SURGICAL SITE INFECTION (SSI) IN ABDOMINAL SURGERY

AT THE KENYATTA NATIONAL HOSPITAL

A DISSERTATION SUBMITTED IN PART FULFILMENT FOR THE DEGREE OF MASTER OF MEDICINE (SURGERY), OF THE UNIVERSITY OF NAIROBI

BY

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DECLARATION

I HEREBY CERTIFY THAT THIS IS MY ORIGINAL WORK AND HAS NOT BEEN PRESENTED FOR A DEGREE IN ANY OTHER UNIVERSITY

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THIS DISSERTATION HAS BEEN SUBMITTED FOR EXAMINATION WITH MY APPROVAL AS UNIVERSITY SUPERVISOR.

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DEDICATION

To my dear children, Doris Kisio Mwendwa and Jean Gathoni Mwendwa for their love and appreciation.

To my parents and friends who offered great advise and inspiration during my studies.

CONTENTS

COMMON ABBREVIATIONS USED IN THIS PAPER

SSI:	Surgical Site Infection
CDC:	Center for disease Control and Prevention
NNIS:	National Nosocommial Infection Surveillance
SPSS:	Statistical Package for Social Sciences
NAS/ NRC	American national Academy of sciences/ National Research Council

SUMMARY

A Six- month prospective surveillance study of surgical site infections (SSI), an indicator of healthcare quality, was conducted at the department of general surgery at Kenyatta National Hospital. Surgical Site Infections were classified according to American Centre for Disease Control (CDC) criteria and identified by active bedside surveillance and post discharge follow up.

This study showed that the overall SSI rates in abdominal surgery was 22.4%. Of these, 25 % were superficial SSI's, 37.5% deep incisional and 37.5 % Organ or space. The mean time to diagnose SSI was 7 days postoperatively. Emergency operations had higher infection rates of 75 % compared to elective procedures 25%.

Staphylococcus aureus has the highest incidence of SSI , 44.4% followed by *E. coli*, 17.5%. About 50 % of organisms cultured are single colonies while the rest are mixed colonies, usually two pathogens.

No protocol of antibiotic prophylaxis was observed in emergency procedures and indiscriminate use of these was observed in the postoperative period.

The use of cephalosporins as antimicrobial prophylaxis is relatively low due to hospital restriction policy where as the resistance patterns to the commonly used antibiotics, penicillin and aminoglycoside (gentamicin) is fairly high. There's a need for Senior House Officers to prescribe prophylactic antibiotics in the preoperative period considering that the bulk of the general surgical operations are in abdominal surgery.

CHAPTER 1

1.1. INTRODUCTION

Surgical Site Infections (SSI) are the most common nosocomial Infections and a major cause of postoperative morbidity and resource utilization [1, 2]. An infected wound can prolong hospitalization by 5 to 20 days and subsequently increase medical costs. [3]

Currently, in the United States alone, an estimated 27 million surgical procedures are performed each year [4]. The National Nosocomial Infection Surveillance System (NNIS) established in 1970, monitors reported trends in nosocomial infections in the US acute care hospitals. Based on these reports, Surgical Site Infections (SSI's) are the most frequently reported nosocomial infections accounting for 14% to 16% of all nosocomial infections among hospitalized patients [5].

The recent English Nosocomial Infection National Surveillance Scheme (NINSS) reported that the overall incidence of SSI's was 4.3% of all surgical operations, of which 25% were serious deep or organ/ space infections [6]

In Nigeria, the rates of SSI have been quoted to vary from 4% to 15% [7]

In order to accurately assess success in infection prophylaxis, a standard "acceptable" wound infection rate must be established at each institution.

Numerous studies on surgical wound infections have appeared in the literature and perhaps the most thorough and comprehensive study was one between five University centers in which 14,854 patients had 15,613 operative wounds as reported in *Annals of surgery* 40 years ago [8]

The efforts of Geubbels and colleagues point out the difficulties with which all countries struggle in monitoring Surgical Site Infection rates [9].With the above in mind, the identification of SSI's involves interpretation of clinical and laboratory findings, and it is crucial that a surveillance programme uses definitions that are consistent and standardized; otherwise inaccurate or uninterpretable SSI rates will be computed and reported [10].

General surgery has seen dramatic changes over the past 30 years. It has evolved from open procedures with few drug treatments to a specialty that has enthusiastically embraced minimal invasive techniques and new drug treatments.

The growing attention and advancements in the field of hospital infection prevention has mainly taken place in countries with adequate resources. Many countries with few resources have ineffective hospital infection prevention programmes, if any at all. While the SSI rates have decreased in countries with more resources, the relatively few studies conducted in countries with more limited health budgets identified higher rates[11]. Extending nosocomial infection surveillance and prevention efforts to countries that presently lack effective programme is therefore viewed as a challenge for the future.

At Kenyatta National Hospital (KNH), a teaching and referral hospital, open abdominal surgery plays a vital role in therapeutic and diagnostic services. Functional outcomes are the true values of care, and it has been evident for several surgical generations that when patients experience complications, their outcomes are markedly compromised on several levels.

Surveillance of SSI with feedback of appropriate data to surgeons has been shown to be an important component of strategies to reduce SSI risk. To create an effective hospital infection programme, information about local patterns is essential. This type of data is useful for both individual hospitals and national health care planners in setting programme priorities, monitoring effects of different preventive actions and in setting goals for their infection control efforts.

CHAPTER 2

LITERATURE REVIEW

2.1 HISTORICAL PERSPECTIVE

It is not known as to when the first abdominal surgery was performed [12]. In the ancient times where history was recorded, there were tough laws governing surgery.
In the code of Hammurabi, the Babylonian law provided that if a free person died from an operation, the surgeon's right hand was to be amputated, and in case the person was a slave then the surgeon was bound to repay the owner of the slave an equal value[13].

In 1809, McDowell performed a laparotomy on one Jane Todd Crawford in Kentucky, to remove a giant ovarian tumour before the introduction of antisepsis. His townsmen gathered around his house in large numbers with a rope slung over a tree ready for use, if the doctor should fail in the "butchery" they were convinced he was committing. They might well have hanged him had his patient died [14]. This was a set back to abdominal surgery.

There were other setbacks to major surgery in " hospitalism", the term coined by the 18th century surgeon who used it to describe post surgical infection so commonly found in surgical wounds, *Erysipelas, Pyemia, Septicaemia* and hospital gangrene [15,16].

Following the introduction of antibiotics, early clinical trials in the 1950's reported either no benefit or a higher infection rate with antibiotic prophylaxis [17,18]. Moreover the emergence of resistant strains was attributed, in part, to such use of antibiotics. Although a small number of authors supported the use of prophylactic antibiotics for "dirty" or contaminated cases most did not recommend their use in cleaner cases.

Fortunately, studies by Burke in the early 1960's revealed the critical flaw in previous investigations and clinical failures [19]. Burke administered a single dose of penicillin systematically at various times before and after the inoculation of penicillin- sensitive *staphylococcus aureus* in the dermis of guinea pigs. Delaying the administration of antibiotics by as little as 3 hours resulted in lesions identical to those in animals not receiving antibiotics.

The field of hospital infection prevention gained momentum by the end of 1960's. The main focus was on the number and the nature of the micro-organisms contaminating wounds and the nature of human microbial flora in disease states. This led to major advancement in the use of prophylaxis and therapeutic antibiotics in surgical patients. From mid 1980's to mid 1990's, the focus was on procedure specific patient risk factors and how they influence the development of SSI. In recent studies, the emphasis has been placed on identifying host-related factors in high-risk surgical patients[20].

2.2 CRITERIA FOR DEFINING A SURGICAL SITE INFECTION (SSI)

In the United States of America, National Nosocomial Infection Surveillance (NNIS) has developed standardized surveillance criteria for defining SSI's [21], as illustrated in figure 1.

The term *surgical site infection* refers to an infection in the postoperative period involving the incision, deep space or organ accessed at the time of surgery. Rather than focusing solely on wound infections, these definitions extend to involve the broader spectrum of local postoperative infections. Thus, a pelvic abscess following colorectal surgery would be captured as an organ/space SSI, while a simple wound infection would be classified as a superficial SSI. If a SSI involves superficial and deep incisional sites, it is classified as a deep incisional SSI. Very occasionally a space infection drains through an incision. These infections rarely require re-operation and are considered a complication of the incision. As such, these are classified as deep incisional SSI.

By the CDC's criterion, SSIs are classified as:

A. SUPERFICIAL INCISIONAL

Infection within 30 days after operation, involving the skin and subcutaneous tissue of incision only.

AND AT LEAST

Purulent discharge, with/without laboratory confirmation.

At least one of the following signs and symptoms: Pain, tenderness, local swelling, redness, or heat and the Surgeon deliberately opens superficial incision, unless incision is culture negative.

B. DEEP INCISIONAL

Infection within 30 days of operation if no implant left in place or within 1 year if implant is in place.

AND

Involves deep soft tissues (e.g. fascial and muscle layers) of incision.

AND AT LEAST

1. Purulent drainage from the deep incision

2. A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs/symptoms:
   - Fever of more than 38 degrees celcius.
   - Localized pain.

3. An abscess or other evidence of infection involving the deep incision is found on direct examination, during re-operation or by histopathological or radiological examination.

4. Diagnosis of deep incisional SSI by a surgeon.

C. ORGAN/SPACE SSIs

Infection within 30 days after operation involves any part of the anatomy (e.g. organs or spaces) other than the incision, which was opened or manipulated during an operation.

AND AT LEAST

1. Purulent drainage from a drain placed through a stab wound into the organ/space.

2. Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space.

3. An abscess or evidence of infection on direct examination during re-operation, or by histological or radiological examination.

4. Diagnosis of an organ/space SSI by a surgeon.

If an area around a stab wound becomes infected, it is not an SSI. It is considered a skin or soft tissue infection depending on its depth.

Failure to use objective criteria to define SSI's has been shown to substantially affect reported SSI rates [22]. The NNIS definitions of SSI's have applied consistently by surveillance and surgical personnel in many settings and currently are a *de facto* national standard [23].

The three categories of SSI are illustrated in Figure 1 below.

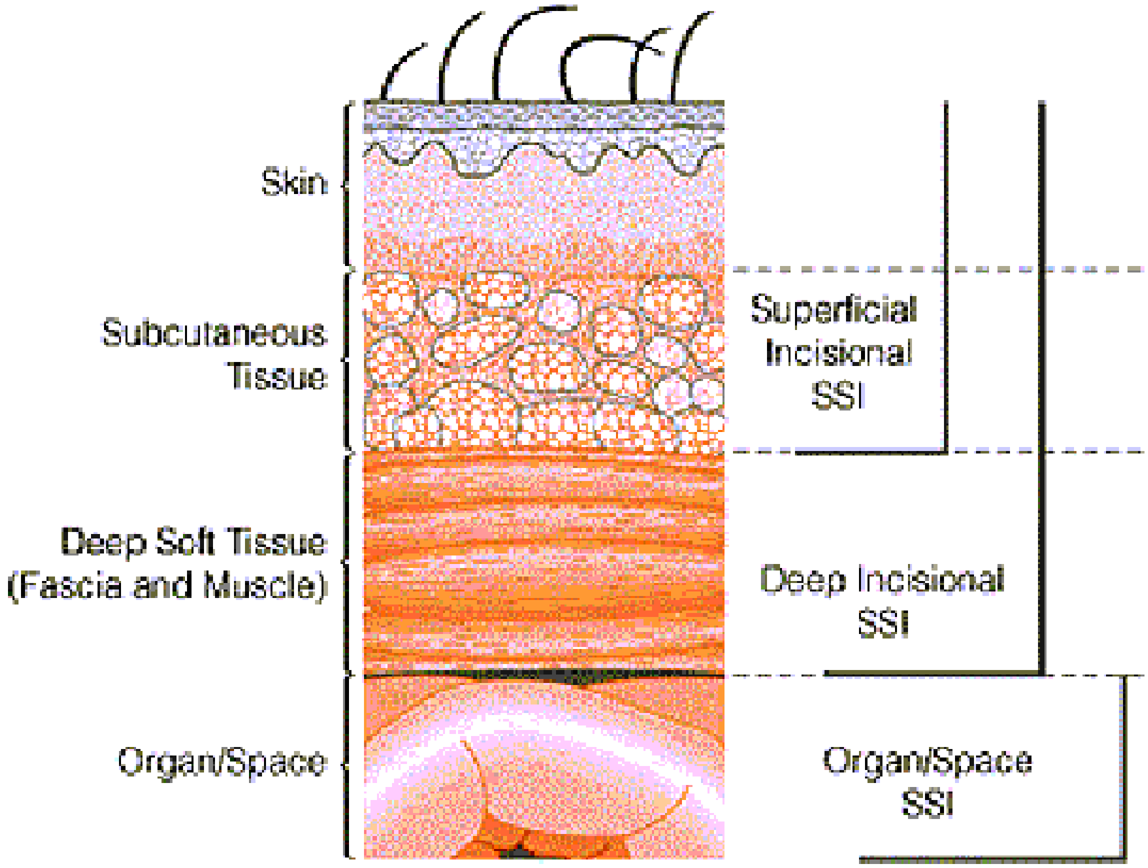


Figure 1.

2.3 MICROBIOLOGY

According to the available data and published articles, the distribution of pathogens isolated from SSI's has not changed markedly over the past 17years[24, 25.] *Staphylococcus aureus*, coagulase negative *staphylococci*, enterococcus spp. and *E. Coli* remain the most frequently isolated pathogens, as shown in **Table 1** below. An increasing proportion of SSI's are caused by antimicrobial resistant pathogens, such as methicillin- resistant *S. aureus* (MRSA) [26,27]or by *Candida albicans* [28]

TABLE 1

DISTRIBUTION OF PATHOGENS ISOLATED FROM SURGICAL SITE INFECTION, NATIONAL NOSOCOMIAL INFECTION SURVEILLANCE SYSTEM 1986 TO 1996

PATHOGEN **PERCENTAGE OF ISOLATES**

	1986-89[29]	**1990-96[25]**
Staphylococcus	29	34
Enterobacter spp	13	12
E. Coli	10	8
Pseudomonas aeruginosa	8	8
Enterobacter spp.	8	8
Proteus mirabillis	4	3
Klebsiela pneumoniae	3	3
Other Streptococcus spp.	3	3
Candida albicans	2	3
Group D streptococcus	-	2
Other Gram-positive aerobes	-	2
Bacteroides fragilis	-	2

Outbreaks or clusters of SSI's have also been caused by unusual pathogens, such as *Rhizopus orzae, Clostridium perfringes, Rhodococcus branchialis, Norcadia farcinia, Legionella dumoffi and Pseudomonas multivorans.*

These rare outbreaks have been traced to contaminated dressings [30], elastic bandages [31], colonized personnel [32, 33] or contaminated disinfectant solutions [34].

When a cluster of SSIs involves an unusual organism, a formal epidemiological investigation should be conducted.

2.4 PATHOGENESIS OF SURGICAL SITE INFECTIONS

Quantitatively it has been shown that if a surgical site is contaminated with $>10^5$ microorganisms per gram of tissue, the risk of developing SSI's is increased markedly [35]. However the dose of contaminating microorganisms required to produce an infection may be much lower when foreign material is present at the site (e.g. 100 staphylococci per gram of tissue introduced in silk sutures) [36,37].

Microorganisms contain or produce toxins or other substances that increase their virulence to host defence, producing damage within the host, or survive in host tissues. Many gram- negative bacteria produce endotoxins, which stimulate cytokine production. In turn, cytokines can trigger the systemic inflammatory response syndrome that sometimes leads to multiple system organ failure [38,39]. One of the most common causes of multiple system failure in modern surgical care is intra- abdominal infection [40,41]. Some bacterial surface components, notably polysaccharide capsules, inhibit phagocytosis [42], a critical and early host defence response to microbial contamination. Certain strains of *clostridia* and *streptococci* produce potent exotoxins that disrupt cell membrane or alter cellular metabolism [43]. A variety of microorganisms including gram-positive bacteria such as coagulase negative *staphylococci* produce *glycocalyx* and associated component called "slime"[44,45], which physically shields bacteria from phagocytes or inhibit the binding or penetration of antimicrobial agents. Although these and other factors are well defined, their mechanistic relationship to SSI development has not been fully determined.

For most SSI, the sources of pathogens are endogenous flora of the patient's skin, mucous membrane or hollow viscus [46]. When mucous membrane is incised, the exposed tissues are at risk for contamination with endogenous flora [47]. These organisms are usually aerobic gram-positive cocci (e.g. *staphylococci*), but may include faecal flora (e.g.

anaerobic bacteria and gram-negative aerobes) when incisions are made near the perineum or groin.

When a gastro-intestinal tract (GIT) organ is opened during an operation and becomes the source of pathogens, gram-negative bacilli (e.g. *E. Coli*), gram-positive organisms and sometimes anaerobes (e.g. *Bacillus fragillis*) are the typical SSI isolates. Seeding of the operative site from a distant focus of infection can be another source of SSI pathogens[48,49], particularly in patients who have prostheses or implants placed during the operation. Such devices provide a nidus for attachment of the organism[50, 51].

Exogenous sources of SSI pathogens include surgical personnel (especially members of the surgical team) [52], operating room environment (including air), and tools, instruments, and materials brought to the sterile field during an operation. Exogenous floras are primarily aerobes, especially gram-positive organisms (e.g. *staphylococcus* and *streptococci*). Fungi from endogenous and exogenous sources rarely cause SSI and their pathogenesis is not well-understood [53].

2.5 RISKS AND PREVENTION OF SSI.

The term risk factor has a particular meaning in epidemiology. In surgical literature, it is often used in broad sense to include patient or operation features, which although associated with SSI development, in univariate analysis are not necessarily independent predictors [54]. Different risk factors associated with the patients and the operations have been studied to identify to what degree they influence the risk of SSI. Information about the surgical procedure and patient characteristics, which might influence the risk of SSI development, are useful in two ways:

1) They allow stratification of the procedures, making data more comprehensive.
2) Knowledge of risk factors before surgery may allow for targeted prevention measures.

Risk stratification also enables one to identify variation in SSI rates that are not due to differences in unalterable circumstances, such as the susceptibility of the patient.

2.6 SURGICAL SITE INFECTION SURVEILLANCE

Surveillance of SSI with feedback of appropriate data to surgeons has been shown to be an important component of strategies to reduce SSI risk[3]. A successful surveillance programme includes the use of epidemiologically sound infection definitions and effective surveillance methods, stratification of SSI rates according to risk factors associated with SSI development, and data feedback.

2.7 RISK INDEX FOR SSIs

There are different systems developed to stratify and predict SSI. Surgical wound classification was the only variable used to predict SSI. Two CDC efforts – The study on the efficacy of nosocomial infection control study (SENIC) [3] and the National Nosocomial Infection surveillance (NNIS) [21] system incorporated other predictor variables into SSI risk indices. The rationale for this was the observed misclassification of incisions, and also that even within the category of clean wounds the SSI risk varied by several percentages

Three categories of variables have proven to be reliable predictors of SSI risk. They are:

1. Those that estimate the intrinsic degree of microbial contamination of the surgical site.

2. Those that measure the duration of an operation

3. Those that serve as markers for host susceptibility

2.8 SSI SURVEILLANCE METHODS

SSI surveillance methods used in both the SENIC project and the NNIS system were designed for monitoring in-patient at acute care hospitals.

Over the past decade, the shift from in-patient to outpatient surgical care (also called ambulatory or day surgery) has been dramatic. It was estimated that 75% of all operations in the United States would be performed in outpatient setting by the year 2000[55].

The 5-day follow-up has been increasingly used, as a standard for the identification of SSI such limited follow-up is believed to miss over 50% of SSI's. It is however been claimed that it may be these early SSI's which occur in hospital that are the most important[56].

Most hospitals/investigators do not have the resources to monitor all surgical patients all the time, nor is it likely that the same intensity of surveillance is necessary for certain low risk procedures. Instead, hospitals should target surveillance efforts towards high-risk procedures in the in-patient[53].

2.9 IN-PATIENT SSI SURVEILLANCE

Two methods alone or together, have been used to identify in-patients with SSI's

1. Direct observation of the surgical site by the surgeon, trained nurse of Infection control personnel [57].

2. Indirect detection by the infection control personnel through review of laboratory reports, patients' records, and discussions with primary care providers[58]

The surgical literature suggests that direct observation of surgical sites is the most accurate method to detect SSI's, although sensitivity data are lacking[59].

Infection control personnel can readily perform indirect SSI detection during surveillance rounds. The work includes gathering demographic, infection, surgical and laboratory data on patients who have undergone operations of interest[60].

2.10 POST-DISCHARGE SSI SURVEILLANCE

Between 12% and 84 % of SSI are detected after patients are discharged from the hospital[61]. At least two studies have shown that most SSI becomes evident within 21 days after operation. Dependence solely on in-patient case finding will result in underestimates of SSI rates for some operations (e.g. coronary artery bypass graft)[62]. Methods used for post discharge surveillance have varying degrees of success for different procedures and among hospitals and include

1. Direct examination of patients wounds during follow-up visits to surgery clinics
2. Review of medical records of surgical clinic patients.
3. Patient surveys by mail or telephone
4. Surgeon surveys by mail or telephone

2.11 SURGICAL WOUND CLASSIFICATION

Operations can be categorized by the cleanliness of the procedure. The classification scheme describes case features that post-operatively grade the degree of intra-operative microbial contamination. This system was developed by the 1964 NAS/NCR co-operative research study and modified in 1982 by the CDC for use in surveillance [63,64].

CLASS I: CLEAN

An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital or uninfected urinary tract is not entered.

CLASS II: CLEAN-CONTAMINATED

An operative wound in which respiratory, alimentary, genital or urinary tracts are entered under controlled conditions and without unusual contamination.
There should be no evidence of infection or major break in technique encountered.

CLASS III: CONTAMINATED

Open, fresh, accidental wounds, operations with major breaks in sterile technique or gross spillage from GIT, and incisions in which acute, non-purulent inflammation is encountered.

CLASS IV: DIRTY INFECTED

Purulent inflammation (e.g. abscess); pre-operative perforation of respiratory, gastrointestinal, billiary or genitourinary tract, penetrating trauma of more than 4 hours old [65,66].

Among these categories, infection risk ranges historically (prior to modern understanding and practice of perioperative antibiotic prophylaxis) from 2% for clean wounds to 30% to 40% for dirty wounds when the skin is closed primarily[66].

Four variables have independently been proved to contribute towards development of SSI's. These are

1. An abdominal operation
2. Wound class
3. An operation lasting more than 2 hours
4. An operation performed on a patient having more than three diagnoses

Each of these equally weighed factors contributes a point when present, such that the risk index value range from 0 to 4[67].

2.12 ANTIBIOTIC PROPHYLAXIS

The choice of parenteral prophylactic antibiotic agents and the timing and route of administration have become standardized on the basis of well-planned prospective clinical studies[68]. It is generally recommended in elective clean surgical procedures using a foreign body and in clean-contaminated procedures that a single dose of cephalosporin, be administered intravenously by anaesthesia personnel in the operative suite just before incision. Additional doses are generally recommended only when the operation lasts longer than 2 to 3 hours.

2.13 SSI RATES IN ABDOMINAL SURGERY

An important question for hospitals with no SSI surveillance is: What are the related causes in this hospital, given the global problem of antibiotic resistance it is important for a hospital to identify the most common pathogens and their resistance pattern.

Centre for Disease Control has produced several recommendations to prevent SSI; many of them are difficult to meet at Kenyatta National Hospital. The CDC recommendations are valuable, but these might be a need for guidelines that are applicable in countries with more limited health budgets.

Studies that try to find the reasons for the higher rates for SSI in developing countries have not been identified. It seems that this knowledge is lacking.

CHAPTER 3

3.1 **RATIONALE FOR THE STUDY**

Laparotomy is one of the most commonly performed surgeries at the Kenyatta National Hospital. It is the basis of training for a senior house officer in the General Surgery course at the Hospital. Among the outcomes of laparotomies is an adverse effect of surgical site infection. Where as previous studies focused on wound infection as a whole, qualitative analysis of the problem in each of the surgical procedures is worth investigating.

This study focuses on the laparotomies performed in both emergency and elective cases. And it is aimed at setting a trend for future studies in other sub-groups of operations at this referral and teaching hospital.

Classification of Infections by the CDC criteria is the way forward all over the world and gives qualitative as well as quantitative analysis of the problem.

CHAPTER 4

4.1 **BROAD OBJECTIVES**

To establish the overall incidence of SSI in abdominal surgery and isolate organisms implicated and study the resistance patterns to commonly used anti-microbials.

4. **2 SPECIFIC OBJECTIVES**

1. Establish the incidence (in percentage) of SSI in abdominal surgery.

2. Classify all infected abdominal surgery wounds by the American *National Nosocomial Infection Surveillance criteria(NNIS).*

3. Isolate and culture pathogens in identified infected wounds and determine their sensitivity patterns to commonly used antibiotics.

4. Determine if SSI affects duration of hospital stay and for how long.

CHAPTER 5

5.1 MATERIALS AND METHODS

This was a prospective study conducted at the Kenyatta National Hospital from 10th September,2003 to 10th February, 2004. All patients from the three general surgical units that underwent surgery in the study period were included. The records scrutinized include:

1. Patients files/Inventory
2. Operating theatre records
3. Anaesthetic chart records (Anaesthetic)
4. Laboratory reports
5. Theatre master record book

5.2 INCLUSION CRITERIA

All patients on whom abdominal surgery was performed, and stayed in hospital for at least 5 days post-operatively.

5.3 ETHICAL CONSIDERATION

This study was commenced after approval by the Ethical and Research committee of Kenyatta National Hospital. Confidentiality was observed and no names were quoted. All patients' files were considered private and confidential as per hospital ethical and research committee regulations.

5.4 STUDY POPULATION AND SAMPLE SIZE

This study focuses on patients admitted to the general surgical units of Kenyatta National Hospital for elective or emergency abdominal surgery. A total of 249 patients were selected for the study.

The Current International SSI's rates for abdominal surgery is 20% [1]. Using this, the sample size was computed from the formula;

$$\mathbf{N = Z^2 (1 – P) X P/ C^2}$$

N = sample size

Z = Standard normal deviate corresponding to 95% confidence interval = 1.96

C = Absolute precision required (set at + or – 5%)

P = prevalence of abdominal wound infections (estimated at 20%)

C = 5% , z = 1.96 , and P = 20 %

$$N = \frac{\mathbf{1.96^2 (0.20 \times 0.8)}}{\mathbf{0.05^2}}$$

N = 249

5.5 RESEARCH METHODOLOGY

A prospective audit was conducted on all patients in the post-operative period in the three General surgical wards from 10th September 2003 to 10th February 2004, inclusive. A patient was defined as having had an operation when the following had occurred: they were taken to the operating theatre, given anaesthesia and a laparatomy was performed. The wounds were observed three to seven days after surgery for the development of SSI. Other nosocomial infections were not recorded.

Patients were assessed for systemic (fever, chills) and local (pain, redness, warmth, swelling, purulent drainage) signs of infections. It was not possible to regard redness of the incisions as a parameter for SSI. The investigator performed bedside observation on third, fifth and seventh day of post-operative period. Examination of surgical incision during dressing changes, participation in house officers' ward rounds, and review of patient records was done.

Patients re-admitted to the hospital were also observed for infections. If one patient had two or more operations of more than thirty days apart each operation was recorded as independent of each other. If the second operation was a result of SSI it was recorded as a consequence of the SSI.

If SSI was present, the type of SSI, according to the CDC criteria, date of onset, and the micro-organism(s) cultured were reported. The treatment given, readmission and re-operation were documented.

Wounds that were confined to the skin and subcutaneous tissue were classified as superficial. Presence of swelling, tenderness obvious oozing of pus were the main determinants for inclusion into this category.

Abscesses were opened in the ward to give way for the pus under pressure, while pus swabs were taken for microbial sampling. All the patients with these wounds were not re-operated, but secondary repair was undertaken after control of the sepsis. No report of mortality was observed from this group of patients.

Deep/ organ SSI was determined either through ultrasonography, clinical signs of intra-abdominal sepsis or at operation.

Specimens were obtained by sterile swabs using aseptic technique and immediate transport and processing of the specimen after collection was done. Constant monitoring of the culture systems to detect growth identification of the organism and antibiotic sensitivity testing were done at 16 hours. Reading of the Antibiotic Sensitivity Test was taken 16 hours after putting the antibiotic disc. Dispatch, collection and interpretation of the results was not possible in the immediate period.

5.6 DATA PROCESSING AND ANALYSIS

All the questionnaires were coded and the collected data entered into the computer using SPSS for windows 2000, release 10.0 (SPSS Inc.) for analysis.

Descriptive statistics analysed were mean, median and mode. In addition, the standard normal deviate test was used to make comparisons where appropriate. Association between SSI and Operative characteristics were calculated using univariate logistic analysis. Results were presented in forms of tables, graphs and diagrams.

CHAPTER 6

6.1 **RESULTS**

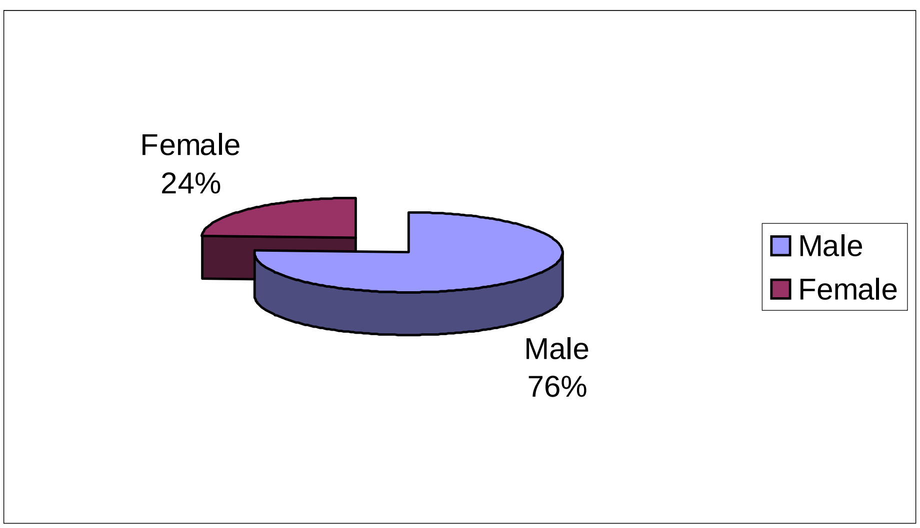
A total of 249 abdominal surgical procedures were included into this study. Of these, 189(75.9%) operations were performed on male and 60(24.1%) on female patients, illustrated in table 2 and figure 2 below.

SEX DISTRIBUTION

Table 2: Sex distribution in patients undergoing abdominal surgery.

Sex	Frequency	Percentage
Male	189	75.9
Female	60	24.1
Total	249	100

Figure 2. Percentage sex distribution.

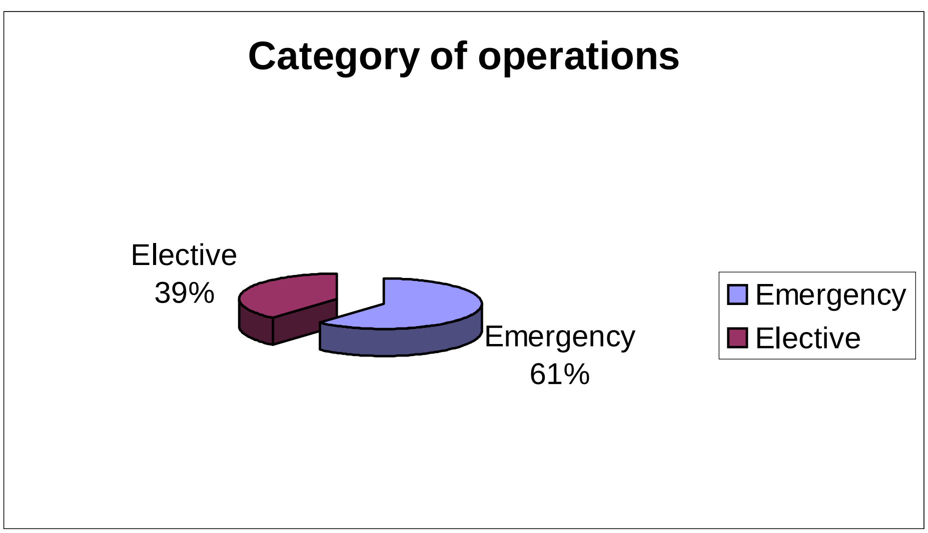


There were 153(61%) emergency surgical operations and 96(39%) elective procedures, Table 3. This demonstrated that the bulk of all general surgical operations are acute conditions. In majority of these emergency operations, Senior House Officers were the surgeons with an exception of few instances depending on the complexity of the operation.

Table 3 Frequency by category of surgery**.**

Type of operation	Frequency	Percentage
Emergency	153	61.4
Elective	96	38.6
Total	249	100

Figure 3 Category of operation in percentage.

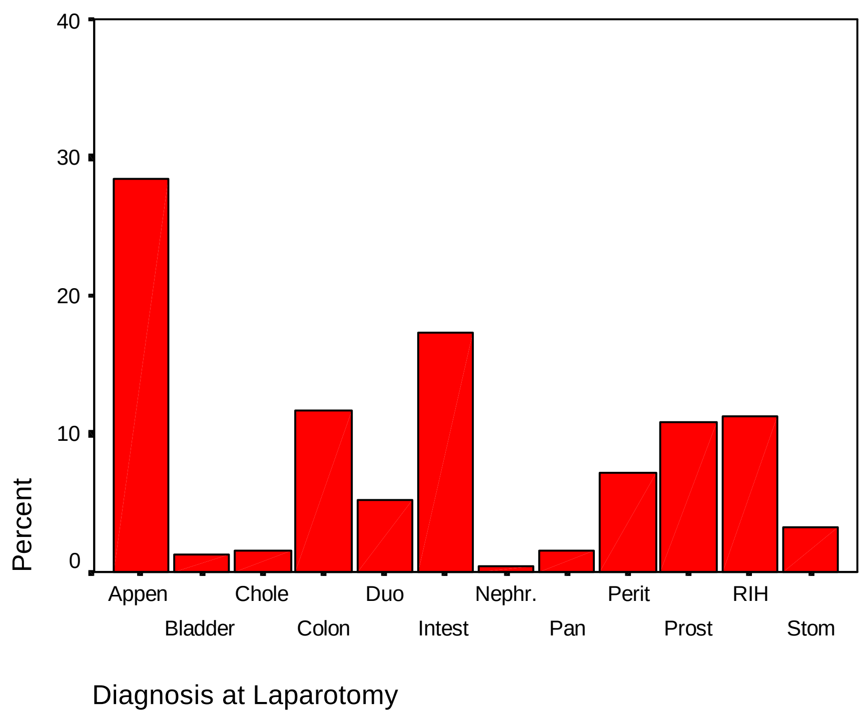


6.2 **PATTERN OF PROCEDURES**

The most commonly performed procedure was surgery pertaining to the appendix accounting for 28.5%(n=71) of the overall laparotomy incidence. Trauma formed a bulk of the workload in emergency though this is not reflected in this study. Figure 4 below outlines the pattern of procedure.

Figure 4

Distribution of surgical procedures by percentage



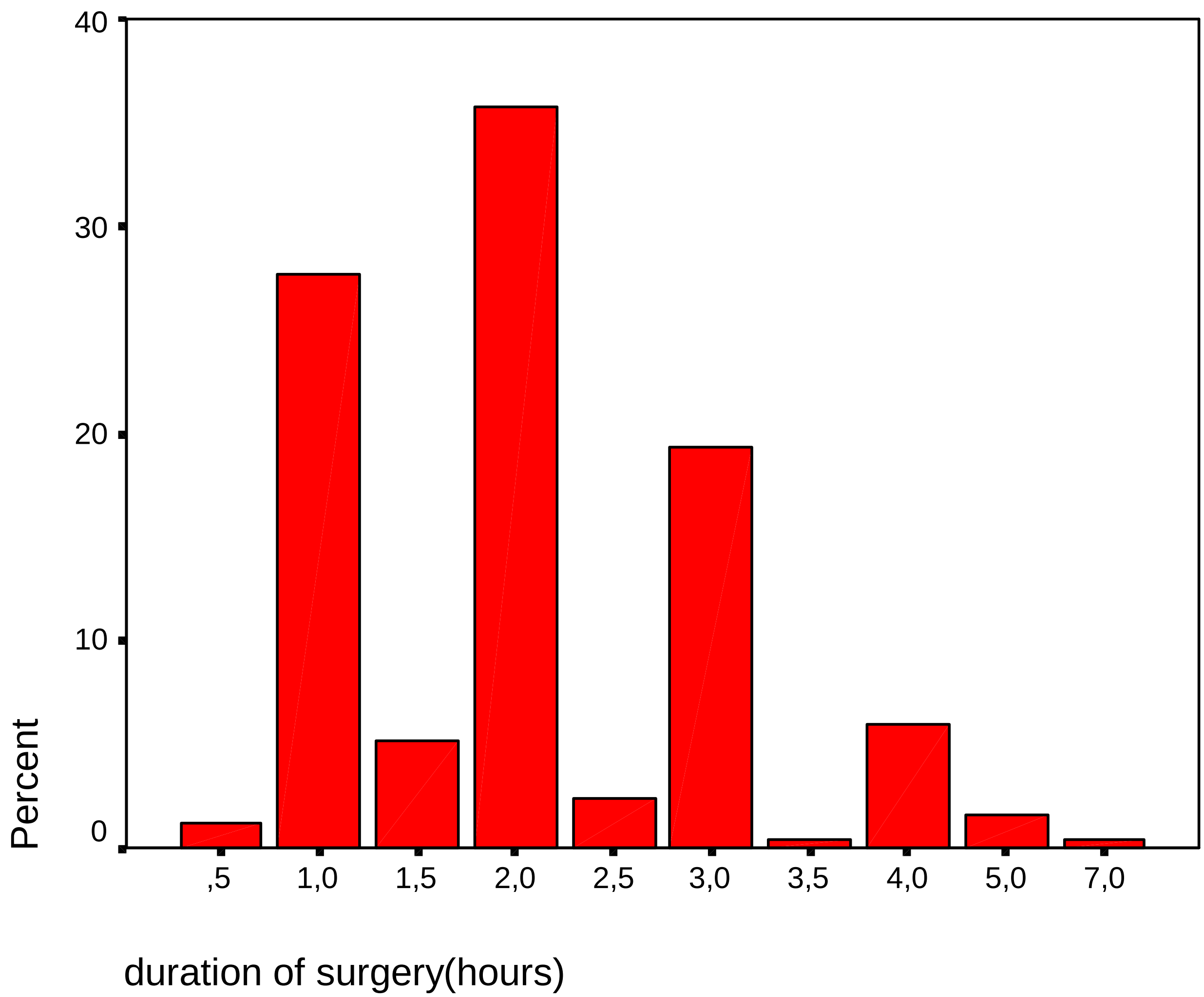
Key; Appen= Appendicitis, Duo= Duodenal perforation, Intest= Small intestinal surgery, Nephr= Nephrectomy, Pan= Pancreatic Carcinoma, Perit= Peritonitis, Prost= Prostate hypertrophy, RIH= Inguinal hernia, Stomach=Gastectomy, Chole=Cholecystectomy

Many of inguinal hernia operations could not be included into this study due to the short duration of post-operative stay.

6. 3 **DURATION OF PROCEDURE**

The operation time was defined as the time from the skin incision to that of wound closure. This was derived from the anaesthetic chart to an estimate of 0.5 hour. The shortest duration recorded was half an hour of surgery, while one procedure lasted 7 hours.Most of the procedures, 92% had a duration of than 3 hours.

Figure 5 Percentage duration of surgery in hours.



The overall mean duration of surgery was 2.078 hours. Infected wounds had a mean duration of 2.5 hours (median 2 hours, range 1 – 7 hours) while non-infected wounds had duration of 1.9 hours (median 2 hours, range 0.5 – 5 hours). In a few cases, surgeries lasted more that 3 hours. The difference was statistically significant ($Z = 3.010$, $p < 0.05$).Table 4 below illustrates the mean duration of surgery in infected and uninfected laparotomy wounds.

Table 4 Duration of operation in patients with and without postoperative infection.

	No. Of Patients	**Mean Duration (hours)**
With Infection	56	2.50
Without Infection	193	1.95
Total	249	2.07

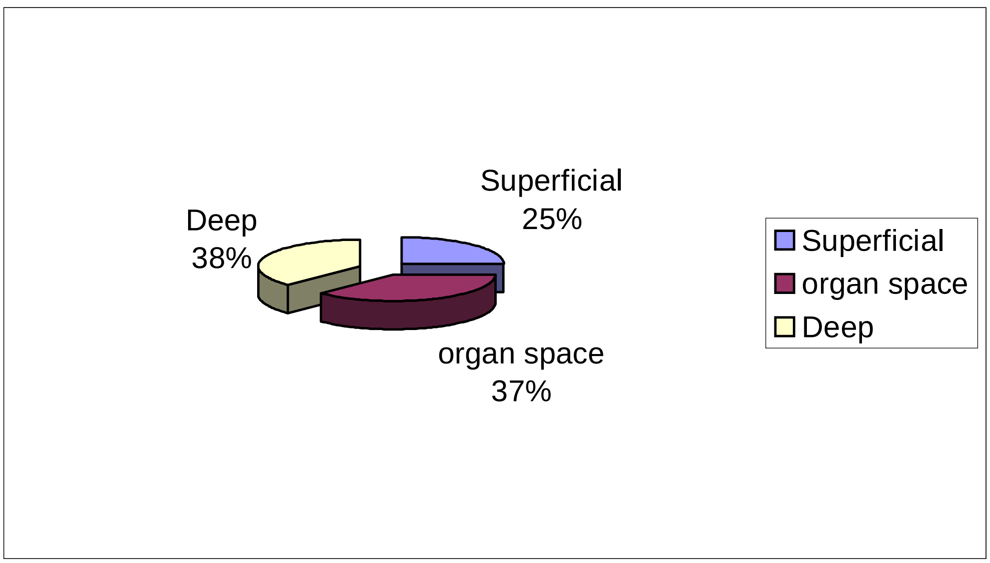
6.4 **TYPE OF SSI**

The overall rate of SSI in abdominal surgery was 22.4 %(56/249). Using the CDC definition, of the 56 cases**;** superficial SSI was found in 14(25%), deep incisional SSI 21(37.5%) whereas organ/space in 21(37.5%). These are shown in table 5 and table 6 below .

Table 5. Frequency distribution among the various SSI's.

	Frequency	**Percentage**
Superficial	14	25
Organ/space	21	37.5
Deep	21	37.5
Total	56	100

Figure 6 Percentage distribution of Surgical Site Infections.



6.5 **SURGICAL SITE INFECTION BY WOUND CLASS.**

The total incidence of SSI assessed by wound classification was as follows:

Clean contaminated, 21

Contaminated, 13

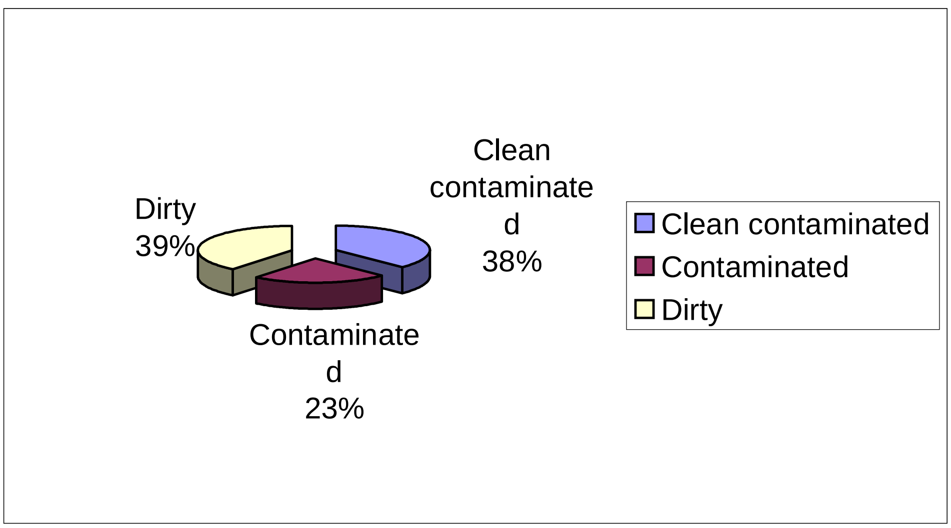
Dirty, 22

These are illustrated in Table 6 and Figure 7 below.

Table 6 Surgical Site Infection by wound class in frequency and percentage.

Wound type	Frequency	Percentage
Clean contaminated	21	37.5
Contaminated	13	23.3
Dirty	22	39.2
Total	56	100

Figure 7 Percentage distribution SSI by wound class.



In clean wounds, there were no Surgical site infections observed.

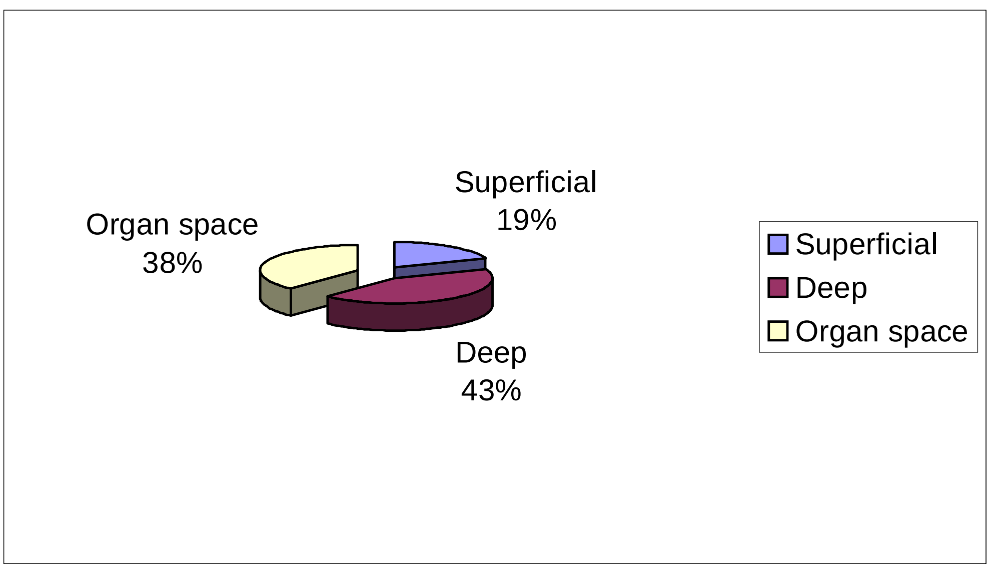
6.6 CLEAN-CONTAMINATED PROCEDURES

In the clean-contaminated procedures there were twenty one SSI. Of these, 4 wounds had superficial, 9 deep incisional and 8 developed organ/space SSI. These are presented in Table 7 and Figure 8 below.

Table 7 Frequency of Surgical Site Infection in clean contaminated wounds.

Type of SSI	Frequency	Percentage
Superficial	4	19
Deep	9	42.8
Organ space	8	38.2

Figure 8 Surgical site infections in precentage in clean contaminated wounds.



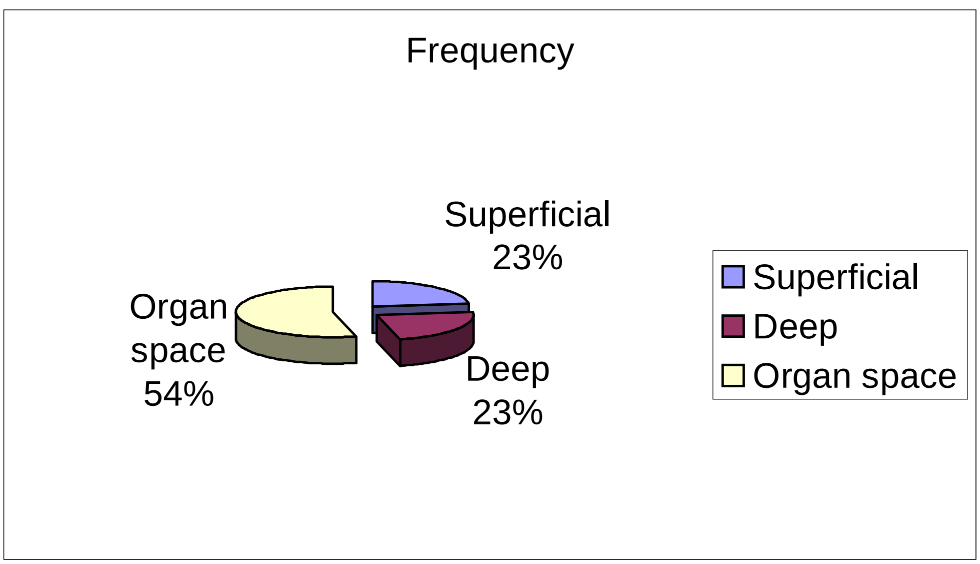
6.7 CONTAMINATED

A total of 13 procedures categorized as contaminated, became complicated with surgical site infections. Of these, 3 had superficial, 3 deep and 7 organ-space SSI. These are presented in figures 8 and 9 below.

Table 8 Frequency of SSI in contaminated abdominal surgeries.

Type of SSI	**Frequency**	**Percentage**
Superficial	3	23.1
Deep	3	23.1
Organ space	7	53.8
Total	13	100

Figure 9 Percentage distribution of type of SSI in Contaminated procedures.



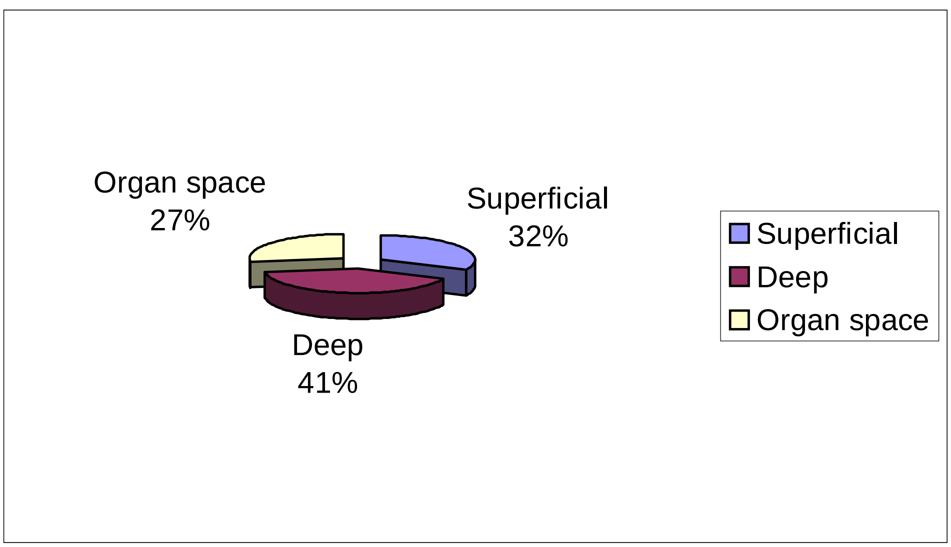
6.8 **DIRTY**

There were 22 procedures classified as dirty which complicated with SSI. Of these, 7 had superfical , 9 deep and 6 organs-space SSI. Table 9 and figure 10 below present the distribution of SSI among dirty procedures.

Table 9 Rates of SSI in wounds classified as Dirty procedures.

Type Of SSI	**Frequency**	**Percentage**
Superficial	7	31.8
Deep	9	40.9
Organ space	6	27.3
Total	22	100

Figure 10 Percentage distribution of SSI in Dirty procedures.



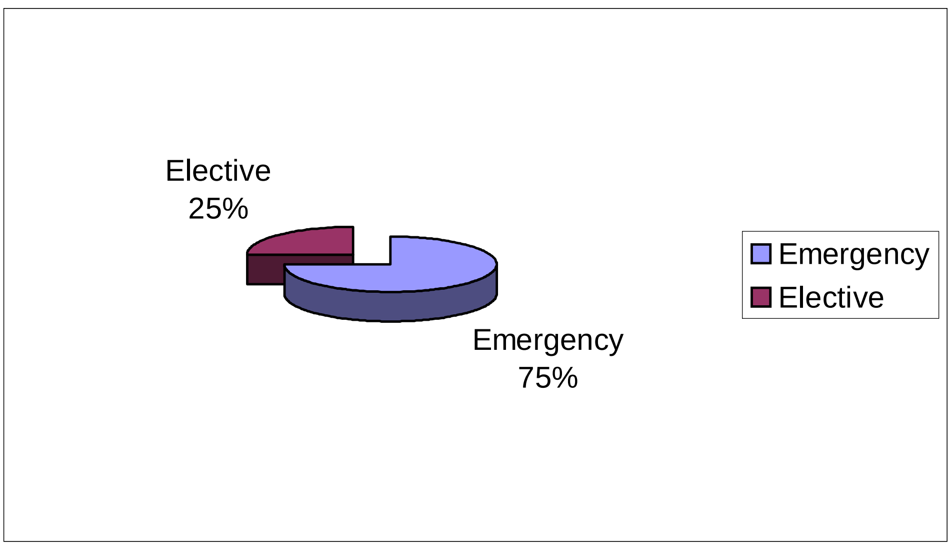
6.9 INFECTION RATES ACCORDING TO OPERATIONS

Of the 56 SSI identified, emergency laparotomy accounted for 75%(42) while elective procedures had 25% (14). See table 10 and figure 11 below.

Table 10 Surgical Site Infection by the category of operation.

Category Of operation	Frequency	Percentage
Emergency	42	75
Elective	14	25
Total	56	100

Figure 11 Percentage of infections by the category of operation.



Of the 153 emergency laparotomies performed during the study period, the infection rate was 27.4%, where as in the 96 elective procedures, the rate was 14%. This implies that the rates of SSI in acute surgeries was almost double that of elective operations.

Among the patients who underwent appendicular surgery the rate of SSI was 18%, while colonic surgery (which is regarded as high risk surgery) the rate among them was 51 %.

7.0 DURATION OF HOSPITAL STAY

This was derived from the day of operation to the day of discharge from the ward. Some patients had prolonged hospital stay either due to financial constrains or otherwise. The excess days in these patients were not included into the study. The overall mean duration of hospital stay following abdominal surgery was 11 days. The mean days of hospital stay in patients with SSI was 27.9 days while in patients without SSI had a hospital stay of 7.9 days. There was a mortality of 8 patients during the study period, 3 as a result of SSI while the rest mortality was from other co-morbidities beside infection. There were 2 re-admissions due to SSI developing in the post-discharge period.

Table 11 Statistical comparison of duration of duration of hospital stay between patients with and without wound infections.

Descriptives

Hosptal stay

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
yes	53	26.19	21.352	2.933	20.30	32.07	4	90
no	188	7.88	5.858	.427	7.04	8.73	2	40
Total	241	11.91	13.537	.872	10.19	13.63	2	90

The duration of hospital stay longer in patients who complicated with SSI. Statistically this was sigificant ($Z = 0.000$, $p > 0.05$).

7.1 IDENTIFIED PATHOGENS

A total of 51 positive cultures were obtained from 56 total swabs taken from clinically infected wounds. Single pathogens were isolated from 28(50%) of these swabs while 23(41%) culture results grew mixed pathogens. In 5 (9%) of the culture results there were no pathogens isolated.

Staphylococcus aureus was the commonest species isolated from the cultures, accounting for 44.4 % of the total organisms isolated from the SSI. *Escherichia coli* accounted for 17.5% and *Klebsiela* species 14.3%.Table 13 below shows the number of different pathogens identified.

Most of the *Proteus, Klebsiela, Pseudomonas* species isolated were from deep incisional and organ-space SSI. Cultures in these were mostly polymicrobial in nature.

Table 12. Distribution of pathogens isolated and respective percentage.

ORGANISM	***FREQUENCY***	***PERCENTAGE***
Staph aureus	28	44.4%
E. Coli	11	17.5%
Klebsiela	9	14.3%
Proteus	5	7.9%
Citrobacter	3	4.8%
Enterobacter	3	4.8%
Pseudomonas	3	4.8%
Bacteroides	1	1.6%
TOTAL	63	100%

7.2 ANTIMICROBIAL SUSCEPTIBILITIES OF BACTERIA.

Table 13 below illustrates the pattern of resistance to the commonly used antimicrobials. Staphylococcus demonstrated highest resistance to Oxacillin (50%) and low resistance to ceftazidine (1%) and ceftriaxone (3%). The sensitivity of this organism is fairly high to the second and third generation cephalosporins.

Resistance of *E. coli* to antimicrobials was lowest for ciprofloxacin (2%) and ceftazidine (9%). Resistance of above 25% was observed in cefuroxime, gentamicin, minocycline, piperacillin, ceftriaxone and augmentin.

Though the species of pseudomonas isolated was low 2, the resistance to tested antibiotics was fairly high above 50%. In two cases, the resistance was 0% for gentamicin and piperacillin.

Table 13

Resistance patterns of the species isolated from SSI against tested antimicrobials

	staph	**Esch**	**Prote**	**Klebs**	**citroba**	**entero**	**pseudo**
Amoxyl	39%(28)	10%(11)	--	--	100%(1)	100%(1)	--
Ceforux	35%(28)	27%(11)	0%(3)	22%(9)	0%(3)	100%(1)	100%(2)
Ciproflox	17%(28)	2%(11)	0%(4)	33%(9)	66%(3)	100%(3)	50%(2)
Gentamic	28%(28)	27%(11)	75%(4)	37%(8)	66%(3)	66%(3)	0%(2)
Minocyc	7%(28)	54%(11)	100%(3)	34%(9)	--	--	100%(1)
Piperac	--	27%(11)	66%(3)	22%(9)	0%(3)	100%(1)	0%(2)
Cefta	0%(1)	9%(11)	0%(4)	11%(9)	0%(3)	100%(1)	33%(3)
Ceftriax	3%(18)	50%(6)	0%(4)	22%(9)	0%(1)	100%(1)	100(1)
Augment	21%(28)	27%(11)	0%(5)	22%(9)	0%(3)	33%(3)	100%(1)
erthrythro	40%(27)	33%(3)	100%(1)	--	--	--	--
Oxacill	50%(28)	100%(1)	--	--	--	--	--
Nitrofur	--	--	--	--	--	0%(2)	--
Vancom	--	--	--	--	--	0%(2)	--
Nalidic	--	--	--	--	--	100%(2)	--
Amika	--	--	--	--	--	--	100%(2)
Tobra	--	--	--	--	--	--	100%(1)
Merop	--	--	--	--	--	--	50%(2)
Strepto	--	--	--	--	--	50%(2)	--
Tazobac	--	--	--	--	--	--	0%(1)

KEY: Table 13

Amoxil:	Amoxycillin	Cefurox:	Cefuroxine
Ciproflox:	Ciprofloxacin	Gentamic:	Gentamicin
Minocyc:	Minocycline	Piperae:	Piperacillin
Cefta:	Ceftazidine	Augment:	Augmentin
Erythro:	Erythromycin	Oxacill:	Oxacillin

Nitrofur:	Nitrofurantoin	Vancom:	Vancomycin
Nalidic:	Nalidixic	Amika:	Amikacin
Tobra:	Tobramycin	Merop:	Meropenem
Strepto:	Streptomycin	Tazobac:	Tazobactam

CHAPTER 7

DISCUSSION

Improvement in peri-operative antibiotic spectra, dosing, and timing, in addition to focus on sterile technique, is associated with a persistent decline in wound infection[69].

The approach used in this study was designed to evaluate the magnitude of SSI at the Kenyatta National Hospital following abdominal surgery.

With the increasing interest in medical-legal aspects and in cost effectiveness of hospital care, true estimates of the morbidity and economics of SSI are of growing importance.

The overall rate of SSI in abdominal surgery was 22.4%. This is indeed a higher rate than that quoted in surgical literature at 12%[70]. Higher infection rate was observed in emergency surgery 27.5%. A number of factors could have contributed to this. *Niinikoski* studied 696 patients undergoing abdominal surgery at the University of Turku, and found an overall rate of 9.8 %, with 12.4% in acute surgery and 7.6% in elective procedures[71]. In his study, the rates for clean-contaminated, contaminated and dirty were 9.1 %, 14.4 % and 28.8% respectively.

Classifying wounds by the degree of contamination is a dying practice[3]. *Haley* demonstrated that the wound infection rate in clean cases to vary from 1 % to 16 % [72] and this led to *Nicolls* comment that 'although unproven, the greatest risk factor for post-operative infection appears to be the patients themselves' [20]. This implies that as long as the traditional practice of adequate patient preparation is in place, the patient factors are predictive of subsequent SSI's. But one should not dismiss that the degree of wound contamination as inconsequential to subsequent SSI development.

Several of the CDC's recommendations were not observed in the majority of the emergency procedures. Pre-operative antibiotics were not prescribed in most of the patients scheduled for emergency appendicectomy. Although the intrinsic risk of infection is low for uncomplicated appendicitis, the pre-operative status of the patient's appendix is typically not known. Prophylaxis is recommended for appendicectomy [73.]

Consultants conducted most of the elective procedures in abdominal surgery, and a rate of 14.6 % is slightly higher than 12% quoted elswhere[69]. The use of antibiotics pre-operatively or intra-operatively was observed in 80% of clean-contaminated, contaminated and dirty procedures. This explains why the rates were lower in elective surgery. Notable though, is the fact that in some instances, administration of prescribed drugs was not mentioned in the treatment sheet.

There were 29 colonic surgeries in this study with an infection rate of 51%. The literature quotes the figure that varies between 9.5% to 22% for elective procedures [69]. Most of these procedures were trauma related emergency surgery, where other risk factors were in place.

The colon contains a huge number of organisms, mainly anaerobes, plus *Enterobacteriaciae* and *enterococci*. There is therefore a potential for infection if there is spillage of bowel contents during surgery. There is good evidence that single dose peri-operative antibiotics do reduce the incidence of wound infection, though there is still debate about the best regimes. A wide range of options are available; suitable choices include aminoglycosides or a cephalosporin, plus metronidazole, or co-amoxiclav alone. There's no evidence that later generation of cephalosporins such as cefotaxime or ceftriaxone are superior to older agents[73]

7.1 DIAGNOSIS OF SSI

The mean time to diagnose SSI in this study was 7 days (range 3 – 35 days).This was applicable to most of the superficial and deep incisional SSI. Organ space SSI had a longer duration which was variable depending on a number of factors. In their study, *Weiss* et al found a mean duration of 20 days (range 4- 149 days) [74]. Other studies have followed-up post-operative wounds for between 3- 6 days and have found infection rate of 1.4 % - 2.9 % for clean surgical procedures [54]. It may be argued that it is these early infections which occur in hospital that are the most important. *Mitchell* showed that patients having SSI which occurs in hospital before discharge had a 25% re-operation rate and mortality of 13.6% [56].It has been shown that over 50% of the infections occur within the first week after operation, and about 90% within two weeks[75].

7.2 PRE-OPERATIVE PREPARATION OF PATIENTS

In 92% of patients scheduled for emergency abdominal surgery the only pre-medications given were atropine and pethidine. The post-operative treatment consisted of penicillin based antibiotic as well as aminoglycoside gentamicin for a five days course. In 38% of these patients a cephalosporin, Cefuroxime was prescribed post-operatively.

Adequate patient preparation was observed in elective cases. Notable though is the fact that patients scheduled for open prostatectomy had a shorter duration of pre-operative hospital stay, of mean 2.37 days compared to those for other procedures. In some of these patients the pre-operative stay was exceedingly longer than recommended. Prolonged pre-operative hospital stay is frequently suggested as the one patient characteristic associated with increased SSI risk[67]. However, the length of preoperative stay is likely a surrogate for severity of illness and co-morbid conditions requiring inpatient work-up and/or therapy before the operation[78]. It is hoped that in future the length of pre-operative stay in elective surgery shall be shorter and adequate. Currently patients scheduled for elective hernia surgery are admitted as day cases.

The current practice is to admit patients for elective procedures shortly before the surgery[76]. This has been proved to reduce rates of SSI.

7.3 SSI MORBIDITY/MORTALITY

Death occurred in 8 patients, 3 of whom the cause was attributed to serious organ/space SSI, during the period of awaiting re-operation. Two of these patients had undergone colonic surgery; one had multiple small gut perforations from typhoid peritonitis and the post-operative outcome was poor. Five of the mortalities were admitted to the Intensive Care Unit. A re-admission was included in the study. This patient had undergone laparotomy for appendicular abscess and was re-admitted with a deep incisional SSI. Current data suggest that superficial SSI, although rarely fatal, represent a significant disease burden. Deep space infections are associated with even greater increases in cost and length of stay[77].

7.4 DURATION OF SURGERY

On average a laparotomy lasted 2 hours, except in few cases where the operation was prolonged due to technical reasons. Duration of procedure has been found to be an independent risk factor and any procedure that lasts longer than 120 minutes is indeed a high-risk operation. *Cruse* showed existence of a direct relationship between operative time and postoperative infection risk. The risk doubles with each additive operative hour [54].

7.5 DURATION OF HOSPITAL STAY

The mean duration of hospital stay in patients with SSI was 27.9 days, about 16 days longer than non-infected patients. *Cruse*, in following 40 622 consecutive general surgery operations, claimed that a SSI added 9.1 days to his patients' stay and estimated that this resulted in an added hospital expense USD 910. No mention was made of how the figures were obtained [54].

Besides the extended admission, patients who had organ/space SSI had to be re-operated, and admitted to the Intensive therapy unit of the hospital. Use of interventional radiology to drain intra-peritoneal abscesses was not observed in this study.

7.6 PATHOGENS

In this study *S. aureus* were isolated in 28 of the infections, *E. coli* in 11 and *Klebsiella* 9 infections. This pattern is consistent with that reported in the literature elsewhere[67]. In 41% of the cultured specimens, a polymicrobial pattern of organism was found. Isolates of two organisms was the norm almost always involving *S. aureus* species and an enterobacteria. There were no isolates of coagulase-negative *staphylococcus*, which is in contrast to isolates from a large-scale study conducted at Fairview University Medical Centre[74]. There is a debate as to whether coagulase-negative *staphylococcus* represent colonization or infection. In the presence of clinical infection is would be appropriate to consider these species as pathogens.

In surgery pertaining to appendix, the expected organisms are usually gram-negative bacilli. In this study, isolates of *staphylococcus* were found in these procedures. This may have been due to inadequate patients cleaning of skin before the procedure, contamination from the surgeon/theatre staff or inappropriate duration of dressing in the post operative period. The organisms responsible for SSI are relatively consistent and are dependent on the operative site[78]. The source of pathogens is most frequently the endogenous flora of the patients' skin, mucous membranes, or hollow viscera. For example, *Escherichia coli* and anaerobic organisms (*e.g.*, *Bacteroides fragilis*) are frequent isolates following colorectal procedures, while *Staphylococcus aureus* and are most frequently implicated following procedures that do not breach the aerodigestive or genitourinary tracts. Exogenous sources are less commonly implicated and include surgical personnel, the operating room environment, and surgical instruments[79]. The consistency of the infecting organisms by surgical site underlies the rationale and success of prophylactic antimicrobial strategies.

The most successful means of preventing SSI has been perioperative administration of systemic antimicrobials [80]. Perioperative systemic antimicrobial prophylaxis is indicated for any procedure in which the risk of SSI is equal to or greater than that of a clean-contaminated procedure, or for those operations after which incisional or organ/space SSI would represent a catastrophe. However, there is evidence that even clean procedures benefit from antimicrobial prophylaxis. For example, in a well-designed randomized controlled trial study, antimicrobial prophylaxis significantly reduced infection rates in patients undergoing elective herniorrhaphy [81].

Only a brief course of antimicrobial prophylaxis (*e.g.*, 24 hours) is warranted. Specific in some clinical settings characterized by contamination rather than established infection, examples include patients operated on promptly following spontaneous gastroduodenal perforation, traumatic hollow viscus injury, necrotic small bowel, and non-gangrenous, non-perforated appendicitis. In these clinical scenarios, a short course of antimicrobials has been proven to be as effective in reducing the rate of SSI as a full course of antibiotic therapy [74,81].

7.7 ANTIMICROBIAL RESISTANCE PATTERNS

It emerged from this study that the resistance to most of the antibiotics tested is fairly high. *Staphylococcus aureus* still poses the great resistance to the commonly used antimicrobials in clinical practice. An average resistance of this species to Oxacillin (50%), amoxicillin (39%) and cefuroxime (35%). This is a relatively lower than that found in the English study oxacillin (42%) [83]. In this institution the antibiotic restriction policy is applicable to most of the cephalosporins (Cefuroxime, ceftazidime, ceftriaxone). This has indeed has controlled the emergence of multi-drug resistance species.

The low resistance of *E. coli* to ciprofloxacin (2%), amoxyl (10%), Ceftazidime (9%), augmentin (27%) demonstrates the low exposure to these antibiotics (restricted antibiotics). Large-scale studies elsewhere have shown the resistance patterns to above-mentioned antibiotics to be above 40% and recommendations for regular surveillance is in force to monitor the trends[82].

8. 0 **CONCLUSION**

This study identified a 22.4% SSI rate in abdominal surgery and showed that several pathogens were resistant to the commonly prescribed antibiotics. The patients' surveillance in the out-patient was not effective due to poor attendance and more of the SSI would have been detected from the surgical outpatient clinic had the turn up been better.

Emergency laparotomy poses a great risk to developing SSI and as such surgeons should enforce the use of prophylactic antibiotics in the peri-operative period. Prescribing full course of antibiotics in the post-operative period is unjustified. Rather, rational and independent administration if these should be on merit basis.

The mortality from organ/space SSI is associated with delays in diagnosis and surgeons should put more emphasis to re-address this problem promptly.

The hospital records department needs computerisation of records. Delivery of files to the clinic in time during follow-up not consistent. Surgeons are then forced to use the patients' discharge summary in cases of lost files.

Second generation cephalosporins should be used in all operations that are either clean-contaminated, contaminated or dirty procedures. The duration of antibiotic coverage could extend in dirty procedure to the post-operative period.

Though not objectively assessed in this study, administration of antibiotics for the preoperative.
Prophylaxis is not consistent
Specific prophylaxis should be:

-Administer 30-60 minutes prior to skin incision
-Dose – 1-2 grams
-Maintain therapeutic levels of antibiotic in both serum and tissue throughout the operation
-If operation lasts longer than 4 hrs give a second dose after the 2nd hour.
-Blood loss greater than 2000 millilitres give second dose

-Prophylactic Antibiotics should be discontinued within 24hrs post-operative

Periodic assessment of the resistance patterns to the commonly used antibiotics is highly recommended.

Senior House Officers need to prescribe second generation cephalosporins in the preoperative preparation of patients. This is more so for the contaminated procedure which form the bulk of their work in emergency operations.

Provide health care system administrators and other decision makers with data on the impact of drug-resistant organisms (e.g., outcome, treatment costs) and on effective prevention and control measures.

Disseminate surveillance data in a timely manner to clinicians, and others who make decisions based on an analysis of the data.

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APPENDIX 1

INFORMED CONSENT AGREEMENT.

A STUDY ON SURGICAL WOUND INFECTIONS.

I ……………………………………………………… (Subject's name) having full capacity to consent for myself and having attained my …………… Birthday do hereby consent to my participation in the research study.

I have the full knowledge that the investigator, Dr. Mwendwa Mutemi Kithome is conducting a study on Surgical Site Infections on abdominal operations. He's to examine my wound from the 3^{rd} postoperative day and hereby agree that he may examine and take pus specimen for laboratory analysis.

The implication of my participation, the nature, duration and purpose, the methods and means by which it will be conducted and the inconveniences and hazards which may be reasonably expected to have been explained to me by

…………………………………………………………………….

I have been given the opportunity to ask questions concerning this investigational study, and many such questions have been answered to my full and complete satisfaction. Should any questions arise, I may contact DR. MWENDWA KITHOME at Telephone 0722 88 65 91, P.O BOX 41766 GPO NBI.

I understand that I may at any time during the course of this study revoke my consent and withdraw myself from the study without prejudice, however I may be requested to have myself undergo further examinations if in the opinion of the doctor such an examination is necessary for my well being.

SUBJECT'S NAME: ______________________________________

SUBJECT'S SIGN: ______________________________________

STUDY NUMBER: ______________________________________

DATE: _______________________________________

WITNESS: _______________________________________

APPENDIX II

QUESTIONNAIRE FOR SURGICAL SITE INFECTION IN ABDOMINAL SURGERY AT KENYATTA NATIONAL HOSPITAL

1. Study Code No. ☐ ☐ ☐
   Date …………

2. IP. No. ☐☐☐☐☐☐☐

3. Sex
   Male ☐ Female ☐

4. Category of operation

   Emergency ☐ Elective ☐

5. Diagnosis of Laparotomy
   ……………………………………………

6. Surgeon

   Consultant ☐ Senior House Officer ☐

7. Duration of surgery/Operation………………………………Hours

8. Is there any surgical site infection

   Yes ☐ No ☐

9. If yes; please categorize

   - Superficial ☐
   - Deep incisional ☐
   - Organ/space ☐

10. If yes, state pathogens isolated

   - Single colony ☐

- Mixed colonies ☐

11. Tick the appropriate pathogen isolated

- ☐ Staphylococcus aureus
- ☐ Esherichia coli
- ☐ Pseudomonas aeruginosa
- ☐ Proteus mirabilis
- ☐ Other streptococcus
- ☐ Bacteroides fragilis
- ☐ Klebsiella pneumoniae
- ☐ Other Gram positive aerobes

12. Sensitivity of isolated pathogens

Penicillin ☐
Cefuroxine ☐

Methicillin ☐
Ceftazidine ☐

Gentamicin ☐
Augmentin ☐

Erythromicin ☐
Chloramphenical ☐

Cotrimoxazole ☐

Tetracycline ☐

Meropenem ☐
Ciprofloxacillin ☐

13. Were antibiotics prescribed pre-operatively?

Yes☐ No☐

14. Duration of hospital stay post-operatively……………… Days