protocols. In LMICs, the lack of resources, overcrowded hospitals, and limited access to antibiotics exacerbate the problem, making SSIs a critical public health issue.[5]

Surgical Site Infections (SSIs) continue to pose a considerable challenge in clinical settings, even with advancements in preventative measures. They are linked to significant rates of morbidity and mortality, along with considerable strain on healthcare resources. The occurrence of SSIs can reach up to 20%, influenced by factors such as the specific surgical procedure, the criteria for monitoring, and the accuracy of data collection. Many SSIs are caused by pathogens that are part of the patient's own microbiota.[7] The pathogens responsible vary according to the surgical type, with common isolates including Staphylococcus

aureus, coagulase-negative staphylococci, Enterococcus species, and Escherichia coli. A variety of factors related to the patient and the procedure itself affect the likelihood of developing an SSI, making it essential to adopt a comprehensive 'bundle' strategy that addresses multiple risk factors to minimize bacterial contamination and enhance the patient's immune response.[8] The guidelines set forth by the Centers for Disease Control and Prevention for SSI prevention highlight the necessity of thorough patient preparation, maintaining an aseptic environment, and following strict surgical techniques. In specific situations, antimicrobial prophylaxis is also recommended.[9]

Given the significant clinical and economic burden of SSIs, there is an urgent need for effective strategies to prevent these infections. Over the years, various interventions have been proposed and implemented to reduce the incidence of SSIs.[4] These include preoperative measures such as patient optimization, skin antisepsis, and antibiotic prophylaxis; intraoperative measures such as maintaining sterile fields, using wound edge protectors, and ensuring proper surgical technique; and postoperative measures such as wound care and surveillance. Despite these efforts, SSIs remain a persistent problem, particularly in resource-limited settings.[10]

One area that has received increasing attention in recent years is the role of sterile gloves and instruments in preventing SSIs. The use of sterile gloves and instruments is a fundamental principle of aseptic technique in surgery.[11] However, the question of whether routine changing of sterile gloves and instruments before abdominal wound closure can reduce the incidence of SSIs remains a topic of debate. While some studies have suggested that changing gloves and instruments before wound closure can reduce the risk of contamination and subsequent infection, others have found no significant benefit. The lack of consensus on this issue highlights the need for further research, particularly in LMICs where the burden of SSIs is highest.[12]

The rationale for this study is rooted in the need to address the high burden of SSIs, particularly in LMICs, and to identify cost-effective strategies for reducing these infections. While several interventions have been proposed to prevent SSIs, many of these are resource-intensive and may not be feasible in low-resource settings. Changing sterile gloves and instruments before abdominal wound closure is a relatively simple and low-cost intervention that has the potential to significantly reduce the risk of SSIs. However, the evidence supporting this practice is limited and conflicting, particularly in the context of LMICs.

This study aims to fill this gap in the literature by investigating the association between routine changing of sterile gloves and instruments before abdominal wound closure and the incidence of SSIs in a tertiary care hospital in a low-resource setting. By conducting a descriptive cross-sectional study over a one-year period, we hope to provide valuable insights into the effectiveness of this intervention and its potential impact on SSI rates. The findings of this study could have important implications for surgical practice, particularly in LMICs where resources are limited and the burden of SSIs is high.

The primary objective of this study is to conduct a thorough investigation into the association between the routine changing of sterile gloves and instruments prior to abdominal wound closure and the subsequent incidence of surgical site infections (SSIs) in patients undergoing various elective surgical procedures, including laparotomies, open cholecystectomies, open appendicectomies, and hysterectomies at a tertiary care hospital. A central focus of this research is to determine the incidence of SSIs among patients who receive routine changes of sterile gloves and instruments compared to those who do not follow this protocol.

In addition to measuring the incidence of SSIs, the study aims to identify specific risk factors associated with the development of these infections within the study population. Furthermore, the research evaluated how the routine changing of sterile gloves and instruments influences various postoperative outcomes, such as the length of hospital stay, the need for additional surgical interventions, and mortality rates among the patients studied.

Finally, the study assessed the cost-effectiveness of implementing routine changes of sterile gloves and instruments, particularly in low-resource settings. Given that healthcare systems often face budget constraints, understanding the economic implications of these infection control practices is vital. This research aims to highlight whether the potential benefits of reducing SSIs through routine glove and instrument changes outweigh the costs involved, ultimately contributing to more informed policy decisions surrounding surgical practices in diverse healthcare environments

Moreover, the anticipated results of this study could serve as a catalyst for ongoing research in the field of SSI prevention. By highlighting the impact of aseptic techniques—specifically the changing of sterile gloves and instruments—this research could reveal gaps in the current understanding and practice regarding infection control in surgical settings. It may prompt a re-evaluation of existing guidelines, thus advocating for a broader investigation into various aseptic practices and their effectiveness in reducing surgical infections worldwide. Such comprehensive research efforts could contribute significantly to the overall enhancement of surgical safety and patient care, particularly in resource-limited environments where every intervention counts.

OBJECTIVES

- To study the association between the routine change of sterile gloves and instruments before abdominal wound closure in preventing the surgical site infection.
- To assess the impact of changing sterile gloves and instruments during abdominal wound closure on patients outcomes.

REVIEW OF LITERATURE

The review of literature provides a comprehensive overview of existing research on surgical site infections (SSIs), their risk factors, and prevention strategies, with a particular focus on the role of sterile gloves and instruments in reducing SSIs. The purpose of this review is to contextualize the current study within the broader body of knowledge, identify gaps in the literature, and highlight the significance of investigating the association between routine changing of sterile gloves and instruments before abdominal wound closure and the incidence of SSIs.

This review is organized thematically, beginning with a historical perspective on SSIs and the evolution of aseptic techniques in surgery. It then examines the global burden of SSIs, including their epidemiology, economic impact, and clinical consequences. The review also explores the risk factors for SSIs, current strategies for their prevention, and the evidence supporting the use of sterile gloves and instruments in reducing SSIs.

1. Historical Context of Surgical Site Infections (SSIs)[13]

The history of surgical site infections (SSIs) dates to the early days of surgery when infections were a common and often fatal complication of surgical procedures. In the 19th century, before the advent of aseptic techniques, surgical mortality rates were exceedingly high, with infections being the primary cause of death.[14] Surgeons operated in unsanitary conditions, often reusing instruments and dressings without proper sterilization. The concept of germs and their role in causing infections was not yet understood, and surgical practices were largely based on trial and error.

The typical complications were referred to as "surgical fever" or "surgical gangrene," likely caused by infection from Streptococcus pyogenes. Surgeons themselves were often unwitting sources of these infections. In Central Europe,

barber-surgeons, who combined haircuts and surgery into their workday, conducted most surgical procedures. Itinerant surgeons removed bladder stones, contributing further to the spread of infection. Surgeons typically wore overcoats during surgeries, which were often stained with dried blood and pus. Probes used to inspect wounds were rarely disinfected between patients, and surgical practices largely disregarded cleanliness. Instruments were frequently returned to their cases immediately after use, even if they had fallen on unclean surfaces or been employed during the amputation of infected limbs. Wounds were seldom properly cleaned, and few measures were taken to securely close incisions to guard against infection.[16]

The pioneering work of Louis Pasteur and Robert Koch in the late 19th century revolutionized the understanding of infectious diseases. Pasteur's germ theory of disease provided the scientific basis for the development of aseptic techniques in surgery. Koch's postulates further established the link between specific microorganisms and infectious diseases, paving the way for the development of antiseptic and sterilization methods.[17]

1. <u>Evolution of Aseptic Techniques</u>

The introduction of aseptic techniques in surgery marked a turning point in the prevention of SSIs. Joseph Lister, often referred to as the "father of modern surgery," was the first to apply Pasteur's germ theory to surgical practice. In the 1860s, Lister introduced the use of carbolic acid (phenol) to sterilize surgical instruments and clean wounds, significantly reducing the incidence of postoperative infections. Lister's methods were initially met with skepticism but eventually gained widespread acceptance, leading to a dramatic decline in surgical mortality rates.[18]

The development of sterile gloves and gowns in the late 19th and early 20th centuries further advanced aseptic techniques in surgery. The use of rubber gloves,

initially introduced to protect the hands of surgical nurses from harsh antiseptics, became standard practice for surgeons to prevent contamination of the surgical site.[19] The introduction of steam sterilization (autoclaving) in the early 20th century provided a reliable method for sterilizing surgical instruments, further reducing the risk of SSIs.

2. Milestones in SSI Prevention

The 20th century saw significant advancements in the prevention of SSIs, including the development of antibiotics, the introduction of surgical checklists, and the implementation of infection control protocols in hospitals.[20] The discovery of penicillin by Alexander Fleming in 1928 revolutionized the treatment of bacterial infections, including SSIs. The widespread use of antibiotics in the mid-20th century led to a further decline in surgical mortality rates, but it also gave rise to the problem of antibiotic resistance.[21]

In recent decades, the focus has shifted from treating infections to preventing them through the implementation of evidence-based practices. The introduction of surgical safety checklists, such as the WHO Surgical Safety Checklist, has been shown to reduce the incidence of SSIs and other surgical complications.[22] These checklists emphasize the importance of aseptic techniques, including the use of sterile gloves and instruments, in preventing infections.

Antimicrobial prophylaxis has also emerged as a cornerstone of SSI prevention. The judicious use of antibiotics plays a crucial role in reducing infection risk. However, this approach faces challenges, particularly the growing issue of antibiotic resistance, which complicates the effectiveness of prophylactic measures.[24]

Furthermore, advances in surgical techniques, including minimally invasive surgery, have contributed to a reduced risk of SSIs. These techniques often lead to

smaller incisions, less tissue trauma, and quicker recovery times, all of which can lower the likelihood of postoperative infections. [25]

Modern medicine has placed a greater emphasis on understanding and enhancing the patient's immune response to infection. This shift recognizes that host factors are critical in the development of SSIs and highlights the importance of supporting patients' natural defense mechanisms (Meakins & Masterson, 2005; Oluwatosin, 2007).

Despite these advancements, the landscape of SSIs continues to evolve, presenting new challenges. The rise of outpatient surgeries and the increasing severity of infections among inpatients have shifted the epidemiology of SSIs.

3. Global Burden of Surgical Site Infections

Surgical site infections (SSIs) are among the most common healthcare-associated infections (HAIs), accounting for a significant proportion of postoperative complications worldwide. The incidence of SSIs varies widely depending on the type of surgery, the patient population, and the healthcare setting. In high-income countries (HICs).

Surgical site infections (SSIs) are a prevalent type of healthcare-associated infection (HAI). These infections can complicate patient recovery, resulting in extended hospital stays, the need for further surgical interventions, potential admission to intensive care units, and an increased risk of death.

The burden of SSIs is particularly high in LMICs, where healthcare resources are limited, and infection control practices are often suboptimal. Factors contributing to the high incidence of SSIs in LMICs include overcrowded hospitals, inadequate sterilization of surgical instruments, and limited access to antibiotics. The lack of

surveillance systems for SSIs in many LMICs further complicates efforts to monitor and control these infections.[20]

3.1 Economic Impact of SSIs

The economic impact of SSIs is substantial, both for healthcare systems and for patients. SSIs are associated with increased healthcare costs due to prolonged hospital stays, additional surgical interventions, and the need for more intensive postoperative care.

A systematic review by Jenks et al. revealed that patients with surgical site infections (SSIs) experienced a median extended hospital stay of 10 days, with a confidence interval of 7 to 13 days. Throughout a two-year study period, the total number of bed days lost due to SSIs was 4,694. The median additional expense related to SSIs was £5,239, with a confidence interval between £4,622 and £6,719. Cumulatively, the extra costs over the duration of the study reached £2,491,424. When evaluating the opportunity cost of eradicating all SSIs during the two years, the estimated overall financial advantage of such an action would have been just £694,007. For seven categories of surgery analyzed, it was determined that the hospital would have been in a worse financial position if it had eliminated all SSIs.[28]

A research study led by Perencevich et al. examined the clinical outcomes and resource usage during the eight weeks following surgery for cases of surgical site infections (SSIs) identified after patients had been discharged. The findings showed that 89 (1.9%) out of 4,571 surgical procedures conducted from May 1997 to October 1998 were associated with SSIs discovered after the patients left the hospital. Patients who developed an SSI showed a notable decrease in their mental health scores as indicated by the SF-12 (Medical Outcomes Study 12-Item Short-Form Health Survey)

in comparison to those without an SSI ($p=0.004$). Furthermore, these patients needed significantly more outpatient appointments, visits to the emergency department, radiology services, hospital readmissions, and home health care compared to the control group. During the eight weeks after discharge, the average total expenses for patients with SSIs amounted to $5,155, while the costs for the control group were $1,773 ($p<0.001$).[29]

In LMICs, the economic burden of SSIs is even more pronounced. Patients often face catastrophic health expenditures, pushing families into poverty and perpetuating cycles of economic hardship. The high cost of treating SSIs in LMICs is exacerbated by the lack of health insurance and the limited availability of affordable healthcare services.[27]

3.2 Morbidity and Mortality Associated with SSIs

SSIs are associated with significant morbidity and mortality, particularly in vulnerable populations such as the elderly, immunocompromised patients, and those with underlying comorbidities. SSIs can lead to a range of complications, including wound dehiscence, abscess formation, sepsis, and organ failure. In severe cases, SSIs can result in death.

Vicentini et al. conducted a research study involving 11,417 colon surgeries and 20,804 hip arthroplasties. In the context of colon surgeries, the incidence of surgical site infections (SSIs) declined significantly, dropping from 9.21% in 2010 to 5.7% in 2019. Additionally, a significant reduction was noted in overall mortality ($p = 0.008$), which fell from 4.96% in 2010 to 2.96% in 2019. Conversely, there were no notable changes in SSI or mortality rates among hip arthroplasty procedures during the same period. Over the course of ten years, the cumulative failure rate (CFR) for

SSIs after colon surgeries was 6.62%, while it was 3.7% for hip arthroplasty procedures.[30]

The impact of SSIs on patient outcomes is particularly severe in LMICs, where access to timely and effective treatment is often limited. Patients with SSIs in LMICs are more likely to experience prolonged hospital stays, readmissions, and long-term disability. The high mortality rate associated with SSIs in LMICs underscores the urgent need for effective prevention strategies.

4. Risk Factors for Surgical Site Infections

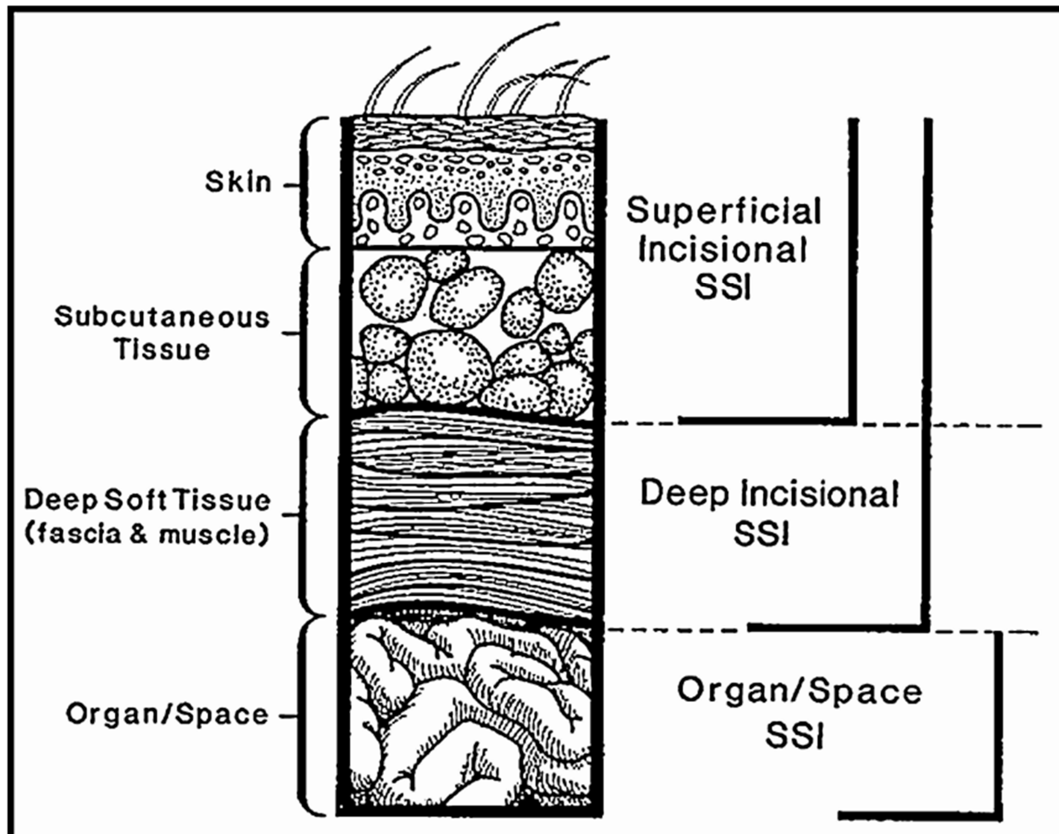

FIG. 1. Types of Surgical Site Infections [31]

5.1 Patient-Related Factors

A variety of potential risk factors for surgical site infections (SSIs) has been recognized, although only a few have been validated through randomized clinical trials. Additional key risk factors include advancing age, ischemic conditions related to vascular diseases, diabetes, smoking habits, and obesity. It is crucial to address any existing infections before proceeding with elective surgeries.

Furthermore, several patient-related characteristics are associated with an increased likelihood of SSIs. These include factors such as age, existing health conditions, nutritional well-being, and immune system function. Patients who are elderly or have chronic illnesses—including diabetes, obesity, and heart disease—are at a greater risk for developing SSIs. Both malnutrition and decreased immune function, which may arise from either illnesses or medications, contribute to this heightened risk.[32]

5.2 Procedure-Related Factors

The factors related to surgical procedures play a crucial role in the incidence of surgical site infections (SSIs). Several key elements are critical in determining the risk of SSIs, including the nature and length of the surgery, the presence of implants, and the degree of contamination at the surgical site. Surgeries performed in emergency situations, those with extended durations, and procedures that involve the gastrointestinal tract tend to have a higher likelihood of resulting in SSIs. Moreover, the incorporation of drains and other foreign objects can heighten the risk of infection.

The length of time spent on surgical scrubs and the use of antiseptic for skin preparation also contribute significantly to the likelihood of SSIs. Particularly, surgeries that exceed 3 to 4 hours in duration further increase this risk. Previously, it was thought that body hair around the surgical area heightened infection risk due to

potential bacterial exposure. However, recent insights indicate that hair entering the surgical site is not significantly influential in terms of contamination, and hair removal is now only deemed necessary if it is excessive.

The use of antimicrobial prophylaxis is vital, as is ensuring adequate ventilation within the operating room, including sufficient exchanges of fresh air. Generally, it is not advisable to flash-sterilize a dropped instrument unless it is absolutely necessary for the completion of the surgery. Any foreign materials present at the surgical site can make a patient more susceptible to infections. Surgical drains should be utilized only when drainage is forecasted, as they can trigger an inflammatory reaction and increase the chances of leaks in surgical connections.
Employing meticulous surgical techniques, such as being gentle with tissues, avoiding the formation of hematomas, and reducing dead space, is crucial. Additionally, exposure to hemoglobin may increase the virulence of bacteria by diminishing phagocytic activity.[32]

5.3 Environmental and Hospital-Related Factors

Environmental and hospital factors play a vital role in preventing surgical site infections (SSIs). Important aspects include ensuring operating rooms are clean, effectively sterilizing surgical tools, and consistently following infection control measures. Issues such as insufficient sterilization of instruments, inadequate hand hygiene, and mistakes in maintaining a sterile environment during surgery can all contribute to SSIs. In low- and middle-income countries (LMICs), the challenges are intensified by a lack of resources and infrastructure necessary for proper infection control.

SSIs often arise from microorganisms that naturally exist on the patient's skin, though they can also stem from the gastrointestinal or female reproductive tracts.

External sources of infection may include the surgeon's hands, the instruments used, or even the surrounding atmosphere. Notable pathogens include Staphylococcus aureus and certain intestinal organisms, both of which can be quite virulent. Less aggressive bacteria can include coagulase-negative staphylococci and Bacteroides species.

The significant contributions of Ignaz Semmelweis, a Hungarian physician in 19th-century Austria, highlighted the importance of handwashing, especially when moving from handling cadavers to caring for expectant mothers. He also promoted the practice of sterilizing instruments with antiseptic solutions. Despite resistance from his peers, Semmelweis was able to reduce the previously high incidence of postpartum endometritis among his patients to around 5%.[32]

5. Current Strategies for Preventing Surgical Site Infections

6.1. Preoperative Measures

Preventing surgical site infections (SSIs) before an operation involves several key strategies: improving patient health, ensuring proper skin antisepsis, and providing prophylactic antibiotics. Patient optimization includes addressing risk factors that can be modified, such as malnutrition, smoking habits, and high blood sugar levels prior to surgery. To minimize the bacterial presence on the skin, skin antisepsis is carried out using chlorhexidine or iodine-based solutions. Administering antibiotic prophylaxis within an hour before the surgical incision is crucial in lowering the likelihood of SSIs, particularly in surgeries classified as clean-contaminated or contaminated.

In a report by Li et al., six evidence-based guidelines were presented concerning preoperative interventions aimed at reducing SSIs. Of these guidelines,

four were recognized as high-quality, while two were considered moderate due to unclear methodological reporting.

The guidelines included recommendations for nasal decolonization with mupirocin, using chlorhexidine gluconate for body washing, and bathing with either antimicrobial or regular soap before surgery. Furthermore, four of the guidelines advocate for the use of alcohol-based antiseptic solutions for skin preparation, while advising against hair removal unless absolutely necessary. Three guidelines suggest conducting mechanical bowel preparation with oral antibiotics for elective colorectal surgeries, and one guideline opposes this practice without providing specific indications or mentioning concurrent antibiotic usage.

Additionally, two guidelines offered insights on managing blood glucose levels around the time of surgery, recommending different target glucose levels. Four guidelines also discussed the best timing for administering prophylactic antibiotics, indicating that it could be done one to two hours before the incision or at the start of anaesthesia. Overall, the strength of these recommendations ranged from conditional to strong, with supporting evidence quality varying from very low to high.[33]

6.2. Intraoperative Measures

To reduce the risk of surgical site infections (SSIs) during procedures, it is crucial to adopt various strategies during the operation. These strategies encompass maintaining a sterile environment, employing wound edge protectors, and practicing proper surgical techniques. The use of sterile gloves and instruments is fundamental to ensuring aseptic conditions in the operating room.

Additionally, it is important to keep the patient’s body temperature within a normal range, enhance oxygen delivery, and minimize tissue damage. Implementing wound

protectors and using antibacterial sutures have proven effective in decreasing SSIs linked to intra-abdominal procedures. In conjunction with this, negative-pressure wound therapy can be beneficial in addressing potential post-surgical complications.

Maintaining normothermia throughout the surgical process is essential in reducing the likelihood of SSIs. Moreover, a thorough understanding of how antibiotics function in the body is vital for timing subsequent doses for patients undergoing surgery for intra-abdominal infections. This knowledge is particularly important in preventing SSIs in urgent surgical situations.[34]

6.3. Postoperative Measures

To minimize the risk of surgical site infections (SSIs) after surgery, it is important to focus on several key measures: effective wound management, diligent monitoring, and prompt identification of infections. Proper management of the surgical site includes the application of sterile dressings and routine checks of the area to help prevent SSIs. Establishing monitoring systems for SSIs, which rely on consistent definitions and reporting protocols, plays a vital role in tracking and managing these infections. Furthermore, prophylactic measures for infections in the postoperative phase may include the use of silver-impregnated or vacuum-assisted dressings, prolonged intravenous antibiotic treatment, and supplemental oxygen administration.[35]

6. Surgical Site Infections and Common Surgical Procedures in General Surgery

Surgical site infections (SSIs) are a frequent and serious complication of general surgery, contributing to increased morbidity, prolonged hospital stays, and higher healthcare costs.[3] The risk of SSIs varies based on the type of surgery, patient factors, and adherence to infection control protocols. In general surgery, procedures such as

laparotomies, cholecystectomies, appendectomies, and hernia repairs are among the most commonly performed operations and are associated with varying SSI risks depending on their classification as clean, clean-contaminated, contaminated, or dirty wounds.[36]

Open abdominal surgeries, referred to as laparotomies, present a notable risk for surgical site infections (SSIs), especially in contaminated or emergency contexts. The likelihood of postoperative infections increases due to factors like intra-abdominal infections, peritoneal contamination, and prolonged surgical times, with infection rates varying between 5% and 30%, influenced by bowel involvement and the administration of perioperative antibiotics.[34] Although laparoscopic cholecystectomy has largely taken the place of open cholecystectomy, the latter still poses a greater risk for SSIs, particularly in cases of acute cholecystitis or biliary obstruction, with infection rates of about higher compared to laparoscopic methods.[37] Common pathogens include Escherichia coli and Enterococcus species, often stemming from the biliary tract.[38] Appendectomies, frequently performed in emergency settings, have an SSI rate of 3% to 5% for uncomplicated cases but can soar to 15% to 30% in instances of perforated appendicitis, highlighting the importance of perioperative antibiotics in such scenarios.[39] Hernia repairs, especially those involving mesh, have specific infection risks; clean inguinal repairs show low infection rates, but ventral and incisional repairs carry higher risks linked to bowel injury and mesh complications. Finally, colorectal surgeries are among the highest in terms of SSI rates, ranging from 10% to 40%, primarily due to the substantial bacterial load in the colon and factors like extended surgical duration and inadequate bowel preparation.[40] Recent research suggests that combining mechanical bowel preparation with oral antibiotics can effectively reduce SSI rates in these procedures.

7. The Role of Sterile Gloves and Instrument Change in SSI Prevention

ChEETAh Study which From June 24, 2020, to March 31, 2022, a total of 81 clusters were randomly divided, involving 13,301 consecutive patients (7,157 in the current practice group and 6,144 in the intervention group). Among these patients, 11,825 (88.9%) were adults. Of the total, 6,125 (46.0%) underwent elective surgeries, while 8,086 (60.8%) had clean-contaminated surgeries, and 5,215 (39.2%) underwent contaminated-dirty surgeries. In the current practice group, glove and instrument changes occurred in 58 patients (0.8%), compared to 6,044 patients (98.3%) in the intervention group. The incidence of surgical site infections (SSIs) was seen in 1,280 patients (18.9%) out of 6,768 in the current practice group, while 931 patients (16.0%) out of 5,789 in the intervention group experienced SSIs. The adjusted risk ratio was calculated to be 0.87 (95% CI: 0.79–0.95; p=0.0032). There were no indications of differing effects across any of the predefined subgroup analyses. Moreover, we did not expect or gather specific information on serious adverse events.[12]

Several clinical trials have investigated the impact of changing sterile gloves and instruments before wound closure on the incidence of SSIs. Some studies have found that changing gloves and instruments before wound closure reduces the risk of contamination and subsequent infection, while others have found no significant benefit. The lack of high-quality evidence, particularly from LMICs, highlights the need for further research on this topic.[41]

Carrol et al. carried out a prospective observational study approved by the institutional review board, focusing on the surgical debridement of infected wounds over a 17-month timeframe at a single site. In each case, two distinct sterile surgical tables were employed: Table A for the initial debridement process and Table B for the

subsequent wound coverage or closure. After completing the debridement, swabs were collected from each table and their associated instruments before moving on to coverage or closure. The main outcome measured was bacterial growth identified after 48 hours. The study included a total of 72 cases. Results showed that Table A exhibited bacterial growth in 23 out of 72 cases (32%) at the 48-hour mark, while Table B showed growth in only 5 out of 72 cases (7%), with a significant difference noted (P = .001). These results suggest a notable level of bacterial contamination on the instruments used for debridement of infected wounds. Implementing a two-table system led to a 78% reduction in instrument cross-contamination, indicating that the risk of re-contaminating the wound is potentially avoidable[42.]

The GlobalSurg Collaborative carried out a study from January 4 to July 31, 2016, during which they analyzed 13,265 records. The research included 12,539 patients from 343 hospitals across 66 different countries. Among these patients, 7,339 (58.5%) were from high-Human Development Index (HDI) nations (involving 193 hospitals in 30 countries), while 3,918 (31.2%) were from middle-HDI countries (82 hospitals in 18 countries), and 1,282 (10.2%) were from low-HDI countries (68 hospitals in 18 countries). Overall, 1,538 patients (12.3%) experienced surgical site infections (SSI) within 30 days following their operations. The rate of SSI was inconsistent across various countries: 9.4% (691 patients) in those with high HDI, 14.0% (549 patients) in middle HDI nations, and 23.2% (298 patients) in low HDI countries ($p < 0.001$). In each HDI category, the most significant SSI rates were seen after dirty surgical procedures: 17.8% (102 patients) in high-HDI countries, 31.4% (74 patients) in middle-HDI countries, and 39.8% (72 patients) in low-HDI countries. When taking risk factors into account, patients from low-HDI countries had the highest likelihood of developing an SSI, with an adjusted odds ratio of 1.60 (95%

credible interval 1.05–2.37; $p = 0.030$). Furthermore, of the 610 patients who had an SSI with a microbiology culture performed, 132 (21.6%) had infections that were resistant to the antibiotic used for prevention. Resistance was identified in 49 (16.6%) of the 295 patients in high-HDI countries, 37 (19.8%) of the 187 patients in middle-HDI nations, and 46 (35.9%) of the 128 patients in low-HDI countries ($p < 0.001$).[44]

Allegranzi et al. conducted a review of a selection of articles related to health-care-associated infections. While a large number of articles were initially considered, only a portion was used in the final analysis. The data collected revealed that many regions and countries were not adequately represented. A significant number of the studies were of low quality. The findings indicated that high-quality studies generally reported higher frequencies of infections compared to low-quality ones. The prevalence of health-care-associated infections was notably higher in these robust studies than the rates found in Europe and the United States. In adult intensive care units, the incidence of health-care-associated infections was reported to be considerably elevated, far exceeding figures from the USA. Gram-negative bacilli were the most frequently identified pathogens in these settings. Although resistance to meticillin was noted in a substantial portion of Staphylococcus aureus isolates, there was a lack of comprehensive reporting on antimicrobial resistance in the literature[45].

In the research conducted by Pinkney et al., 60 patients participated, with 382 allocated to the device group and 378 to the control group. Out of these, six individuals in the device group and five in the control group did not have laparotomy performed. Furthermore, fourteen patients, with seven from each group, were lost to follow-up during the study. In total, 184 patients developed surgical site infections within 30 days post-surgery. This included 91 infections in the device group (24.7% of 369 patients) and 93 infections in the control group (25.4% of 366 patients),

resulting in an odds ratio of 0.97 and a 95% confidence interval ranging from 0.69 to 1.36 (P=0.85). The findings indicated no significant advantage of the device, as consistent results were observed across wound evaluations by clinicians and self-reports from patients, as well as within all secondary outcomes examined. Additionally, the secondary analyses did not reveal any specific subgroup that demonstrated a clinical benefit from the device's usage.[46]

In their analysis, Narice et al. reviewed seven randomized controlled trials that included a total of 1,948 women. They discovered that changing gloves during a cesarean section significantly decreased the risk of wound infections, with a relative risk (RR) of 0.41 (95% confidence interval [CI] 0.26-0.65, $p < 0.0001$), indicating moderate quality evidence. This practice appeared to be beneficial only when executed after the placenta was delivered. However, there were no significant differences noted in the rates of endometritis (RR 0.96, 95% CI 0.78-1.20, $p = 0.74$) or febrile morbidity (RR 0.73, 95% CI 0.30-1.81, $p = 0.50$), regardless of the timing of glove changes, both of which were also evaluated with moderate quality evidence.[47]

Although sterile gloves and instruments are commonly utilized in surgical procedures, there is insufficient high-quality evidence to support the practice of changing gloves and instruments prior to wound closure as a means of reducing surgical site infections (SSIs). Many of the current studies on this topic are constrained by issues such as small participant groups, lack of proper randomization, and inconsistencies in study methodologies.

Several critical questions remain unanswered regarding practices to prevent SSIs. These include evaluating the cost-effectiveness of routinely changing gloves and instruments, understanding the impact of such interventions across different types

of surgical procedures, and examining how other variables—like surgical techniques and the presence of patient comorbidities—contribute to the occurrence of SSIs.

Reviewing the existing literature reveals the considerable challenge posed by SSIs, particularly in LMICs, and points to the necessity for effective, economical strategies to mitigate these infections. While adhering to the principles of aseptic technique through the use of sterile gloves and instruments is standard practice, the evidence supporting the routine replacement of these items before closing a wound is limited and often contradictory.

This study aims to fill this critical gap in knowledge by exploring the relationship between the routine practice of changing sterile gloves and instruments before abdominal wound closure and the subsequent incidence of SSIs in a tertiary care hospital situated in a low-resource setting. By conducting this research, we hope to contribute valuable insights that may inform clinical practices and policies to enhance patient safety and reduce the burden of SSIs in similar healthcare environments.

MATERIALS AND METHODS

Source of Data

The data for this study was collected from KLE'S Dr. Prabhakar Kore hospital and Medical Research Centre, Belagavi, a tertiary care hospital located in Belagavi, Karnataka, India. This hospital serves a large population, including patients from both urban and rural areas, and performs a wide range of surgical procedures, making it an ideal setting for this study. The hospital has a well-established surgical department with standardized protocols for infection control, which ensures consistency in the data collection process.

The data was obtained from patients undergoing elective surgeries, including elective laparotomies, open cholecystectomies, open appendicectomies, and hysterectomies. The hospital maintains detailed medical records for all patients, including preoperative, intraoperative, and postoperative data, which was used for this study. Additionally, postoperative follow-up data was collected during the patients' visits to the hospital for wound assessment and management.

Study Design

This study employs a descriptive cross-sectional study design. A cross-sectional design is appropriate for this study as it allows for the collection of data at a single point in time or over a short period, providing a snapshot of the association between routine changing of sterile gloves and instruments before abdominal wound closure and the incidence of surgical site infections (SSIs). The study compared two groups of patients: Group A- group in which sterile gloves and instruments are routinely changed before wound closure and Group B- group in which this practice is not followed.

The cross-sectional design is particularly suitable for this study as it allows for the assessment of the prevalence of SSIs and the identification of risk factors associated with SSIs in a real-world clinical setting. The study also evaluated the impact of routine glove and instrument change on postoperative outcomes, including length of hospital stay, need for additional surgical interventions, and mortality.

Study Period

The study was conducted over a period of one year, from September 1, 2023, to August 31, 2024. This duration is sufficient to enroll an adequate number of patients and to capture the incidence of SSIs, which typically occur within 30 days of surgery (or 90 days if an implant is involved). The one-year study period also allows for seasonal variations in surgical procedures and infection rates, ensuring that the findings are representative of the entire year.

Place of Study

The study was conducted at the Department of General Surgery, Jawaharlal Nehru Medical College (JNMC), which is part of the KLE’S Dr. Prabhakar Kore hospital and Medical Research Centre in Belagavi, Karnataka, India. The hospital is a tertiary care center with a high volume of surgical procedures, making it an ideal location for this study. The hospital has a well-established infection control program, and all surgical procedures are performed under standardized protocols, ensuring consistency in the data collection process.

Sample Size

The sample size for this study was calculated based on the expected prevalence of SSIs in the study population. According to a previous study by Ademuyiwa et al. (2022), the SSI rate in patients undergoing abdominal surgeries is approximately 18.9%. Using this prevalence, the sample size was calculated with a

95% confidence level and an absolute precision of 7.8%. The following formula was used for sample size calculation:

Where:

$$N = \frac{Z^2 P(1-P)}{d^2}$$

- n = Sample size
- Z = Z statistic for a 95% confidence level (1.960)
- P = Expected prevalence of SSIs (0.189)
- d = Precision (0.078)

Using this formula, the required sample size was calculated to be 97 patients. To account for potential attrition, an additional 5% of patients were added to the sample size, resulting in a final sample size of 102 patients. For practical purposes, the sample size was rounded up to 105 patients.

Sampling Method

The study used consecutive sampling to ensure that the sample is representative of the patient population undergoing elective abdominal surgeries. Patients were seen based on whether they undergo routine changing of sterile gloves and instruments before abdominal wound closure or not.

Inclusion Criteria

The following inclusion criteria were used to select patients for the study:

1. Age: Patients aged 18 to 65 years.
2. Type of Surgery: Patients undergoing elective laparotomies, open cholecystectomies, open appendicectomies, or hysterectomies.
3. Consent: Patients who are willing to provide informed consent for participation in the study.

4. No Immunodeficiency: Patients who are not immunodeficient or on corticosteroid therapy.
5. No HIV or Hepatitis B: Patients who are HIV and HBsAg seronegative.

Exclusion Criteria

The following exclusion criteria was applied to ensure that the study population is homogeneous and that confounding factors are minimized:

1. Cesarean Sections: Patients undergoing cesarean sections were excluded, as these procedures have different risk factors for SSIs.
2. Laparoscopic Surgeries: Patients undergoing laparoscopic surgeries were excluded, as these procedures have a lower risk of SSIs compared to open surgeries.
3. Emergency Surgeries: Patients undergoing emergency laparotomies were excluded, as these procedures are associated with higher rates of contamination and infection.
4. Immunodeficiency: Patients who are immunodeficient or on corticosteroid therapy was excluded, as these conditions increase the risk of SSIs.
5. HIV or Hepatitis B: Patients who are HIV or HBsAg seropositive were excluded, as these conditions may affect wound healing and increase the risk of SSIs.

Method of Data Collection

Data was collected using a structured proforma that includes both preoperative and postoperative variables. The proforma was designed to capture all relevant data, including patient demographics, surgical details, and postoperative outcomes. The following data collection procedure was followed:

1. Preoperative Data Collection:
    i. Patient demographics (age, sex, address, religion, education, occupation).
    ii. Medical history (past surgical history, comorbidities, medication use).
    iii. Preoperative investigations (hemoglobin, blood sugar, renal function tests, etc.).
2. Intraoperative Data Collection:
    i. Type of surgery (elective laparotomy, open cholecystectomy, open appendicectomy, or hysterectomy).
    ii. Duration of surgery.
    iii. Whether sterile gloves and instruments were changed before wound closure.
3. Postoperative Data Collection:
    i. Wound assessment on postoperative day 3, day 7, and day 14 using the Southampton Wound Grading System.
    ii. Sending culture for data analysis
    iii. Presence of SSIs, including wound discharge, erythema, or purulent exudate.
    iv. Length of hospital stay.
    v. Need for additional surgical interventions (e.g., wound debridement, drainage of abscess).
    vi. Mortality within 30 days of surgery.

SOUTHAMPTON WOUND GRADING SYSTEM

GRADE	APPEARANCE
0	**Normal healing**
I	**Normal healing with mild bruising or erythema**
Ia	Some bruising
Ib	Considerable bruising
Ic	Mild erythema
II	**Erythema plus other signs**
IIa	At one point
IIb	Around sutures
IIc	Along wound
III	**Clear or haemoserous discharge**
IIIa	At one point only (< 2cm)
IIIb	Along wound (>2 cm)
IIIc	Large volume
IV	**Pus**
IVa	At one point only (< 2 cm)
IVb	Along wound (>2 cm)
V	**Deep or severe wound infection with or without tissue breakdown; hematoma requiring aspiration**

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The Southampton Wound Grading System was used to assess the severity of SSIs. The grading system is as above[50].

Statistical Analysis

The data was analyzed using SPSS version 25.0 (Statistical Package for the Social Sciences). The following statistical methods were used:

1. Descriptive Analysis:

i. Quantitative variables (e.g., age, duration of surgery) was summarized using mean and standard deviation.

ii. Categorical variables (e.g., presence of SSIs, type of surgery) were summarized using frequency and percentage.

2. Inferential Analysis:

i. The association between categorical explanatory variables (e.g., type of surgery, use of prophylactic antibiotics) and quantitative outcomes (e.g., length of hospital stay) was assessed using independent sample t-tests or ANOVA.

ii. The association between categorical explanatory variables and categorical outcomes (e.g., presence of SSIs) was assessed using chi-square tests or Fisher's exact test.

iii. Univariate binary logistic regression was used to assess the association between explanatory variables and the presence of SSIs. Variables with a p-value < 0.05 in the univariate analysis was included in a multivariate logistic regression model to identify independent risk factors for SSIs.

Variables List

The following variables were included in the study:

1. Independent Variables:

i. Routine changing of sterile gloves and instruments before wound closure (yes/no).

ii. Type of surgery (elective laparotomy, open cholecystectomy, open appendicectomy, hysterectomy).

iii. Duration of surgery.

iv. Use of prophylactic antibiotics.

v. Patient comorbidities (diabetes, hypertension, obesity).

2. Dependent Variables:

i. Incidence of SSIs (yes/no).

ii. Severity of SSIs (Southampton Wound Grading System).

iii. Length of hospital stay.

iv. Need for additional surgical interventions.

v. Mortality within 30 days of surgery.

RESULTS

Table 1. Distribution of age of the patients among the two groups (N=105)

Age group (in years)	Group A		Group B		P value*
	n	%	n	%	
17-30	11	23.4	8	13.8	0.53
31-40	8	17.0	9	15.5	
41-50	14	29.8	18	31.0	
51-60	8	17.0	18	31.0	
61-70	4	8.5	4	6.9	
71-80	2	4.3	1	1.7	
Total	**47**	**100.0**	**58**	**100.0**	

*Chi-Squared test

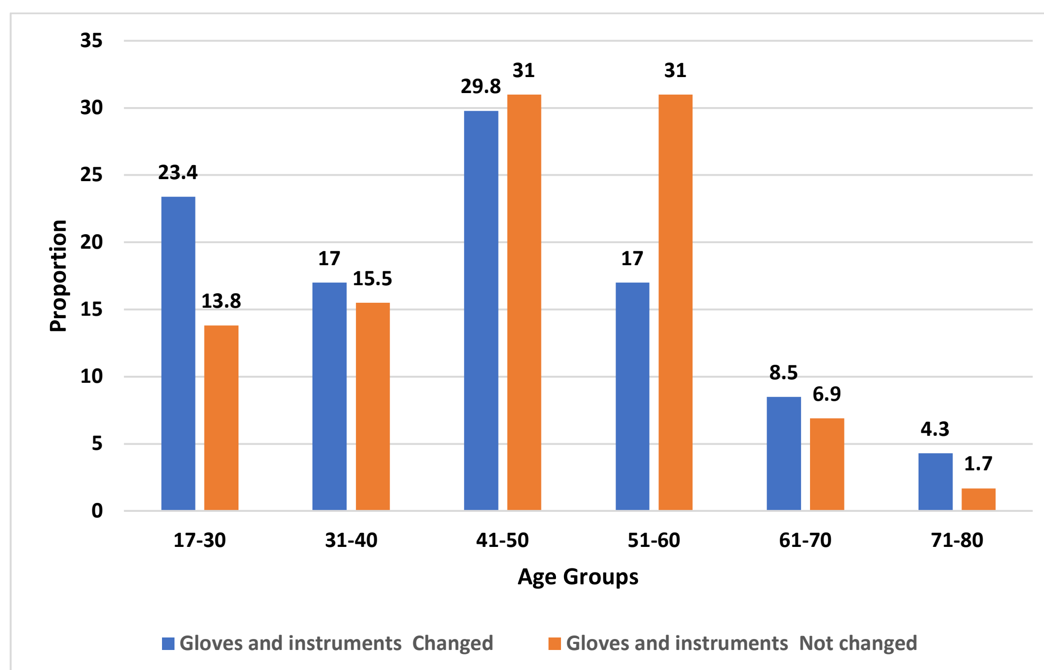

Figure 1. Distribution of age of the patients among the two groups

Table 1 presents the age group distribution for Group A versus Group B. The age group 17-30 years had 23.4% (11 patients) in the group A and 13.8% (8 patients) in the group B. The 31-40 years group had 17.0% (8 patients) in the group A and 15.5% (9 patients) in the. For the 41-50 years group, 29.8% (14 patients) were in the group A, while 31.0% (18 patients) were in the group B. Among those aged 51-60 years, 17.0% (8 patients) were in group A, compared to 31.0% (18 patients) in group B. The 61-70 years age group consisted of 8.5% (4 patients) in the group A and 6.9% (4 patients) in the group B. For those aged 71-80 years, 4.3% (2 patients) were in group A, and only 1.7% (1 patient) were in group B. In total, 47 patients (100%) in the group A and 58 patients (100%) in the group B were included in the study.

Table 2. Distribution of gender of the patients among the two groups (N=105)

Gender	Gloves and instruments				P value*
	Group A		Group B		
	n	%	n	%	
Male	28	59.6	32	55.2	0.65
Female	19	40.4	26	44.8	
Total	**47**	**100.0**	**58**	**100.0**	

*Chi-Squared test

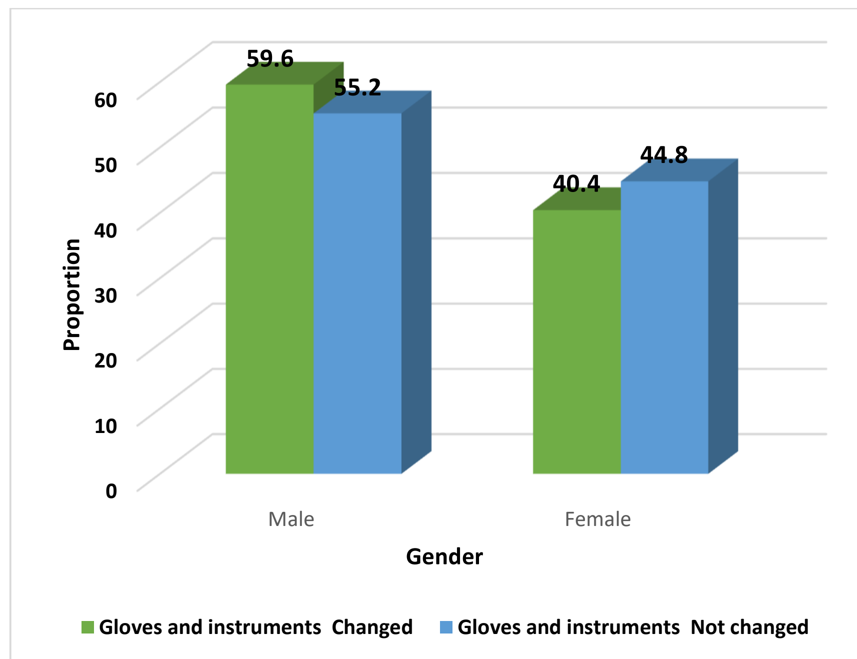

Figure 2. Distribution of gender of the patients among the two groups

Table 2 presents the gender distribution of Group A versus those Group B. Among males, 59.6% (28 patients) were in the group A, while 55.2% (32 patients) were in the group B. For females, 40.4% (19 patients) were in the group A, and 44.8% (26 patients) were in the group B.

Table 3. Comparison of comorbidities and previous surgeries of the patients among the two groups (N=105)

Comorbidities and previous surgeries	Gloves and instruments				P value*
	Group A		Group B		
	n	%	n	%	
Hernia repair	1	2.1	1	1.7	0.15
Hysterectomy	2	4.3	0	0.0	
Left inguinal hernia	2	4.3	0	0.0	
Right inguinal hernia	1	2.1	0	0.0	
LSCS	2	4.3	0	0.0	
Old CVA	0	0.0	1	1.7	
Tubectomy	0	0.0	1	1.7	
Nil	39	83.0	55	94.8	
Total	**47**	**100.0**	**58**	**100.0**	

*Chi-Squared test

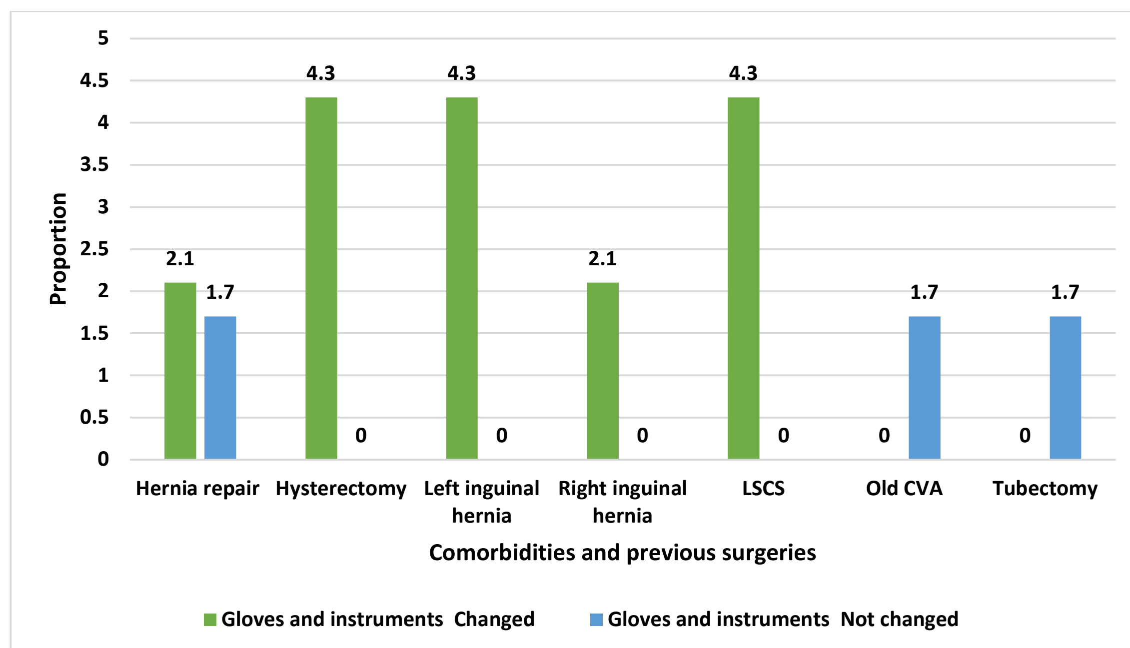

Figure 3. Comparison of comorbidities and previous surgeries of the patients among the two groups

Table 3 presents the distribution of comorbidities and previous surgeries among Group A versus Group B. For patients in group A, 2.1% (1 patient) had a hernia repair, 4.3% (2 patients) had a hysterectomy, 4.3% (2 patients) had a left inguinal hernia, 2.1% (1 patient) had a right inguinal hernia, and 4.3% (2 patients) had an LSCS. No patients in the group A had a previous CVA or tubectomy. In the group B, 1.7% (1 patient) had a hernia repair, while no patients had a hysterectomy, left inguinal hernia, right inguinal hernia, or LSCS. However, 1.7% (1 patient) in the group B had an old CVA, and another 1.7% (1 patient) had a tubectomy. The majority of patients in both groups reported no previous comorbidities or surgeries, with 83.0% (39 patients) in the group A and 94.8% (55 patients) in the group B.

Table 4. Comparison of procedure of the patients among the two groups (N=105)

Procedure of the patients	Gloves and instruments				P value*
	Group A		Group B		
	n	%	n	%	
EL+ Appendectomy	9	19.2	17	29.3	0.32
EL+ Cholecystectomy	4	8.5	9	15.5	
EL+ R & A	27	57.5	24	41.4	
Others	7	14.8	8	13.8	
Total	**47**	**100.0**	**58**	**100.0**	

*Chi-Squared test

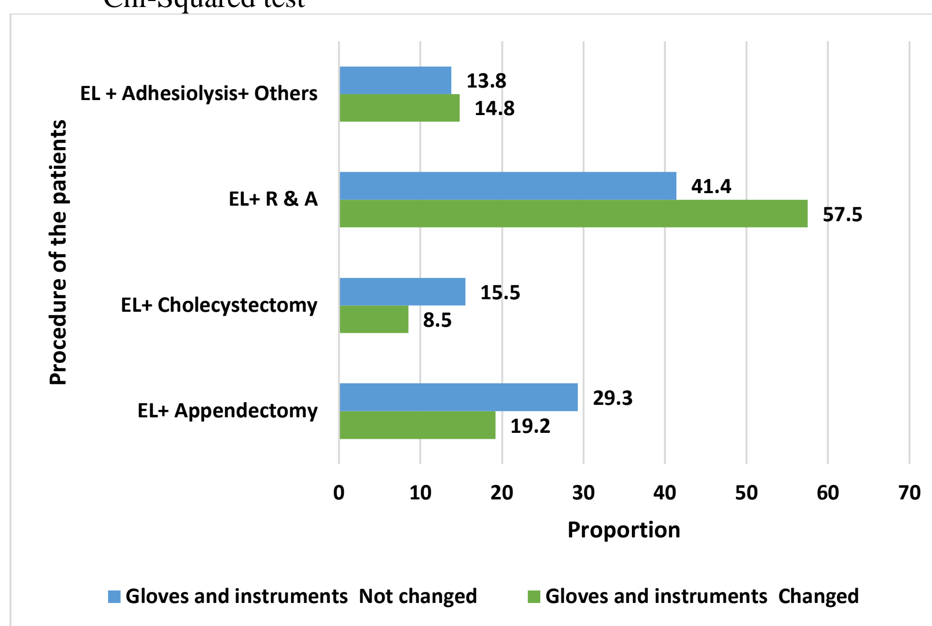

Figure 4. Comparison of procedure of the patients among the two groups

Table 4 compares the procedures performed on patients between the two groups (N=105) Group A and Group B, where “N” is the total number of participants in the study categorized by whether gloves and instruments were changed. In the Group A, 19.2% of patients underwent EL+ Appendectomy, 8.5% had EL+ Cholecystectomy, 57.5% underwent EL+ R & A, and 14.8% had EL+ Adhesiolysis and others. In the Group B, 29.3% had EL+ Appendectomy, 15.5% had EL+ Cholecystectomy, 41.4% underwent EL+R&A, and 13.8% underwent other procedures.

Table 5. Comparison of duration of stay in hospital and duration of surgery among the two groups (N=105)

Variables	Gloves and instruments Mean (SD)		P value*
	Group A	Group B	
Duration of stay (day)	10.8 (4.6)	11.1 (3.6)	0.71
Duration of surgery (hour)	2.7 (0.9)	2.6 (0.8)	0.55

*Independent T test

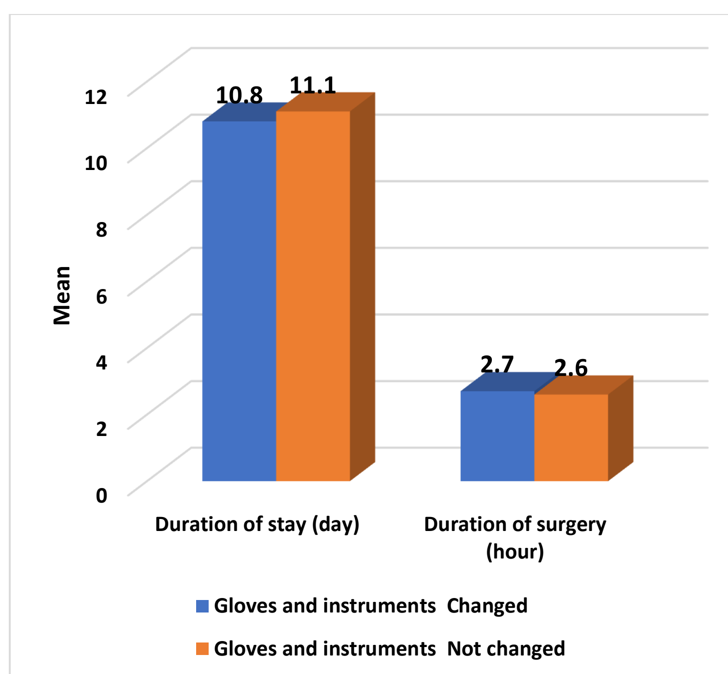

Figure 5. Comparison of duration of stay in hospital and duration of surgery among the two groups

Table 5 compares the duration of hospital stay and duration of surgery between the two groups (N=105). For the duration of hospital stay, the mean for the group A was 10.8 days with a standard deviation of 4.6, while the group B had a mean of 11.1 days with a standard deviation of 3.6. Regarding the duration of surgery, the group A had a mean duration of 2.7 hours (SD = 0.9), while the group B had a mean of 2.6 hours (SD = 0.8).

Table 6. Comparison of clinical profile among the two groups (N=105)

Variables	Gloves and instruments Mean (SD)		P value*
	Group A	**Group B**	
Haemoglobin (g/dL)	12.1 (±1.5)	11.7 (±1.8)	0.14
RBS (mg/dL)	112.8 (±11.3)	111.9 (±14.4)	0.71
WBC (cells per μL)	9627.7 (±2325.3)	10974.1 (±2370.2)	**0.004**
Platelets (mm)	165085.1 (±38043.9)	180465.5 (±42677.9)	0.05

*Independent T test

Table 6 compares the clinical profile of patients in the two groups (N=105) where "N" is the total number of participants in the study. For hemoglobin levels, the mean for the group A was 12.1 g/dL (SD = 1.5), while group B had a mean of 11.7 g/dL (SD = 1.8). Regarding random blood sugar (RBS), group A had a mean of 112.8 mg/dL (SD = 11.3), and group B had a mean of 111.9 mg/dL (SD = 14.4). For white blood cell (WBC) count, group A had a mean of 9627.7 cells per μL (SD = 2325.3), while group B had a mean of 10974.1 cells per μL (SD = 2370.2), with a p-value of 0.004, suggesting a statistically significant difference between the two groups. Finally, for platelet count, group A had a mean of 165,085.1/mm³ (SD = 38,043.9), while group B had a mean of 180,465.5/mm³ (SD = 42,677.9), with a p-value of 0.05, indicating a borderline significant difference.

Table 7. Comparison of type of surgical wound of the patients among the two groups (N=105)

Type of surgical wound	Gloves and instruments				P value*
	Group A		Group B		
	n	%	n	%	
Contaminated	2	4.3	0	0.0	0.26
Clean	5	10.6	8	13.8	
Clean contaminated	40	85.1	50	86.2	
Total	**47**	**100.0**	**58**	**100.0**	

*Chi-Squared test

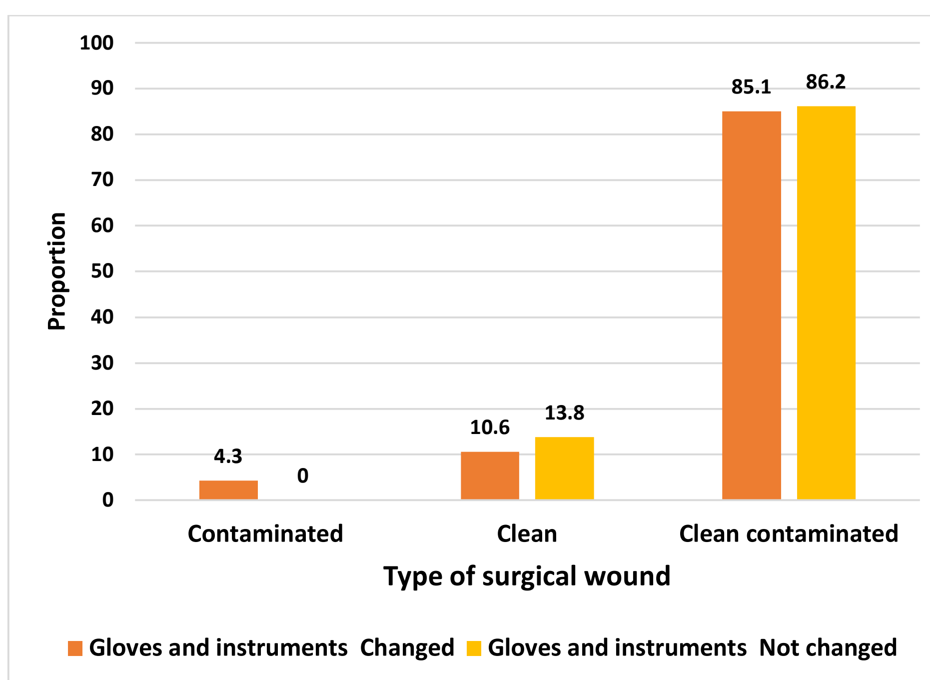

Figure 6. Comparison of type of surgical wound of the patients among the two groups

Table 7 presents the distribution of surgical wound types in Group A versus Group B. For contaminated wounds, 4.3% (2 patients) were in the group A, while none (0%) in the group B had a contaminated wound. For clean wounds, 10.6% (5 patients) were in the group A, compared to 13.8% (8 patients) in the group B. In the clean contaminated wound category, 85.1% (40 patients) were in the group A, while 86.2% (50 patients) were in the group B.

Table 8. Comparison of anaesthesia given to the patients among the two groups (N=105)

Anaesthesia	Gloves and instruments				P value*
	Group A		Group B		
	n	%	n	%	
GA	46	97.9	58	100.0	0.26
SA	1	2.1	0	0.0	
Total	**47**	**100.0**	**58**	**100.0**	

*Chi-Squared test

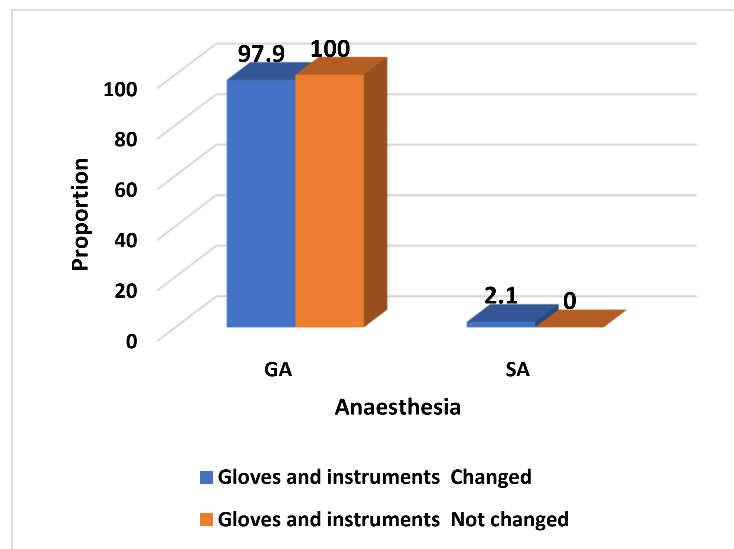

Figure 7. Comparison of anaesthesia given to the patients among the two groups

Table 8 compares the type of anaesthesia given to patients in the two groups (N=105). For general anaesthesia (GA), 97.9% (46 patients) in the group A received GA, while 100.0% (58 patients) in the group B received GA. For spinal anaesthesia (SA), 2.1% (1 patient) in the group A received SA, and no patients (0%) in the group B received SA.

Table 9. Comparison of organisms on culture among the two groups (N=105)

Organisms	Gloves and instruments				P value*
	Group A		Group B		
	n	%	n	%	
Staphylococcus Aureus	0	0.0	1	1.7	<0.001
MRSA	0	0.0	1	1.7	
Klebshiella	0	0.0	3	5.2	
E. coli	1	2.1	30	51.7	
No organisms	46	97.9	23	39.7	
Total	**47**	**100.0**	**58**	**100.0**	

*Chi-Squared test

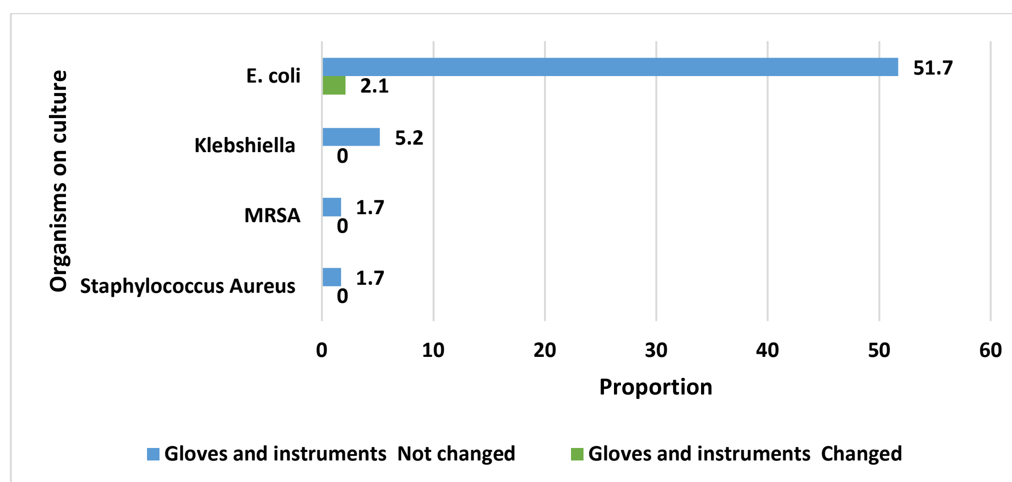

Figure 8. Comparison of organisms on culture among the two groups

Table 9 compares the organisms found in cultures between the two groups (N=105). For **Staphylococcus aureus**, no patients in the group A had this organism, while 1.7% (1 patient) in the group B tested positive for it. Similarly, no patients in the group A had **MRSA**, while 1.7% (1 patient) in the group B tested positive for it. For **Klebsiella**, no patients in the group A were affected, compared to 5.2% (3 patients) in the group B, Regarding **E. coli**, 2.1% (1 patient) in the group A had this organism, while 51.7% (30 patients) in the group B were affected. In the group A, 97.9% (46 patients) had no organisms detected, while 39.7% (23 patients) in the group B showed no organisms. The p-values (<0.001) indicate a significant difference between the two groups.

Table 10. Comparison of Southampton wound grading score among the two groups (N=105)

Southampton wound grading score	Gloves and instruments				P value*
	Group A		Group B		
	n	%	n	%	
1A	44	93.6	11	19.0	**<0.001**
1B	2	4.3	5	8.6	
1C	0	0.0	11	19.0	
2A	1	2.1	10	17.3	
2B	0	0.0	14	24.1	
2C	0	0.0	1	1.7	
3A	0	0.0	6	10.3	
Total	**47**	**100.0**	**58**	**100.0**	

*Chi-Squared test

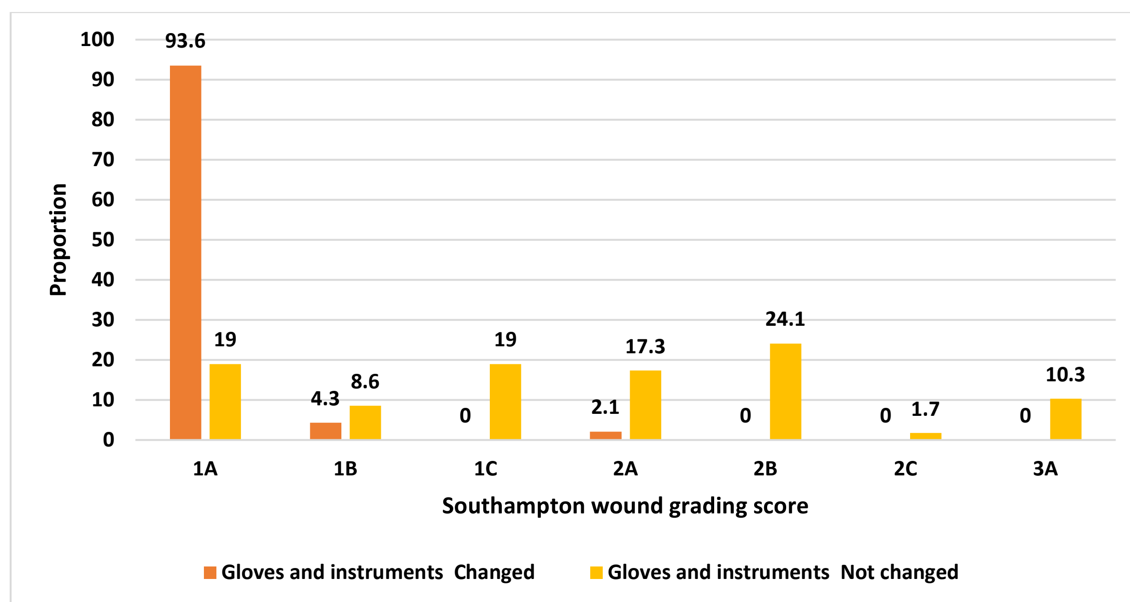

Figure 9. Comparison of Southampton wound grading score among the two groups

Table 10 compares the Southampton wound grading scores between the two groups (N=105). For **Grade 1A**, 93.6% (44 patients) in the group A had this score, while only 19.0% (11 patients) in the group B had a Grade 1A wound. For **Grade 1B**, 4.3% (2 patients) in the group A had this score, compared to 8.6% (5 patients) in the group B. For **Grade 1C**, no patients in the group A had this score, while 19.0% (11 patients) in the group B did. Regarding **Grade 2A**, 2.1% (1 patient) in the group A had this score, while 17.3% (10 patients) in the group B had a Grade 2A wound. For **Grade 2B**, no patients in the group A had this score, while 24.1% (14 patients) in the group B did. For **Grade 2C**, no patients in the group A had this score, while 1.7% (1 patient) in the group B did. For **Grade 3A**, no patients in the group A had this score, while 10.3% (6 patients) in the group B did. The p-value indicates a significant difference in the distribution of Southampton wound grading scores between the two groups.

Table 11. Comparison of dressing changed post operatively among the two groups (N=105)

Dressing changed post operatively	Gloves and instruments				P value*
	Group A		Group B		
	n	%	n	%	
POD- 3rd 4th 5th 6th 7th 14th	0	0.0	7	12.1	0.01
POD- 3rd 7th 14th	47	100.0	58	87.9	
Total	**47**	**100.0**	**58**	**100.0**	

*Chi-Squared test

Table 11 compares the timing of dressing changes post-operatively between two groups (N=105) based on whether gloves and instruments were changed. In the group A, 100% of patients had their dressings changed on the 3rd, 7th, and 14th post-operative days. In contrast, only 87.9% of patients in the group B had their dressing changed on these days, with 12.1% of them having their dressings changed on other days (POD-3rd, 4th, 5th, 6th, 7th, and 14th). The differences in timing between the two groups were statistically significant (P = 0.01), as indicated by the Chi-squared test.

Table 12. Comparison of culture sent post operatively among the two groups (N=105)

Culture sent post operatively	Gloves and instruments			
	Group A		Group B	
	n	%	n	%
POD- 3rd	47	100.0	58	100.0
Total	**47**	**100.0**	**58**	**100.0**

Table 12 compares the timing of culture samples sent post-operatively between the two groups (N=105). All patients in both the groups had a culture sent on the 3rd post-operative day, with 100.0% (47 patients) in the group A and 100.0% (58 patients) in the group B. There were no differences between the two groups in the timing of cultures sent post-operatively.

DISCUSSION

The results of this study provide valuable insights into the association between the routine changing of sterile gloves and instruments before abdominal wound closure and the incidence of surgical site infections (SSIs) in a tertiary care hospital setting. The findings offer important clinical observations and trends.

The age distribution of patients in our study was relatively balanced across different age groups. Among the 105 patients, the largest proportion belonged to the 41–50 years category, comprising 29.8% of the intervention group and 31.0% of the control group. The 17–30 years and 51–60 years age groups also had notable representation, accounting for 23.4% and 17.0% in the intervention group, respectively. Older age groups (61–70 years and 71–80 years) were less frequent, with only a small percentage of patients in each category. Nayak et al. found that the demographic characteristics of both groups were similar, with 13% of the cases and 12.3% of the controls under 18.[48] A good gender balance is noted, with 59.6.1% vs 55.2% of males and 40.4% vs 44.8% of female participants among cases and controls.

Duration of Hospital Stay and Surgery

The duration of hospital stay was slightly lower in the Group A (10.8 ± 4.6 days) compared to the Group B (11.1 ± 3.6 days), but this difference was not significant (p=0.71). Similarly, the mean duration of surgery was comparable between the two groups (2.7 ± 0.9 hours vs. 2.6 ± 0.8 hours, p=0.55). These results indicate that changes in gloves and instruments did not substantially impact surgical duration or hospital stay, suggesting other factors may play a more dominant role in determining these outcomes.

Clinical Profile

Patients in the Group A had a slightly higher mean hemoglobin level (12.1 ± 1.5 g/dL) compared to the Group B(11.7 ± 1.8 g/dL), though this was not significant (p=0.14). Random blood sugar (RBS) levels were nearly identical between the groups. However, the white blood cell (WBC) count was significantly lower in the Group A (9627.7 ± 2325.3 cells/µL) compared to the Group B (10974.1 ± 2370.2 cells/µL), with a significant p-value of 0.004. Additionally, platelet counts were marginally lower in the Group A(165085.1 ± 38043.9) compared to the Group B(180465.5 ± 42677.9), with a borderline significant p-value of 0.05. The lower WBC and platelet counts in the Group A suggest a potentially reduced inflammatory response, which could have implications for post-operative infection control.

Surgical Wound Classification and Anaesthesia

The classification of surgical wounds was similar between the groups, with most wounds categorized as clean-contaminated. A small number of contaminated wounds (4.3%) were observed in the Group A, whereas none were found in the Group B. The type of anesthesia used was also consistent across both groups, with general anesthesia (GA) being the predominant choice. These findings indicate that surgical approach and wound classification were unlikely to influence the differences observed in post-operative outcomes. A study by Nayak et al. examined the distribution of surgical site infections (SSIs) based on wound classification in case and control groups, revealing significant differences. Clean-contaminated wounds were most common, with 42.1% of SSI-positive patients in the case group having this classification, compared to 75.7% in the SSI-negative group. In the control group, 78.6% of SSI-positive cases were clean-contaminated, with 69.9% being SSI-

negative. Contaminated wounds accounted for 36.8% of SSI-positive cases in the case group, compared to 16.7% in the control group. The percentage of SSI-negative cases was similar in both groups (15.8% vs. 17.6%). Dirty wounds had the highest SSI rates, with 21.1% of SSI-positive cases in the case group classified as dirty, versus 8.6% of SSI-negative cases. In the control group, 4.8% of SSI-positive cases were dirty, while 12.4% of SSI-negative cases were in this category. These findings highlight the link between wound contamination and the risk of postoperative infections, underscoring the need for strict infection control measures, particularly for contaminated and dirty wounds.[48]

Microbiological Findings

A notable difference was observed in the presence of organisms on culture. While 51.7% of patients in the "not changed" group had *E. coli* infections, only 2.1% of the "changed" group exhibited the same. Furthermore, 97.9% of patients in the "changed" group showed no organism growth on culture, compared to only 39.7% in the "not changed" group. This suggests that changing gloves and instruments could be associated with a substantial reduction in microbial contamination, thereby potentially reducing the risk of post-operative infections. The observed lower rate of microbial contamination in the "changed" group aligns with findings from the ChEETAh trial, which demonstrated a significant reduction in SSIs when gloves and instruments were changed before abdominal wound closure. The ChEETAh study, conducted across multiple LMICs, found a 13% reduction in SSI rates when this practice was implemented. This supports the notion that routine glove and instrument changes may play a crucial role in reducing SSIs, even in resource-limited settings.[12]

Wound Healing Outcomes

The Southampton wound grading score was significantly better in the "changed" group. A remarkable 93.6% of patients in this group had a 1A wound score (indicating optimal healing), compared to only 19.0% in the "not changed" group. Conversely, higher grades of wound infection and delayed healing were more frequent in the "not changed" group (e.g., 24.1% had grade 2B wounds vs. 0% in the "changed" group). This further supports the potential benefits of changing gloves and instruments in reducing post-operative wound complications. Wolfhagen et al. discovered that the introduction of a new set of gloves and instruments used by all surgical staff, including scrub nurses, before closing the abdomen led to a significant and lasting decrease in surgical site infections (SSI) across various metrics. This indicates that making a straightforward adjustment to standard procedures can enhance patient outcomes in abdominal surgeries by lowering the risk of SSI, which is crucial since such infections can elevate morbidity and mortality rates and also create financial burdens for patients and the healthcare system.[49]

Post-operative Dressing and Culture

All patients in both groups underwent dressing changes on postoperative day 3, 7, and 14, and for the wounds with active discharge the dressings were done on post operative day 3, 4, 5, 6, 7 and 14 cultures were sent on postoperative day 3. This uniformity in post-operative care ensures that the observed differences in infection rates and healing outcomes were likely attributable to intraoperative practices rather than variations in post-operative management.

These observed trends indicate meaningful differences in clinical outcomes. The findings suggest that changing gloves and instruments may contribute to lower post-operative infection rates, improved wound healing, and reduced systemic inflammatory responses, as evidenced by lower WBC counts and improved Southampton wound grading. These insights emphasize the importance of maintaining stringent intraoperative sterility protocols. Future studies with larger sample sizes are warranted to confirm these findings and further elucidate the mechanisms underlying these trends.

Strengths

1. This study provides valuable insights into the role of routine glove and instrument changes in reducing SSIs, particularly in resource-limited settings.
2. The inclusion of microbiological data adds robustness to the findings, as the reduction in microbial contamination directly supports the observed lower SSI rates in the intervention group.
3. The study contributes to existing literature by comparing findings with large-scale trials such as ChEETAh and other relevant research, strengthening the external validity of the results.
4. By analyzing a range of clinical and surgical parameters, including WBC counts, platelet levels, and wound grading, the study offers a comprehensive assessment of post-operative infection risk factors.

Limitations

1. The study's sample size was relatively small, limiting the statistical power to detect significant differences across all variables.
2. Some p-values were not statistically significant, potentially due to sample size constraints, limiting the ability to draw definitive conclusions.
3. The study was conducted in a single tertiary care hospital, which may limit the generalizability of findings to other healthcare settings, particularly in different geographic regions.
4. The study did not account for additional confounding variables such as surgeon experience, variations in post-operative care, and differences in antibiotic use, which could have influenced SSI outcomes.
5. A longer follow-up period would be beneficial to assess long-term outcomes, as some infections may manifest beyond the study’s observational window.

CONCLUSION

This study underscores the potential benefits of routine glove and instrument changes before wound closure in reducing SSIs. While statistical significance was not achieved for all parameters, the observed trends indicate meaningful differences in postoperative outcomes, including lower microbial contamination rates, reduced inflammatory markers, and improved wound healing. These findings align with previous large-scale studies, reinforcing the importance of intraoperative sterility in mitigating infection risks.

Given the global burden of SSIs, particularly in LMICs, cost-effective strategies such as routine glove and instrument changes can offer a practical solution to improving surgical outcomes. Future research should focus on larger, multi-centre trials to validate these findings and explore additional factors influencing SSIs. Furthermore, cost-effectiveness analyses and long-term follow-up studies are needed to establish the feasibility of incorporating this practice into standard surgical protocols. By strengthening aseptic measures during surgery, healthcare systems can take a proactive step toward reducing the morbidity and economic burden associated with SSIs.

SUMMARY

Surgical Site Infections (SSIs) remain a major challenge in healthcare, particularly in LMICs, where infection rates are higher due to resource constraints. This study examines whether routine changes of sterile gloves and instruments before abdominal wound closure can reduce SSIs in elective surgeries. Conducted at a tertiary care hospital in India, the study included 105 patients divided into an intervention group (routine change of gloves and instruments) and a control group (no change). Data were collected on demographic variables, surgical procedures, and microbiological cultures, with SSI assessment based on the Southampton Wound Grading System. The findings revealed that the intervention group experienced significantly lower SSI rates, particularly with reduced *E. coli* contamination. Additionally, wound healing outcomes were superior in the intervention group, while no significant differences were noted in hospital stay duration or surgery length. These results align with previous research, such as the ChEETAh trial, supporting the adoption of routine glove and instrument changes as a simple, cost-effective strategy to mitigate SSIs. Further large-scale studies are needed to confirm long-term benefits and cost-effectiveness across different healthcare settings.

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ANEXURE I – INFORMED CONSENT FORM

KAHERs JNMC, BELAGAVI

CONSENT STATEMENT

I am making a voluntary decision to participate in the study "**THE ASSOCIATION OF STERILE GLOVE AND INSTRUMENT CHANGE AT THE TIME OF ABDOMINAL WOUND CLOSURE TO PREVENT SURGICAL SITE INFECTIONS- ONE YEAR DESCRIPTIVE CROSS SECTIONAL STUDY"** My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

ANEXURE II – PROFORMA / QUESTIONNAIRE USED FOR DATA COLLECTION

This proforma is to being used for the data collection for the study titled: **ASSOCIATION OF THE ROUTINE CHANGE OF STERILE GLOVES AND INSTRUMENTS AT THE TIME OF ABDOMINAL WOUND CLOSURE TO THE SURGICAL SITE INFECTIONS – ONE YEAR DECRIPTIVE CROSS SECTIONAL STUDY** is as –

GROUP –

NAME-

IP NUMBER-

SEX-

AGE-

ADDRESS-

RELIGION-

EDUCATION-

DATE OF ADMISSION –

OCCUPATION –

DATE OF DISCHARGE –

CHIEF COMPLAINTS –

HISTORY OF PRESENTING ILLNESS –

PAST HISTORY –

PERSONAL HISTORY –

FAMILY HISTORY –

GENERAL PHYSICAL EXAMINATION –

BUILT AND NOURISHMENT-

WEIGHT –

PALLOR/ICTERUS/CLUBBING/CYANOSIS/EDEMA/

LYMPHADENOPATHY- VITAL SIGNS: PR, BP, TEMPERATURE

SYSTEMIC EXAMINATION –

ABDOMEN-

INSPECTION

PALPATION

PERCUSSION

AUSCULTATION

CARDIOVASCULAR SYSTEM-

RESPIRATORY SYSTEM-

CLINICAL IMPRESSION –

PROCEDURE DONE —

DURATION OF THE PROCEDURE –

ANESTHESIA –

INVESTIGATIONS –

HEMOGLOBIN-

TOTAL AND DIFFERENTIAL LEUKOCYTE COUNT –

PLATELETS –

RBS –

CULTURE AND SENSITIVITY –

DRESSING CHANGED ON DAY-

ASSESSMENT OF SURGICAL SITE INFECTIONS
SOUTHAMPTON WOUND GRADING SYSTEM

GRADE	APPEARANCE
0	**Normal healing**
1	**Normal healing with mild bruising or erythema**
1A	Some bruising
1B	Considerable bruising
1C	Mild Erythema
2	**Erythema plus other signs**
2A	At one point
2B	Around sutures
2C	Along wound
3	**Clean of hemoserous discharge**
3A	At one point only <2cm
3B	Along wound >2cm
3C	Large volume
4	**Pus**
4A	At one point only <2cm
4B	Along wound >2cm
5	**Deep or severe wound infections with or without tissue breakdown; hematoma requiring aspiration**

Follow up on Day-3, Day-7 and Day-14–

ANEXURE III - KEY TO MASTER CHART

DOS - DURATION OF STAY

CO MORBS AND PS - CO MORBIDITIES AND PREVIOUS SURGERIES

COP - CATEGORY OF PROCEDURE

TOSW - TYPE OF SURGICAL WOUND

HB - HEMOGLOBIN

WBC - WHITE BLOOD CELLS

RBS - RANDOM BLOOD SUGAR

PLT - PLATELETS

SSS - SOUTHAMPTOM SCORING SYSTEM

DCD - DRESSING CHANGE DAY

GROUP	SEX	AGE	DOS	CO MORBS AND PS	DIAGNOSIS	PROCEDURES	COP	TOSW	DOS2	HB/WBC/RBS/PLT	CULTURE	SSS	DCD
2	FEMALE	59	15	HYSTERECTOMY	INTESTINAL OBSTRUCTION	EL+R&A	3	CC	2	9.7/7,000/119/2,44,000	NO ORGANISMS	1A	POD - 3,7,14
2	FEMALE	23	17	-	INTESTINAL OBSTRUCTION	EL+ADHESIOLYSIS	4	CC	2.5	12.6/7,000/100/1,20,000	NO ORGANISMS	1A	POD - 3,7,14
1	MALE	45	7	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	3	13/8,000/100/1,50,000	NO ORGANISMS	1C	POD - 3,7,14
1	MALE	45	7	-	INTESTINAL OBSTRUCTION	EL+R&A	3	CC	5	15/12,000/110/1,50,000	E.COLI	2A	POD - 3,7,14
2	MALE	25	5	-	INTESTINAL OBSTRUCTION	EL+R&A	3	CC	2	10/11,000/111/1,44,000	NO ORGANISMS	1A	POD - 3,7,14
1	MALE	51	6	-	GALLBLADDER CALCULI	EL+CHOLECYSTECTOMY	2	CC	2	9/11,000/120/2,50,000	NO ORGANISMS	1A	POD - 3,7,14
1	MALE	45	8	-	DUODENAL OBSTRUCTION	EL+R&A	3	CC	3	12/8,000/120/2,53,000	NO ORGANISMS	1A	POD - 3,7,14
1	FEMALE	70	6	-	ANNULAR PANCREAS	EL+GASTROJEJUNOSTOMY	4	C	4	11/7,000/160/1,50,000	E.COLI	1A	POD - 3,7,14
2	FEMALE	45	11	-	ANNULAR PANCREAS	EL+GASTROJEJUNOSTOMY	4	C	4	12/7,000100//1,00,000	NO ORGANISMS	1A	POD - 3,7,14
1	MALE	56	8	-	GANGRENOUS BOWEL WITH SMA THROMBOSIS	EL+DUODENOCOLOSTOMY + R&A	3	CC	2.5	10/11,000/108/2,00,000	E.COLI	2B	POD - 3,7,14
1	FEMALE	51	9	-	SMALL BOWEL OBSTRUCTION	EL+RESECTION AND IJ ANASTOMOSIS	3	CC	4	10/11,000/120/2,53,000	E.COLI	2B	POD - 3,7,14
2	MALE	45	5	LSCS	SMALL BOWEL OBSTRUCTION	EL+R&A	3	CC	3.5	13/11,000,100/1,80,000	NO ORGANISMS	1A	POD - 3,7,14
1	FEMALE	41	9	-	RIGHT OVARIAN CYST	EL+RIGHT OVARIAN CYSTECTOMY	4	C	2	10/11,000/101/1,44,000	E.COLI	3A	POD - 3,4,5,6,7,14
1	FEMALE	52	7	TUBECTOMY	SMALL BOWEL OBSTRUCTION	EL+R&A	3	CC	2	10/11,000/111/2,00,000	STAPH AUREUS	2B	POD - 3,7,14
1	FEMALE	35	9	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	2	13/12,000/100/1,44,000	NO ORGANISMS	1B	POD - 3,7,14
1	MALE	56	10	-	SMALL BOWEL OBSTRUCTION	EL+R&A	3	CC	3	10/7,000/120/2,00,000	KLEBSHIELLA	2A	POD - 3,7,14
1	MALE	50	8	-	SMALL BOWEL OBSTRUCTION	EL+R&A	3	CC	3	11/11,500/110/2,83,000	E.COLI	1C	POD - 3,7,14
2	FEMALE	28	10	-	SUBACUTE INTESTINAL OBSTRUCTION	EL+JEJUNOJEJUNOSTOMY	3	CC	2	12/8,000/101/1,44,000	NO ORGANISMS	1A	POD - 3,7,14
2	MALE	39	8	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	1	13/11,000/115/1,80,000	NO ORGANISMS	1A	POD - 3,7,14
1	MALE	62	13	-	BILIARY STRICTURE WITH GB CALCULI	EL+CHOLECYSTECTOMY	2	CC	3	10/12,000/112/1,44,000	E.COLI	3A	POD - 3,4,5,6,7,14
1	FEMALE	39	9	-	ACUTE APPENDIX	EL+APPENDECTOMY+PL	1	CC	2	11/8,000/101/1,44,000	MRSA	2B	POD - 3,7,14
1	MALE	24	7	-	SMA THROMBOSIS	EL+R&A	3	CC	1.5	13/11,000/102/1,90,000	NO ORGANISMS	1C	POD - 3,7,14

1	MALE	55	7	HERNIA REPAIR	DUODENAL OBSTRUCTION	EL+R&A	3	CC	2	16/12,000/110/1,44,000	E.COLI	2C	POD - 3,4,5,6,7,14
1	FEMALE	65	9	-	SUBACTE INTESTINAL OBSTRUCTION	EL+R&A+PERITONEAL LAVAGE	3	CC	3	11/10,000/101/1,44,000	NO ORGANISMS	1C	POD -3,7,14
1	FEMALE	49	8	-	ACUTE INESTINAL OBSTRUCTION	EL+RIGHT HEMICOLECTOMY+ILEOTRANSVERSE ANASTOMOSIS	3	CC	3	13/12,000/119/1,80,000	E.COLI	3A	POD - 3,4,5,6,7,14
1	FEMALE	52	7	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	1	13/11,000/111/2,00,000	E.COLI	3A	POD - 3,4,5,6,7,14
1	FEMALE	25	8	-	UTERINE MASS	EL+HYSTERECTOMY+PERITONEAL LAVAGE	4	C	3	13/8,000/110/2,00,000	NO ORGANISMS	1C	POD -3,7,14
1	MALE	55	16	OLD CVA	GASTRIC OUTLET OBSTRUCTION	EL+GASTRECTOMY	4	C	3	14/7,000/121/1,20,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	24	8	-	NECROTIZING PANCREATITIS	EL+PACREATIC NECROSECTOMY	4	CC	3.5	15/11,000/110/1,50,000	NO ORGANISMS	1A	POD -3,7,14
2	FEMALE	52	8	HYSTERECTOMY	INTESTINAL OBSTRUCTION	EL+R&A	3	CC	2	12/5,000/120/1,50,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	45	6	LIHR	SUACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	2	11/17,000/123/1,50,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	55	7	LIHR	DUODENAL OBSTRUCTION	EL+R&A	3	CC	2	12/10,000/145/1,50,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	54	7	RIHR	SMALL BOWEL OBSTRUCTION	EL+LOOP ILEOSTOMY	3	CC	2	12/11,000/123/1,50,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	49	5	-	DUODENAL OBSTRUCTION	EL+R&A	3	CC	3	11/10,000/1,50,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	38	2	-	SUBACUTE INTESTINAL OBSTRUCTION	EL+R&A	3	CC	2	12/7,000/110/1,80,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	55	8	-	SMALL BOWEL OBSTRUCTION	EL+REDUCTION OF INTESTINAL HERNIA	4	CC	3	12/11,000/110/1,23,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	72	10	-	PERFORATED APPENDIX	EL+OPEN APPENDECTOMY	1	CC	3	12/10,000/160/1,80,000	NO ORGANISMS	1B	POD -3,7,14
2	MALE	18	6	-	DUODENAL OBSTRUCTION	EL+R&A	3	CC	3	12/7,000/110/1,80,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	65	9	-	LARGE BOWEL OBSTRUCTION	EL+RESECTION AND ANASTOMOSIS	3	CC	3	13/10,000/110/1,80,000	NO ORGANISMS	1A	POD -3,7,14
2	FEMALE	47	8	-	ILEAL OBSTRUCTION	EL+RESECTION WITH DOUBLE BARREL ILEOSTOMY	3	CC	4	12/11,000/110/1,50,000	NO ORGANISMS	1A	POD -3,7,14
1	MALE	57	7	-	INTESTINAL OBSTRUCTION	EL+R&A	3	CC	3	12/10,000/110/1,00,000	NO ORGANISMS	1A	POD -3,7,14
2	FEMALE	22	8	LSCS	RIGHT OVARIAN CYST	EL+RIGHT SALPINGECTOMY	4	C	5	18/12,000/110/1,80,000	NO ORGANISMS	1B	POD -3,7,14
1	FEMALE	44	7	-	UTERINE MASS	EL+HYSTERECTOMY	4	C	3	10/11,000/120/2,50,000	E.COLI	2B	POD -3,7,14
2	FEMALE	34	8	-	CHOLELITHIASIS	LAPAROSCOPIC CONVERTED TO OPEN CHOLECYSTECTOMY	2	CC	3	12/11,000/110/1,80,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	42	11	-	CARCINOMA COLON	DIAGNOSTIC LAP F/B EL+HEMICOLECTOMY COLOCOLIC ANASTOMOSIS	3	CON	4	14/11,000/110/2,50,000	NO ORGANISMS	1A	POD -3,7,14
2	FEMALE	24	9	-	SUBACUTE INTESTINAL OBSTRUCTION	EL+R&A	3	CON	5	13/8,000/130/1,50,000	NO ORGANISMS	1A	POD -3,7,14
2	FEMALE	39	5	-	INTESTINAL OBSTRUCTION	EL+R&A	3	CC	1	13/7,000/100/1,80,000	NO ORGANISMS	1A	POD -3,7,14
2	FEMALE	42	11	-	CARCINOMA COLON	EL+TOTAL COLECTOMY+CHOLECYSTECTOMY+ILEOSTOMY	3	C	3	10/11,000/120/1,80,000	E.COLI	2A	POD -3,7,14

2	FEMALE	50	12	-	INTESTINAL OBSTRUCTION	EL+R&A	3	CC	3	13/5,000/110/1,20,000	NO ORGANISMS	1A	POD -3,7,14
1	MALE	45	7	-	INTESTINAL OBSTRUCTION	EL+R&A	3	CC	3	11/11,000/120/1,80,000	E.COLI	2A	POD -3,7,14
2	FEMALE	70	6	HERNIA REPAIR	ACUTE APPENDICITIS	EL+OPEN APPENDECTOMY	1	CC	1.15	14/11,000/120/1,80,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	28	5	-	SMALL BOWEL OBSTRUCTION	EL+R&A	3	CC	2	10/8,000/100/2,80,000	NO ORGANISMS	1A	POD -3,7,14
2	FEMALE	74	5	-	SMALL BOWEL OBSTRUCTION	EL+R&A	3	CC	2.15	12/7,500/120/2,10,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	26	9	-	PSEUDOCYST OF PANCREAS	EL+PANCREATIC NECROSECTOMY+CYSTOGASTROSTOMY	4	CC	5	13/10,000/120/1,80,000	NO ORGANISMS	1A	POD -3,7,14
1	MALE	41	6	-	PERFORATED APPENDIX	EL+OPEN APPENDECTOMY	1	CC	2	10/7,000/110/1,50,000	NO ORGANISMS	1C	POD -3,7,14
2	MALE	45	11	-	INTESTINAL OBSTRUCTION	EL+R&A	3	CC	3	12/11,000/110/1,80,000	NO ORGANISMS	1A	POD -3,7,14
1	MALE	38	9	-	INTESTINAL OBSTRUCTION	EL+R&A	3	CC	2	12/12,000/120/2,00,000	E.COLI	3A	POD - 3,4,5,6,7,14
2	MALE	65	9	-	INTESTINAL OBSTRUCTION	EL+RIGHT HEMICOLECTOMY+END TO END ANASTOMOSIS	3	CC	2	10/7,000/119/1,44,000	NO ORGANISMS	1A	POD -3,7,14
1	MALE	38	17	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	1	10/13,000/100/1,80,000	NO ORGANISMS	1C	POD -3,7,14
1	FEMALE	18	13	-	CHOLELITHIASIS	EL+CHOLECYSTECTOMY	2	CC	2	10/12,000/100/1,10,000	KLEBSHIELLA	2B	POD -3,7,14
1	MALE	42	17	-	CARCINOMA COLON	EL+HEMICOLECTOMY+COLOCOLIC ANASTOMOSIS	3	C	4	12/10,000/110/1,80,000	E.COLI	1B	POD -3,7,14
1	MALE	38	14	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	2	10/12,000/110/1,80,000	E.COLI	2A	POD -3,7,14
1	FEMALE	60	13	-	SMALL BOWEL OBSTRUCTION	EL+ADHESIOLYSIS+ENTEROSTOMY	4	CC	3	12/12,000/180/2,80,000	NO ORGANISMS	1B	POD -3,7,14
1	MALE	58	12	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	2	18/17,000/121/2,53,000	NO ORGANISMS	1A	POD -3,7,14
1	FEMALE	34	20	-	CHOLELITHIASIS+DILATED CBD	EL+CHOLECYSTECTOMY+CBD EXPLORATION	2	CC	4	12/11,000/110/1,80,000	E.COLI	2A	POD -3,7,14
1	FEMALE	23	12	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	2	10/11,000/110/1,80,000	NO ORGANISMS	1A	POD -3,7,14
1	MALE	53	12	-	CHOLELITHIASIS	EL+CHOLECYSTECTOMY	2	CC	1.5	12/15,000/110/1,80,000	E.COLI	1B	POD -3,7,14
1	MALE	45	10	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	2	17/18,000/110/1,80,000	NO ORGANISMS	1A	POD -3,7,14
1	MALE	54	10	-	SMALL BOWEL OBSTRUCTION	EL+R&A	3	CC	3	12/7,000/121/1,80,000	E.COLI	2A	POD -3,7,14
1	MALE	48	12	-	CHOLELITHIASIS	EL+CHOLECYSTECTMY	2	CC	2	10/10,000/120/1,80,000	KLEBSHIELLA	2B	POD -3,7,14
1	FEMALE	57	9	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	3	12/11,000/121/2,50,000	E.COLI	2B	POD -3,7,14

1	FEMALE	35	14	-	UTERINE MASS	EL+HYSTERECTOMY	4	C	3	10/13,000/120/1,80,000	E.COLI	2B	POD -3,7,14
1	MALE	62	16	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	1	10/18,000/110/1,80,000	E.COLI	2A	POD -3,7,14
1	MALE	51	10	-	CHOLELITHIASIS	EL+CHOLECYSTECTOMY+ROUX-EN-Y JEJUNOSTOMY	3	CC	4	13/12,000/109/1,80,000	NO ORGANISMS	1A	POD -3,7,14
1	MALE	38	17	-	DUODENAL OBSTRUCTION	EL+R&A	3	CC	2	12/12,000/120/2,00,000	E.COLI	3A	POD -3,4,5,6,7,14
1	FEMALE	22	14	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	3	13/13,000/100/1,90,000	E.COLI	2A	POD -3,7,14
1	FEMALE	36	15	-	COLONIC MASS	EL+R&A	3	C	3	12/10,000/100/1,10,000	E.COLI	2B	POD -3,7,14
1	FEMALE	50	15	-	SUBACUTE OBSTRUCTION	EL+R&A	3	CC	2	12/11,000/100/1,80,000	E.COLI	2B	POD -3,7,14
1	FEMALE	42	15	-	COLONIC MASS	EL+TOTAL COLECTOMY+CHOLECYSTECTOMY	3	CC	3	13/10,000/100/1,10,000	NO ORGANISMS	1C	POD -3,7,14
1	MALE	72	15	-	CHOLEDOCHOLITHIASIS	EL+CHOLECYSTECTOMY+CBD EXPLORATION	2	CC	3	12/10,000/100/1,10,000	NO ORGANISMS	1B	POD -3,7,14
1	FEMALE	28	16	-	CHOLELITHIASIS+DILATED CBD	EL+CHOLECYSTECTOMY+CBD EXPLORATION	2	CC	2	12/11,000/100/1,80,000	E.COLI	2B	POD -3,7,14
1	FEMALE	47	14	-	SUBACUTE OBSTRUCTION	EL+R&A	3	CC	2	12/10,000/90/2,10,000	NO ORGANISMS	1A	POD -3,7,14
1	MALE	17	10	-	APPENDICULAR MASS	EL+APPENDECTOMY	1	CC	3	10/10,000/100/1,80,000	NO ORGANISMS	1A	POD -3,7,14
1	FEMALE	55	14	-	SMALL BOWEL OBSTRUCTION	EL+STRICTUROPLASTY	4	CC	3	12/13,000/110/1,80,000	E.COLI	2A	POD -3,7,14
1	FEMALE	24	12	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	3	10/11,000/100/2,11,000	E.COLI	2A	POD -3,7,14
1	MALE	55	14	-	SMALL BOWEL OBSTRUCTION	EL+R&A	3	CC	3	12/10,000/110/1,80,000	NO ORGANISMS	1C	POD -3,7,14
1	MALE	41	6	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	2	10/7,000/140/1,50,000	NO ORGANISMS	1C	POD -3,7,14
1	MALE	46	15	-	CHOLEDCHOLITHIASIS	EL+CHOLECYSTECTOMY+CBD EXPLORATION	2	CC	2	12/11,000/100/1,10,000	E.COLI	2B	POD -3,7,14
1	MALE	46	13	-	S/P EL WITH JEJUNOSTOMY	RE-EL+JEJUNOSTOMY CLOSURE	3	CC	3	10/11,000/110/2,10,000	E.COLI	2B	POD -3,7,14
1	FEMALE	54	12	-	APPENDICULAR MASS	EL+APPENDECTOMY	1	CC	2	10/12,000/100/1,80,000	NO ORGANISMS	1C	POD -3,7,14
2	FEMALE	43	19	-	SUBACUTE OBSTRUCTION	EL+R&A	3	CC	3	10/11,000/100/1,80,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	18	16	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	3	10/12,000/110/2,10,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	35	17	-	DUODENAL STENOSIS	EL+GJ+TRUNCHAL VAGOTOMY	4	C	3	12/10,000/110/1,80,000	NO	1A	POD -3,7,14

											ORGANISMS		
2	MALE	31	17	-	SUBACUTE INTESTINAL OBSTRUCTION	EL+R&A	3	CC	3	12/11,000/109/1,90,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	62	16	-	RECTAL MASS	EL+R&A	3	C	2	10/5,000/110/1,80,000	NO ORGANISMS	1A	POD -3,7,14
2	FEMALE	45	15	-	SUBACUTE OBSTRUCTION	EL+R&A	3	CC	2	14/6,000/100/1,10,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	50	18	-	CHOLELITHIASIS WITH CHOLEDOCHOLITHIASIS	EL+CHOLECYSTECTOMY+CBD EXPLORATION	2	CC	4	13/11,000/100/1,80,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	38	18	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	2	13/12,000/110/1,10,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	55	15	-	SUBACUTE INTESTINAL OBSTRUCTION	EL+R&A	3	CC	2	13/11,000/110/1,10,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	50	12	-	SMALL BOWEL OBSTRUCTION	EL+R&A	3	CC	3	12/9,000/109/1,20,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	45	15	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	2	12/10,000/120/1,10,000	NO ORGANISMS	1A	POD -3,7,14
2	FEMALE	56	19	-	CHOLEITHIASIS+CHOLEDOCHOLITHIASIS	EL+CHOLECYTECTOMY+CBD EXPLORATION	2	CC	3	13/10,000/110/1,80,000	NO ORGANISMS	1A	POD -3,7,14
2	FEMALE	22	17	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	2	12/10,000/110/1,10,000	NO ORGANISMS	1A	POD -3,7,14
2	MALE	35	16	-	ACUTE APPENDICITIS	EL+APPENDECTOMY	1	CC	2	12/11,000/110/1,80,000	NO ORGANISMS	1A	POD -3,7,14
2	FEMALE	52	12	-	CHOLELITHIASIS	EL+CHOLECYTECTOMY	2	CC	2	11/12,000/110/1,90,000	NO ORGANISMS	1A	POD -3,7,14