

Incidence, Characteristics, and Consequences of Surgical Site Infections After Laparotomy at Hoima Regional Referral Hospital

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ABSTRACT

Surgical Site Infections (SSIs) are infections that occur within 30 days of a surgical incision, making them the most common form of hospital-acquired infections in sub-Saharan Africa. These infections increase the risk of complications, length of hospital stays, healthcare-related costs, laparotomy, and death. A retrospective study at Hoima Regional Referral Hospital assessed the incidence, patterns, and outcomes of SSIs following laparotomy. The study found that 17.6% of patients received SSI, with the majority (46.5%) having superficial incisional SSI, 34.8% having organ/space infection, and 18.6% having incisional SSI. The percentage of patients dying in the SSI group was higher than that in the group without SSI (4.7% vs. 3.5%). However, the difference was not significant. 55.8% of SSI patients were re-operated, while no patient with no SSI was re-operated. The average length of hospital stay among SSI patients was 16.26 days longer than that of patients without SSI. SSI remains a significant burden in midwestern Uganda, with increased LOS and need for reoperation. The study recommends implementing measures to reduce SSIs as outlined by the World Health Organization.

Keywords: Surgical Site Infections, Surgical incision, Healthcare-related costs, Laparotomy, patient.

INTRODUCTION

Infection refers to the occurrence and growth of pathogens in tissues of the body [1]. This chapter contains the background, problem statement, objectives, research questions, conceptual framework, justification and scope of the study. In an essay dedicated to Ignazio Semmelweis, the celebrated author Luis Ferdinand Celine writes that during the Pasteur era, nine of ten surgeries ended in death due to infection [2]. The first reliable statistics on operative mortality were published in 1841 by the Frenchman Malgaigne (1806-1863). They noted that the average mortality of amputation was 60% and was primarily caused by hospital diseases. Despite the general term “hospital diseases”, five clinical entities were diagnosed with significant frequencies: erysipelas, tetanus, pyemia, septicemia, and nosocomial gangrene [2]. In this era, these would be considered surgical site

infections. For the past two decades, attention to sepsis has intensified because of growing recognition that it is one of the most common and lethal conditions we face, whether as a patient, provider, hospital, or public health agency [3], [4]. Until now, we have had incomplete accountability of the global epidemiology of sepsis, with several reports from high-income countries and relatively few from countries of low and middle income [4]. Over the past few decades, various advancements in procedural and management systems have developed, but still nosocomial infections are important risks in pre and post-surgery [1]. The germ theory of disease was the basis of our study. It states that; microorganisms known as pathogens or “germs” can lead to disease [5]. These small organisms too small to see without magnification, invade humans, other animals and other living hosts [5].

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The advent of the germ theory of disease, anticipated by Ignaz Semmelweis (1818-65) and consolidated by Louis Pasteur (1822-95), strongly influenced medical opinion toward an antibacterial stance [5]. Without antiseptic and aseptic environments and procedures, along with antibiotics and antiviral and antifungal agents, modern Surgery would be nearly impossible [5]. In relation to the germ theory, bacteria are the cause of surgical site infection. In this study, we shall determine the incidence of surgical site infection among patients who have undergone abdominal surgery in addition to the patterns and outcomes. Surgical site infection (SSI) is defined as one that occurs within 30 days after a surgical procedure if no implant is left in place, or within 1 year when there is a prosthetic implant [6]. Surgical site infection following laparotomy is categorized into three i.e., superficial incisional SSI, Deep Incisional SSI or organ/ space SSI. Nearly, two-thirds of all SSIs are restricted to the incision while the rest are linked to organs or spaces tangled in surgical routes. Exogenous or endogenous sources are involved in micro-organism origination [1]. Patient skin, mucous membranes, or hollow viscera are sources for endogenous flora, and surgical team members, devices, air, or any contaminated item is considered an exogenous source for SSI [1]. For infection development, greater than 10⁵ microorganisms per gram of tissue must be present, except when foreign material is present at the site of surgery like mesh

Study design

This was a retrospective study in which patient records were reviewed. This method was used to obtain quantitative data to achieve the objectives of this study.

Area of Study

The study was done at HRRH, which is a satellite teaching hospital for KIU located in mid-western Uganda, a government hospital in Hoima city about 200 Km from Kampala with a bed capacity of about 600. It has 3 general surgeons and 3 senior house officers who are responsible for the

or sutures [1]. Superficial incisional SSI is an infection affecting the subcutaneous tissue and skin [1]. This type of infection may be indicated by localized signs such as pain, heat, swelling, or redness at the site of incision or by pus drainage [1]. Deep incisional SSI is the type that affects the fascia and layers of muscle [1].

There is a paucity of data about the incidence, patterns and outcome of SSI in Uganda. However, a study was conducted in southwestern Uganda at MRRH about hospital mortality from sepsis [7] which did not adequately address the issue of patterns associated with and the incidence of sepsis occurrence. Another study that was conducted in the same hospital revealing the incidence and patterns of SSI [8] did not report the outcomes, and there is no such study in Midwestern Uganda. A study which was conducted in Midwestern Uganda at HRRH [9] was limited to sepsis following cesarean section in obstetrics and gynecology ward leaving a question on the incidence, patterns and outcome of SSI following other forms of abdominal surgeries which would even lead to an increased risk of infection as stated by the study which was done in the USA where SSI incidence was highest among colon surgery and Coronary Artery Bypass Graft Surgery (CABG) cases, and lowest among C-section and vaginal hysterectomy [10]. This study determined the Incidence, Patterns and Outcomes of Surgical Site Infection Following Laparotomy at Hoima Regional Referral Hospital.

METHODOLOGY

operations, the surgery department does emergency and elective surgeries inclusive laparotomies.

Study population

All files of patients that had laparotomy in the period from 1st of July 2021 to 30th June 2022, were reviewed.

Inclusion Criteria

All files of patients that had laparotomy in the study period.

Exclusion Criteria

All files that had missing information that was significant to the study according to the data collection form

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were excluded.

Sample size

Using the Kish Leslie (1965) formula: $n = Z^2 p(1-p) / E^2$

Whereby,

n=estimated minimum sample size required

P=proportion of characteristic in a sample (16.4%)

Z=1.96 (for 95% Confidence interval)

E= Margin of error set at 5%

Using the study which was conducted at MRRH in 2017 where incidence was 16.4% [8],

$n = (1.96)^2 \times 0.164 (1-0.164) / (0.05)^2$

n= 210.7

Therefore,

n=211

We added 10% to cater for the files that were excluded; 211+21=232

Therefore, the minimum sample size required was 232 patient files.

Sampling Technique

Consecutive recruitment was done; all files from 1st of July 2021 to 30th June 2022 that fulfilled the eligibility criteria were included.

Study procedure

All files for the patients who had laparotomy during the study period were reviewed following administrative

approval from the hospital administration. The clinical history, examination and operative notes were revised to understand the clinical profile and indication. The details of ward round notes and nurses' notes were read to understand if a patient had a surgical site infection. Any patient for whom the records showed that there was pus discharge from the incision site, was considered to have had surgical site infection. Also, any patient for whom the doctor wrote surgical site infection or incision infection, or post-operative infection, or incision abscess or any related term suggestive of surgical site infection was considered to have had surgical site infection. The pattern (type of SSI) was determined using the examination findings written by the doctor who diagnosed surgical site infection and the operation notes for those who were re-operated. The information obtained was recorded in the data collection forms that had an identification number and not the patient's name in order to maintain confidentiality. The data collection form is shown in the appendix.

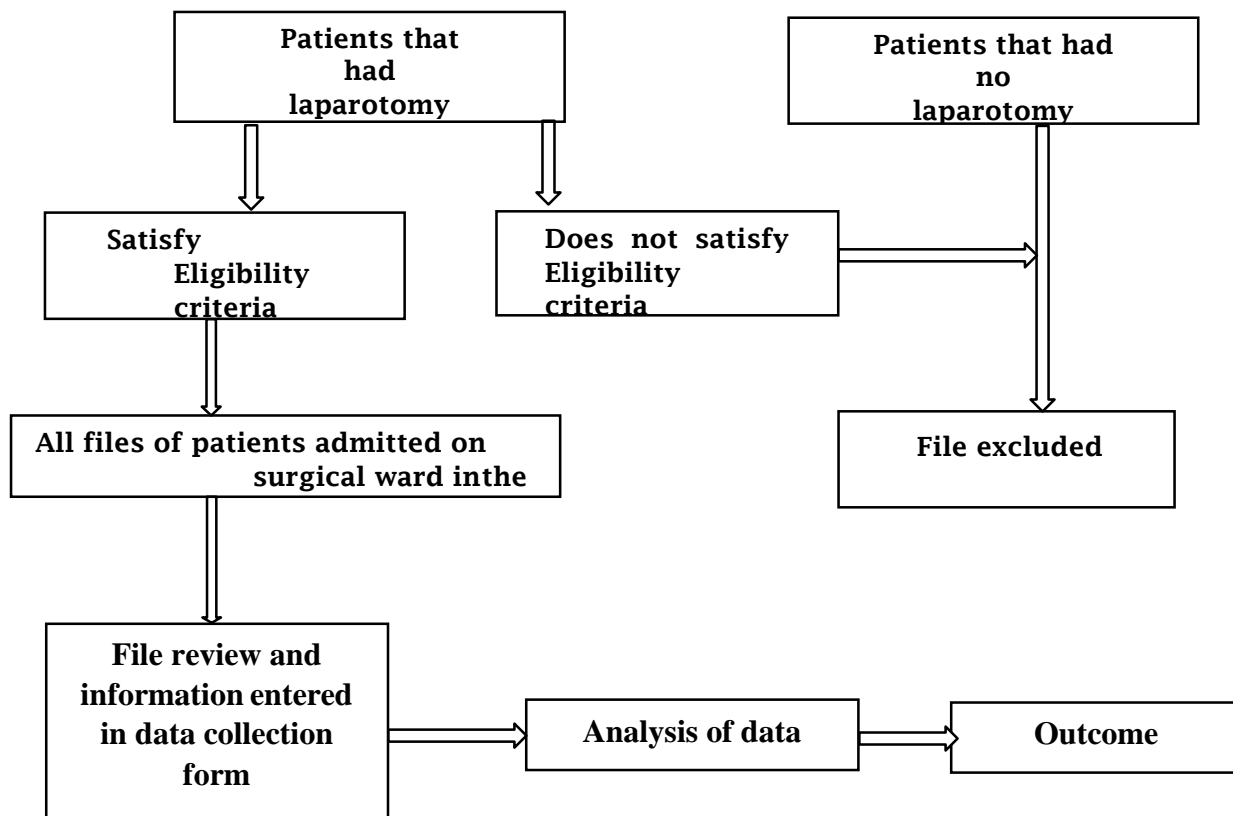


Figure 1: Shows the process of sampling, data collection and analysis flow chart.

Study variables

The primary outcome variable was the occurrence of surgical site infection. The secondary outcome variable was the pattern of SSI, mortality, LOS and need for re-operation. Independent variables included; age, sex and patient clinical characteristics.

Data collection tools and instruments

A data collection form was used to collect patient particulars and other relevant data obtained from the patient's file as shown in Appendix 2.

Data collection methods

Using the data collection form (Appendix 2), information relevant to the study was recorded from the patient's files.

Data processing and analysis plan

The data obtained was summarized in Excel sheets using Microsoft Office Excel. The summarized data was imported into Statistical Package for the Social Sciences (SPSS Inc., Chicago, USA, version 22.0 for Windows). For objective one, the

incidence was computed as a proportion of the patients that developed surgical site infection and presented as a percentage of all the patients included in the study in a pie chart. For objective two, the percentage of each type of surgical site infection of the total number of patients that developed surgical site infection was computed and presented in a bar graph. For objective three, the percentage of patients that were re-operated and those that died were compared between those that had SSI and those that did not use the cross-tabulation procedure and the corresponding chi-square test P value was used to determine if there was a significant difference. The average length of hospital stay of the two groups was also compared using the student t-test, and the corresponding p-value was used to determine significance. A p-value less or equal to 0.05 was considered significant.

Data management

The data collection forms had patient codes instead of names and were only made accessible to investigators. Hard copy records were kept in a locked cabinet and 6 months following completion of the study, they will be destroyed but electronic records will be kept in a password-protected file on the investigator's password-protected computer, and on completion of the study, they will be saved on a Digital Versatile Disc (DVD) that will be submitted to the KIU registry so that when the investigator has a valid reason to access them, will request access from the KIU registry management.

Ethical considerations

Approvals

I got approval from the hospital administration of HRRH which allowed me to review records.

Protecting Data Confidentiality

The information provided to us was confidential. The form we filled out did not contain the name of the patient or other information that would identify the participant. The records were kept under lock and key in the case of paper documents and password-protected documents for electronic data.

COVID-19 Standard Operating Procedures (SOPs)

To minimize the spread of infection, regular hand washing or alcohol hand rub, use of appropriately worn face masks and other prevention strategies as recommended by the Uganda ministry of health from time to time were adhered to. The Uganda National Guidelines for currying out Research in COVID- 19 pandemic [11] were also followed.

Study Limitations

Some files lacked the vital information we needed in the study.

Mitigation of Limitations

Files with missing information were excluded from the study, and replaced by other complete files and a 10% allowance was added to cater for these files while estimating the required sample size.

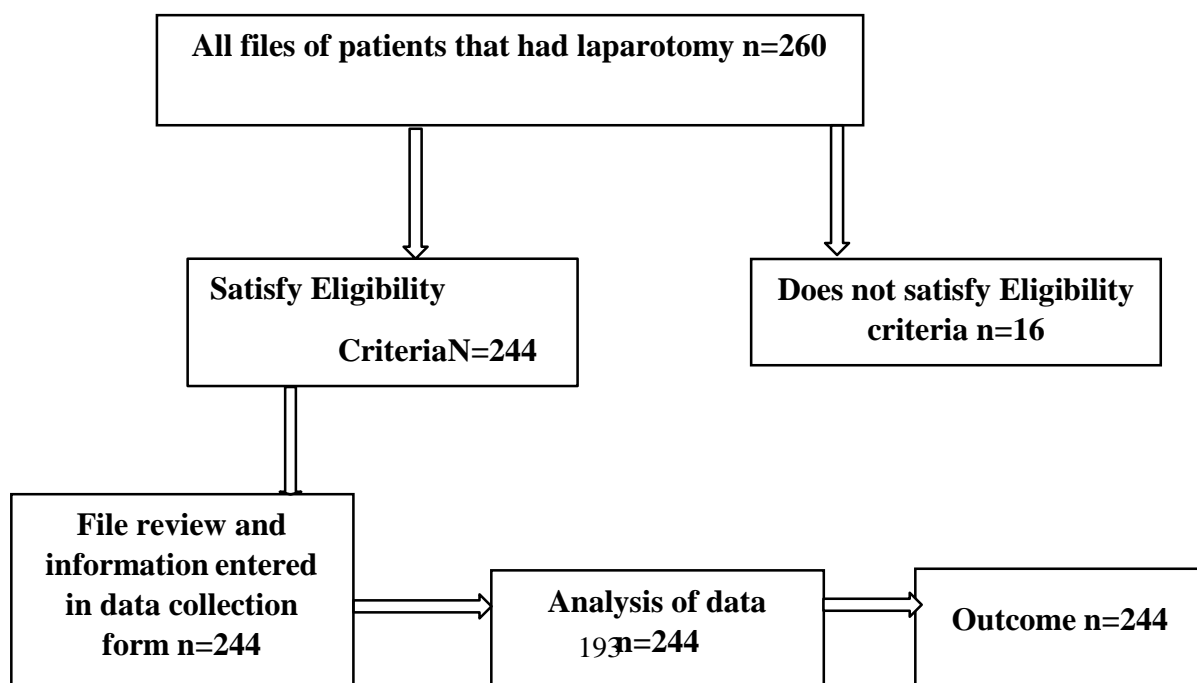
Quality control

The data entered was re-read twice to ensure no mistakes were made.

Dissemination

This report will be submitted to the lecturer Mr. Mbina .A. Solomon for marking, then a copy of the report will be submitted to the libraries of KIU-TH and HRRH. A manuscript was submitted to the *international* journal of surgery open on 17th September 2022 (**Manuscript number IJSOPEN-D-22-00184**) and is currently undergoing the pear review process as of 24th October.

RESULTS



Characteristics of study participants

Table 1: Showing characteristics of the study participants

Characteristic	Statistic	
Age in years	Mean=28.21 SD= 17.94 Min=<1 Max= 90	
	Frequency	Percentage
Sex		
Male	178	73.0
Female	66	27.0
Indication for Surgery		
Gut Perforation	81	33.2
Intestinal Obstruction	72	29.5
Raptured spleen	27	11.1
Appendicitis	20	8.2
Appendicular abscess	5	2.0
Other Intra Abd. Abscess	6	2.5
Unspecified Peritonitis	5	2.0
Penetrating Abd. Trauma	9	3.7
Blunt Abd. Trauma	8	3.3
Cholecystitis	4	1.6
Other	7	2.9
Home District		
Hoima	67	27.5
Kikuube	64	26.2
Kakumiro	33	13.5
Kyankwanzi	21	8.6
Masindi	20	8.2
Kiboga	18	7.4
Others	21	8.6
Month of admission		
July 2021	27	11.1
Aug 2021	24	9.8
September 2021	21	8.6
October 2021	14	5.7
November 2021	16	6.6
December 2021	19	7.8
January 2022	24	9.8
February 2022	26	10.7
March 2022	10	4.1
April 2022	24	9.8
May 2022	18	7.4
June 2022	21	8.6

SD=Standard deviation, Min= Minimum, Max= Maximum, Abd.= Abdominal

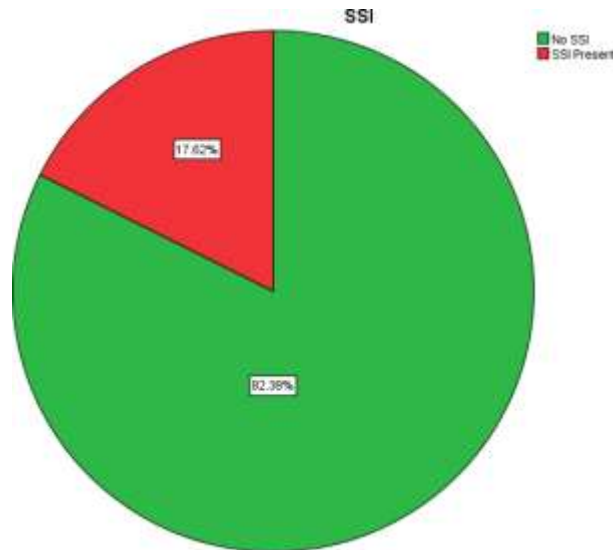
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In this study, Majority of the patients were male accounting for 73%. The average age of the patients was 28.21 ± 17.94 years. The commonest indication for surgery was gut perforation

accounting for 33.2%. Most of the patients were from the Hoima district (27.5%) and the majority were admitted in the month of July 2021 (11.1%).

Incidence of surgical site infection following laparotomy at Hoima Regional Referral Hospital

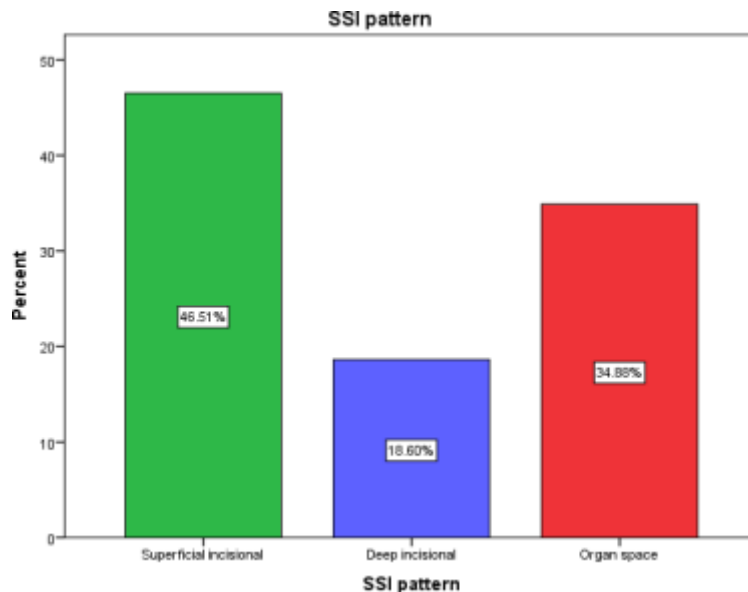


SSI = Surgical site infection

Figure 3: Showing incidence of surgical site infection following laparotomy at Hoima Regional Referral Hospital in a pie chart.

In this study, 43 of the 244 patients got surgical site infection representing 17.6%.

Patterns of surgical site infection following laparotomy at Hoima Regional Referral Hospital



SSI= Surgical site infection

Figure 4: Showing patterns of surgical site infection following laparotomy at Hoima Regional Referral Hospital presented in a bar graph

In this study, of the 43 patients that got surgical site infection (SSI), majority (46.5%) had superficial incisional SSI (Skin and subcutaneous tissue). Organ/space infection was seen in 34.8% and deep (muscle and fascia) seen in 18.6%.

Outcomes of surgical site infection following laparotomy at Hoima Regional Referral Hospital

Table 2: Showing outcomes of surgical site infection following laparotomy at Hoima Regional Referral Hospital.

Outcome	Among patients with SSI (N= 43)		Among patients with no SSI (N=201)		P value
	Frequency	Percentage	Frequency	Percentage	
Death					0.661 [†]
Died	2	4.7	7	3.5	
Survived	41	95.3	194	96.5	
Re operation					<0.001 [†]
Re Operated	24	55.8	0	0.0	
Not re operated	19	44.2	201	100.0	
LOS	Mean=6.76, SD= 4.34		Mean=23.02, SD=14.46		<0.001 [‡]

LOS= Length of hospital stay, SSI= Surgical site infection, [†]= p value of the chi square test, [‡] = Pvalue of the student t test.

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In this study, the percentage of patients that died in the group that had surgical site infection (SSI) was higher than that in the group with no SSI (4.7% vs 3.5%) but this difference was not significant since the p value was 0.661 (>0.05). 55.8% of the patients with surgical site infection were re-operated yet no patient with no

surgical site infection was re-operated and this deference was significant with a p-value of <0.001 . The average length of hospital stay among patients with SSI was 16.26 days longer than that of patients with no surgical site infection and this difference was significant with a p value of <0.001 .

DISCUSSION

Incidence of surgical site infection following laparotomy at Hoima Regional Referral Hospital

In this study, 43 of the 244 patients got SSI representing an incidence of 17.6% which is slightly higher than that of the study which was conducted in MRRH which revealed an incidence of 16.4% [8]. This could be due to the post-COVID-19 effects where the infection control could have been interfered with due to a reduction in staffing and an increase in working hours as a result of adjustments in duty roasts. In addition, a study was conducted in the Netherlands and showed that warm weather seasons are associated with a statistically significant risk increase of 39% in developing SSIs [12]. Hoima being on a lower altitude than Mbarara, clearly indicates that Hoima has warmer weather than Mbarara which could explain the increased incidence of SSI at HRRH. This explains the high incidence of SSI in Gulu the study was conducted on Short-term outcomes of laparotomy in the two teaching hospitals of Gulu University, Northern Uganda [13], which revealed the SSI incidence of 20%, backed up by Gulu being on a lower altitude than Hoima and having relatively higher temperatures, hence the increased risk of SSI. Another study done in India about the Evaluation of various pre and postoperative parameters associated with types of surgical site infections in abdominal surgeries [14], showed an incidence of 11.7%. This was quite lower than the incidence at HRRH because most of the surgeries done were elective compared to those at HRRH where most surgeries were emergency. Emergency operations increase the risk of SSI since there is no adequate preparation among other factors. In contrast, a study done in Bangladesh about the incidence of

surgical site infections after emergency laparotomy for perforation peritonitis was 26.7% [15], which was higher than the incidence at HRRH. This was because Perforation peritonitis is associated with a higher incidence of SSI than other abdominal surgeries [15], In our study the percentage of perforated peritonitis was only 33.2% hence the reason for the lower incidence of SSI.

Patterns of surgical site infection following laparotomy at Hoima Regional Referral Hospital

In this study, of the 43 patients that got surgical site infections, the majority (46.5) had superficial incisional SSI which is in agreement with the study which was done in Sudan about the Incidence and root causes of surgical site infections after gastrointestinal surgery at a public teaching hospital in Sudan, where 81.8% of people that got SSIs had superficial pattern [16]. Another study was done in Saudi Arabia and all patients that got SSI had superficial type [17]. This indicates that the superficial pattern is the most common pattern. According to the study conducted in India in 2019 about the Evaluation of various pre and postoperative parameters associated with types of surgical site infections in abdominal surgeries [14]. Superficial SSI were more common in clean and clean contaminated cases which was the case with our study where most cases were clean contaminated surgeries. In this study, of the 43 patients that had SSI, 34.8% had organ/space pattern being the second most common pattern. In the study done in India in 2019 about the Evaluation of various pre and postoperative parameters associated with types of surgical site infections in abdominal surgeries, Organ/space infection was common with an

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emergency, dirty wound and old age [14]. In our study, most of the participants underwent emergency and dirty operations due to gut perforation and peritonitis also took a high percentage chance having a higher percentage of having an organ space SSI pattern. In this study deep (muscle and fascia) SSI pattern accounted for only 18.6%, being the lowest pattern. A study which was conducted about Occurrence, associated risk factors, and treatment of surgical site infections in Pakistan [1] showed that deep SSI had the lowest occurrence of the patterns which is in agreement with our study.

Outcomes of surgical site infection following laparotomy at Hoima Regional Referral Hospital

In this study, there was an increased length of hospital stay for people who had SSI with the average LOS being 16.26 days longer than that of patients with no SSI and a corresponding P value of (<0.001) which is in agreement with many of the published studies including; [18], [19] and [20] among others. Increased LOS represents a short-term surgical outcome that can have a profound effect on an already overburdened surgical infrastructure. For patients, increased time in the hospital represents higher health care costs which include feeding and other maintenance costs plus time away from earning wages. We found the increased need of reoperation among patients who had SSI yet no patient needed reoperation among those that didn't have SSI giving a significant difference

SSI is a very expensive occurrence where patients are required to stay in wards for more days than they ought to which is accompanied by high expenses even in government hospitals. This is in addition to requiring more surgeries which further increases the cost of care for the government as well.

Recommendation

More studies on how best each pattern should be prevented and managed are still required to improve the health of

with P value of <0.001 which was in agreement with other studies published, among which include [19] and [13] In our study, the percentage of patients that died in the group that had surgical site infection (SSI) was higher than that in the group with no SSI (4.7% vs 3.5%) but this difference was not significant since the p-value was 0.661 (>0.05). A study done at Mulago National Referral Hospital revealed a high mortality (30%) [7] rate due to sepsis which is incongruent with our study at HRRH because our study was considering sepsis secondary to laparotomy unlike at Mulago where sepsis was due to other medical conditions. A study was done in Saudi Arabia and it showed that the mortality rate was 7.5%; of those, 93.8% had SSI, The low rate of mortality is in agreement with our study however not support the relationship between mortality and SSI which strong evidence against the null hypothesis. Strength of the study. This was a cross-sectional study and it was the first study assessing the incidence, Patterns and Outcomes of Surgical Site Infection Following Laparotomy at Hoima Regional Referral Hospital.

Study Limitations

In this study, some files were not tied up together leaving a question of whether all the files of each month were reviewed, and the ones that were found were also not properly kept. Some files also had incomplete data. This was a retrospective study, which could have limited the quality of data.

CONCLUSION

post-laparotomy patients in Midwestern Uganda and the whole nation at large. Proper antibiotic regimens and proper operation techniques should be advocated for and practised by workers so as to have a good outcome of the operation regardless of whether they are emergency or elective surgeries. So, more studies on risk factors and preventive measures still need to be conducted and in this process, the burden of poor outcomes will be reduced.

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