PATTERN OF SUPERFICIAL SURGICAL SITE INFECTION AFTER ELECTIVE ORTHOPAEDIC SURGERY AT KIKUYU P.C.E.A ORTHOPAEDIC REHABILITATION CENTER.

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A dissertation submitted in part fulfillment for the degree of Masters in Medicine in Orthopaedic Surgery, University of Nairobi.

2016

DECLARATION

Student's declaration

I hereby declare that this study is my original work and has not been presented for a degree in any other university.

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Signature_____ Date _____

Supervisor's declaration

I hereby declare that this research proposal is being submitted with my approval as university supervisor.

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Signature.....Date.....

I hereby declare that this research proposal is being submitted with my approval as university supervisor.

Dr. John King'ori

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Signature.....Date.....

CERTIFICATE OF AUTHENTICITY

This is to certify that this thesis is my original work.

This research was carried out at The P.C. E. A. Kikuyu Orthopaedic Rehabilitation center in Kikuyu.

Professor J. E. O Ating'a

Professor of Ortheopedic surgery

Chairman Department of Orthopaedic Surgery

University of Nairobi

Signature…….

Date……..

DEDICATION

This thesis is dedicated to my wife Khadija Alihussein for her understanding and her patience, to our children Hatim, Teikhum and Ruqiayyah for bearing my absence from home.

AKNOWLEDGEMENT

I am sincerely indebted to my supervisors Prof J. E. O Ating'a and Dr. John King'ori, who have given constant encouragement and safe advice. They have offered enormous help in bringing this thesis into fruition in a timely manner.

The work could not have crystallized without the help of Mr. Saifuddin Tarwadi (my father and the sponsor for my studies), colleague registrars and the staff of Kikuyu P. C. E. A. Orthopedci Rehabilitation Center.

Prof. Mulimba J.A.O, the former Chairman; Department of Orthopaedics, has offered insightful counsel.

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ACRONYMS

WHO World Health Organisation

SSI Surgical Site Infection

CDC Center for Disease Control

HIV Human Immunodeficiency Virus

ORIF Open reduction and internal fixation

ASA American Society of Anesthesiologists

ABSTRACT

Background: Surgical site infection (SSI) is the commonest complication of surgery with prevalence rates as high as 20% in the USA. [10] SSIs are a leading cause of morbidity and mortality as well as increase in economic implication to the patient

Objective: The main objective of this study was to determine the local prevalence rates of SSIs and the common causative organisms isolated from the infected wounds with their antibiotic sensitivity. The data derived will be used to better the practice including designing protocols for antibiotic use as prophylaxis

Design and setting: This was a prospective cohort study with the cohort being all patients undergoing elective orthopaedic surgery and was conducted at the P.C.E.A Kikuyu Orthopaedic Rehabilitation center.

Methodology: 243 patients undergoing elective orthopaedic surgery and who consented to participation in the study were followed up for a period of 30 days from the day of surgery, initially in the ward then through specific clinic visits timed at 2 weeks and 30 days after surgery and the wounds were examined for features of infection using the Southampton Wound Scoring System; which is a wound scoring system designed to evaluate superficial surgical site infections,

with wounds being categorized according to any complications and their extent. Wounds with features of infection were swabbed and sample taken for microscopy culture and sensitivity at the hospital labs. All patients were on prophylactic Ceftriaxone given pre-operatively and continued up to 3 days post operatively as standard for the hospital.

Results: Out of the 243 patients 12 patients 4.9% (7 female and 5 male) developed SSI, 8 out of 144 patients (5.6%) that underwent open reduction internal fixation (ORIF) developed SSI, 3 out of 51 (5.8%) patients that underwent arthroplasty developed SSIs and 1 out of 38 that underwent soft tissue surgeries developed SSIs. There were no cases of SSIs in the group that had Arthroscopies. Out of the patients that developed SSI 4 patients were hypertensive, 5 patients diabetic, 1 patient with HIV infection and 2 patients had no known comorbidities. The commonest causative organism isolated from the infected wounds was ***Staphylococcus aureus*** except one in which ***Klebsiella spp*** was isolated. All the isolated Staphylococcus aureus were sensitive to Amoxicillin- clavulinic acid combination, cefuroxime and clindamycine. 3 out of 11 cultured Staphylococcus aureus showed resistance to ciprofloxacin.

CHAPTER ONE

BACKGROUND

According to the 2009 WHO global status report, Kenya recorded 3,760 traffic deaths, the highest in East Africa region. WHO predicts that the increase in road accident related mortality will proportionally increase with an increase in road accidents.[1,2] Due to this increasing amount of trauma from road traffic accidents, the numbers of surgeries in orthopaedics are also bound to increase.

A major complication of any type of orthopaedic surgery is infection and this is sometimes devastating. If infection does occur, the patients are at risk of losing their newly found mobility, it is a great financial burden on patient and on hospital resources including Intensive care and could lead to morbidity and mortality.[3]

Surgical site infections (SSIs) can be divided into either being incisional or organ/space SSIs. Incisional SSIs are further classified into being superficial (involving skin and subcutaneous tissues) or deep (involving the fascia and muscles).[4]

For a wound to qualify as having a superficial incisional SSI, the infection should have occurred within 30 days of operative procedure and involve only the skin and subcutaneous tissue. Deep incisional SSI is an infection occurring after 30 days of operative procedure, if no implant has been used or 1 year if an implant has been used, the infection appears to be related to the surgery and involves the deep soft tissues (fascia and muscle layers).[4]

An organ or space SSIs is defined by an infection occurring in any part of the anatomy other than the incision, opened or manipulated during the surgery, occurring within 30 days if no implant was used and 1 year if an implant was used and appears to be related to the surgical procedure.[4]

There are many reasons as to why a patient can get SSI; which can be divided into as being patient specific or procedure specific and in both the factors can be modifiable or non-modifiable. [5]

Patient specific factors that are modifiable include: Obesity, currently smoking tobacco, hematocrit less than 36%, elevated serum glucose preoperatively or postoperatively, poor nutrition status of the patient and nasal carriage of *Staphylococcus aureus.*[6]

Non modifiable patient specific risk factors for surgical site infections include: Diabetes mellitus, male gender, advanced age, rheumatoid arthritis, recent weight loss, disseminated cancer and ASA (American Society of Anesthesiologists grading system used to assess the degree of a patient's "sickness" or "physical state" prior to selecting the anesthetic or prior to performing surgery) score of III and above; which is a patient with severe systemic disease.[5]

Procedure specific modifiable risk factors include; site and type of surgery, longer procedure time, suboptimal timing of prophylactic antibiotic, technique of skin preparation, presence of suture or foreign body left at site, technique of suturing, haematoma formation and poor tissue perfusion during anaesthesia. The non-modifiable risk factors include: inexperienced surgeon and hospital not equipped for the surgery.[5]

Antibiotic prophylaxis is justified at every surgical intervention involving an implant, because it reduces the rate of infection from 5% to 1%. Antibiotics can eliminate bacteria before they colonize implants or are established intracellularly in the macrophages.[7]

Antimicrobial prophylaxis is a necessary adjunct to the management of fractures that require surgery. In closed fractures, administration of a first-generation cephalosporin 30 minutes before surgery provides adequate coverage.[8] It is not necessary to continue prophylaxis for more than 24 hours.[9]

The common causative organisms from most researches are; *Staphylococcus aureus, Staphylococcus epidermidis, Pseudomonas spp, Klebsiella spp and Escherichia coli*. [11,12,13,14,16,17,18]

The commonly used antibiotics for prophylaxis, from personal observation over the last 2 years, at Kenyatta National Hospital vary from surgeon to surgeon but the common ones include Flucloxacillin, Amoxicillin-clavulinate, cefuroxime and a combination of Ceftriaxone and Gentamycin. No documentation of the above information exists though.

CHAPTER TWO

LITERATURE REVIEW

Klevens et al reported that in 2002, approximately 20% of total healthcare-associated infections (HAIs) were Surgical Site Infections (SSIs), making this the second most common HAI in U.S. hospitals. This report also estimates that 8,205 deaths occur from SSIs annually. Estimates of the total number of patients who have SSIs following all orthopaedic surgery is somewhere between 31,000 and 35,000. Moreover, patients with orthopaedic SSIs have substantially greater physical limitations and significant reductions in their quality of life compared to other surgical procedures.[10]

In a study done by Victor Odhiambo at Aga Khan Hospital Nairobi a 6.8% incidence rate of surgical site infections after general surgical procedures was noted with 30% of the infectious organisms being *Staphylococcus aureus.*[11]

A study conducted by Sohn. A (2002) in a hospital in Vietnam, a developing country, out of 391 patients that underwent any type of elective surgeries, 54 patients developed surgical site infections, that is 14.3%. Only 51% of patients received pre-operative antibiotics and 99.7% received post-operative antibiotics. The antibiotic used was mostly aminoglycoside (gentamycine) to which 92% of

the pathogens were resistant. The commonest organism isolated was *Pseudomonas aeruginosa* (30%) and the least common was *Staphylococcus aureus* (7%) among others. The ratio of gram- negative to gram- positive microbes was 14:1.[12]

Bercion. R et al (2007) did a survey in the orthopaedic surgery department in a hospital in the Central African Republic where they had a surgical site infection incidence of 18% with the commonest organism being *Staphylococcus aureus*.[13]

In 2007 Maksimovic. J et al, in Serbia, looked at 277 patients who underwent elective orthopaedic procedures and noted that 63 patients (22.7%) developed surgical site infections with the commonest organism isolated from cultures being *Staphylococcus aureus* 28.9%, *Acinetobacter spp* 24.1% and the least common being *Citrobacter spp* 2.4%.[14]

A surveillance of surgical site infections was done in major hospitals over Europe in the year 2004 where Belgium reported the highest infection rates (12.6%) and the lowest surgical site infection rate of 0.5% was found in Lithuania with an average rate of 2.2% in the whole of Europe.[15]

Muhammad Shoaib et al did a prospective study in the orthopaedic unit at Ayub Teaching Hospital, Abbottabad, from 1st April 2007 to 30th October 2007 and found 6 patients with surgical site infections from 104 patients that were operated on making an incidence of 5.78% with the commonest organism being *Staphylococcus aureus* 50% and the highest rate of surgical site infection being after SIGN nailing.[16]

In another study done by Afifi and Baghagho in an Egyptian University hospital where they did a three months survey of orthopaedic surgical site infections and noted in 10 patients out of 121 patients giving a incidence rate of 8.264% with *Staphylococcus aureus*, *Pseudomonas* and *E. coli* were the most commonly isolated organisms (20% each).[17]

A study to determine the bacteriology of orthopaedic implant infections and the susceptibility of the isolated organism to antibiotics was done by Khosravi et al in 2009 on 165 patients with post operative infections. They found that *Staphylococcus aureus*, *Klebsiella ozaenae* and *Pseudomonas aeruginosa* were the commonest causative agents. The majority of the isolated bacteria were sensitive to vancomycin, ciprofloxacin and imipenem.[18]

Akinyoola et al carried out an audit of all elective orthopaedic operations performed in children at Awolowo University Teaching Hospital in Ile-Ife, Nigeria between 2000-2005 with the aim to document the clinical outcomes. The results of the study showed that surgical site infection was the commonest post-operative complication accounting for 8.2%. There was however no documentation on the organisms isolated from the wound infection.[19]

According to the Health Protection Agency, *Surveillance of surgical site infections in NHS Hospitals in England, 2010/2011*, the rates of SSI are reducing in most categories of orthopaedic surgeries except for knee prosthesis surgeries which showed an increase and the survey also showed that in orthopaedic surgery *Staphylococcus aureus* was the most common cause of SSI (37%). [20]

On the basis of the favorable pharmacokinetic characteristics described, as well as the antimicrobial properties (i.e. activity against Gram-positive bacteria) and the low toxicity, the first and second generation cephalosporins (such as cephazolin, cefamandole and cefuroxime) are considered the prophylactic antibiotics of choice in most orthopaedic procedures as described in studies done by Neu, H. C. in 1984, Norden, C. W. in 1991 and Kernodle, D. S. and Kaiser, A. B. in 1995.[21,22,23]

Currently, **cefazolin or cefuroxime** are the preferred antibiotics for patients undergoing orthopaedic procedures**. Clindamycin or vancomycin** may be used for patients with a confirmed ß-lactam allergy. [21, 22,23, 24]

In developing countries, the magnitude of the problem remains underestimated or even unknown largely because the diagnosis of nosocomial infections is complex and surveillance activities to guide interventions require expertise and resources.[25] Surveillance systems exist in some developed countries and provide regular reports on national trends of endemic nosocomial infections such as the *National Healthcare Safety Network* of the United States of America or the *German hospital infection surveillance system*.[25] This is not the case in most developing countries because of social and health-care system deficiencies that are aggravated by economic problems.[25]

JUSTIFICATION

As evident from several studies done worldwide, surgical site infections in orthopaedic surgeries is a problem that has not yet been completely resolved, despite surgeons being thoroughly cautious about sterility and managing patients meticulously before and after surgeries.

No studies have been carried out in Kenya regarding superficial surgical site infections in orthopaedic surgery. There are also no available studies showing patterns of prophylactic antibiotic use in orthopaedic surgeries in Kenya.

The data collected and analyzed from this study can be used to open doors for more research on development of protocols for better surgical techniques to reduce surgical site infections and proper prophylactic antibiotic use in orthopaedic surgery.

RESEARCH QUESTION.

What is the pattern of superficial incisional surgical site infections at The P.C.E.A. Kikuyu Hospital Orthopaedic Rehabilitation Center?

OBJECTIVES.

Main Objective:

To determine the pattern of superficial surgical site infection in orthopaedic surgery at P.C.E.A. Kikuyu Hospital Orthopaedic rehabilitation center.

Specific Objectives:

1. To determine the prevalence of superficial surgical site infections after elective orthopaedic surgery, with and without use of implants.
2. To determine the causative organisms of the SSIs.
3. To determine the antibiotic sensitivity profile for the isolated causative organisms.
4. To determine the effect of co-morbidities on the incidence of SSIs, including: Diabetes, Hypertension, Long term steroid use and HIV as the main co-morbidities under study.
5. To determine the procedure specific prevalence rates.

METHODOLOGY

Study design

The study was a prospective cohort study. In which the cohort was all patients who had undergone elective orthopaedic surgery with or without use of an implant.

Setting

The study was conducted in the wards and clinic of the Presbyterian church of East Africa (P.C.E.A.) Kikuyu Orthopaedic rehabilitation center, located a few kilometers from kikuyu town, owned by the Presbyterian church of East Africa, which is a fully equipped hospital with 37 beds, 2 operating theatres, physiotherapy department, a limb shop and it specializes in providing orthopaedic trauma, reconstructive surgery and rehabilitation to the patients. Annually about 5000 patients are seen through the out-patient clinic and over 800 surgical procedures are performed. This is the best place for the study as all the procedures done in the hospital are orthopaedic and there is no cross contamination of the theatre environment by non-orthopaedic surgeries.

Patients are normally seen in the outpatient clinics and the patients for surgery are selected and booked from there. The selected patients who met the criteria for inclusion into the study were recruited on the day of admission, followed up in the ward post operatively and then through clinic visits until the end of study.

Sample size.

Using a confidence level of 95% the sample size calculated using Fisher's formula is 245 patients.[26]

$$n = \frac{(Z_{\alpha/2})^2 (PQ)}{\delta^2}$$

Where:

n = required sample size

δ = the desired precision level set at 10% (0.1)

P = is the expected surgical site infection prevalence = 13%

Q=1-P.

$Z_{\alpha/2}$ (1.96).

Inclusion and Exclusion criteria

Inclusion Criteria.

All patients undergoing elective orthopaedic surgery with or without use of an implant.

Exclusions:

1. Any patient with open fractures, as these are classified by the CDC as being contaminated wounds which already have a high risk of infection.[27]
2. Any patients with existing skin or soft tissue infection at operation site.
3. Any patient with existing deep infections of the fascia, muscle layers or an infected implant.
4. Any patient with osteomyelitis.
5. Any patient who has had previous surgery on the same site in the last 30 days at another facility.

Patient recruitment.

245 Patients undergoing any elective orthopaedic surgery were recruited into the study at the day of admission. The patients were given full details of the purpose of the study and how it would be conducted and on agreement to participate, a consent form (see appendix) was signed by the patient or parent/guardian of the patient in cases of patients under the age of 18.

PROCEDURE

During admission, the patient or parent/ guardians of eligible patients gave consent to participate in the study and filled the consent form (Appendix I).

Assistants (registrars in orthopaedic surgery) worked hand in hand with the main researcher to recruit and follow up patients and the wounds were examined and scored using the ***Southampton wound scoring system***.

Patients selected were interviewed and examined on day of admission and then reviewed on specific intervals by the researcher and assistants in the ward and in the clinics. The following data was collected in data sheets (see appendix).

1. Date of surgery.
2. Age of patient.
3. Sex of patient.
4. Presence of any co-morbidity.
5. Type of surgery the patient will undergo
    - Open reduction internal fixation.
    - Arthroplasty.
    - Soft tissue surgery (tendoplasty, ligament repair, soft tissue releases and meniscectomy).
    - Arthroscopy.

6. The antibiotic used for prophylaxis from intraoperative anesthetic record.
7. The presence or absence of infection in the wound and the days post operatively it occurs.
8. Organisms isolated from infected wounds from swab microscopy and culture report.
9. Antibiotic susceptibility of the isolated organisms.

Duration of follow up.

All patients who underwent elective orthopaedic surgery were followed up for **30 days.** As per **The CDC** the definition of superficial surgical site infection is given as infection occurring within 30 days after a surgical procedure. [27]

Patients were seen on day 3 while in the ward, then at day 14 and day 30 in the clinic after discharge, by research assistants who were trained on what to look for in a wound post operatively to indicate presence of a SSI, grade the wound and record their findings in the data sheets.

The **Southampton wound scoring system** was used to determine presence of wound infection as shown below. [28] The scoring enables surgical wound healing to be graded according to specific criteria, usually giving a numerical value, and therefore provide a more objective assessment of the wound.

GRADE	**APPEARANCE**
0	Normal Healing
I Normal healing with mild bruising or erythema	
A	Some bruising
B	Considerable bruising
C	Mild erythema
II Erythema plus other signs of inflammation	
A	At one point
B	Around sutures
C	Along wound
D	Around wound
III Clear or haemoserous discharge	
A	At one point only (<2cm)
B	Along wound (>2cm)
C	Large volume
D	Prolonged (>3days)
Major complications **IV Pus:**	
A	At one point only (<2cm)
B	Along wound (>2cm)
V Deep or severe wound infection with or without tissue breakdown, haematoma requiring aspiration.	

Presence of wound infection was determined by any wound scoring **III and above** and wounds that scored between **III and IV-B** were swabbed and sample taken for microscopy, culture and sensitivity to the hospital lab at the **expense of the researcher**. Any wound that scored **V** was regarded as deep infection and was excluded from the study.

LIMITATIONS

1. 2 Patients lost to follow up.

DATA HANDLING

Data was collected in data sheets through interviewing patients and from the patient's file. The data sheets were kept safely locked at the researcher's premises and confidential. All data was tallied at the end of the study and organized in MS Excel sheets for easy analysis, this was done by the researcher. The data collected and saved was later presented to a qualified statistician with whose help it was analyzed.

DATA PRESENTATION

Data is presented in form of tables with ordinal variables like age presented in groups of 5 years for example: 0-5, 6-10, 11-15 and so on. Analyzed data including overall prevalence rates, procedure dependent and comorbidities dependent prevalence rates are presented in the results section with use of tables and pie charts. The specific organisms and their prevalence as well as the antibiotic susceptibility profiles is presented in tables.

DATA ANALYSIS

Data analysis was done using the IBM SPSS (Statistical Package for the Social Sciences) Ver. 17. With the help of a qualified statistician. Overall prevalence rates were calculated and verified using the Chi Square test. Procedure specific, comorbidity specific and age specific incidences were also calculated using a p-value of 0.05 and tested using Chi-squared.

WORK PLAN

ACTIVITY	TIME
Confirmation	By December 2013
Proposal writing	By January 2014
Ethical approval	By 8th April 2014
Data collection	Between mid-June to End of September 2014
Data analysis and compilation	4 weeks from end of data collection
Submission	Before 5th November 2014

BUDGET

ITEM	COST KSH
Pus swab M/C/S (1,200/= per test estimate 70pts who get infection from incidence rates of other studies)	**84,000**
Stationary	**5000**
Statistician fees	**15,000**
Assistants' expenses	**20,000**
Total	**124,000**

ETHICAL CONSIDERATIONS.

Ethical approval was sought from **Research and Ethics Committee** – Kenyatta National Hospital and approved on 8th April 2014.

The following considerations were made:

1. Informed consent was obtained from patients participating in the study and a consent form (see appendix) was signed by the patient.
2. Denial of consent did not interfere with the treatment of the patient in any way whatsoever.
3. Confidentiality of patient data was upheld and no names were put on any of the data sheets. At the end of the study, these data sheets were shredded by the investigators to ensure complete destruction.
4. Patients were not made to come for more clinic visits than what was routine.

RESULTS

The analysis of 243 patients who underwent elective orthopaedic surgery at P.C.E.A. Kikuyu Orthopaedic rehabilitation center is presented in this chapter. The median age of the patients was 43 years with a range between 2 years and 90 years. The modal age group was between 41 and 50 years with 47 (19.3%) patients (table 1). The other frequently occurring age groups were: 31-40 years (15.6%) and 51-60 years (15.2%).

Table 1: Age distribution of orthopaedic patients at The P.C.E.A. Kikuyu Orthopaedic rehabilitation center.

Patient age	Frequency (n)	Percent (%)
<10 years	25	10.3
11-20 years	18	7.4
21-30 years	29	11.9
31-40 years	38	15.6
41-50 years	47	19.3
51-60 years	37	15.2
61-70 years	31	12.8
71-80 years	15	6.2
81-90 years	3	1.2
Total	**243**	**100.0**

The sex distribution of participants is presented in table 2. There were 136 (56%) male patients and 107 female patients (44%) operated on at the hospital yielding a Male to female ratio of 1: 1.3.

Table 2: Sex distribution of orthopaedic patients at The hospital

Sex	Frequency (n)	Percent (%)
Male	136	56.0
Female	107	44.0
Total	**243**	**100**

A total of 83 episodes of comorbid illnesses were reported in patients undergoing orthopaedic surgery (table 3). 56 (23.2%) patients had hypertension and 20 (8.3%) had diabetes, which were the two most common comorbidities.

Table 3: Comorbid illnesses among orthopaedic patients at the hospital

Comorbid illness	Frequency (n)	Percent (%)
Hypertension	56	23.2
Diabetes	20	8.3
HIV	3	1.2
Long term steroid use	2	0.8
Other illness	2	0.8

The types of surgeries conducted during elective orthopaedic surgery were: ORIF, arthroplasty, arthroscopy and soft tissue surgery. The most common surgical procedure was ORIF conducted in 144 (59.3%) patients (table 4).

Table 4: Surgical procedures among orthopaedic patients at The P.C.E.A.Kikuyu Orthopaedic rehabilitation center.

Surgical procedure	Frequency (n)	Percent (%)
ORIF	144	59.3
Arthroplasty	52	21.4
Arthroscopy	38	15.6
Soft tissue surgery	9	3.7
Total	**243**	**100.0**

Surgical site infection

The prevalence of superficial surgical site infection was 4.9% representing 12 new superficial surgical site infection in the 243 patients that underwent elective orthopaedic surgery (figure 1).

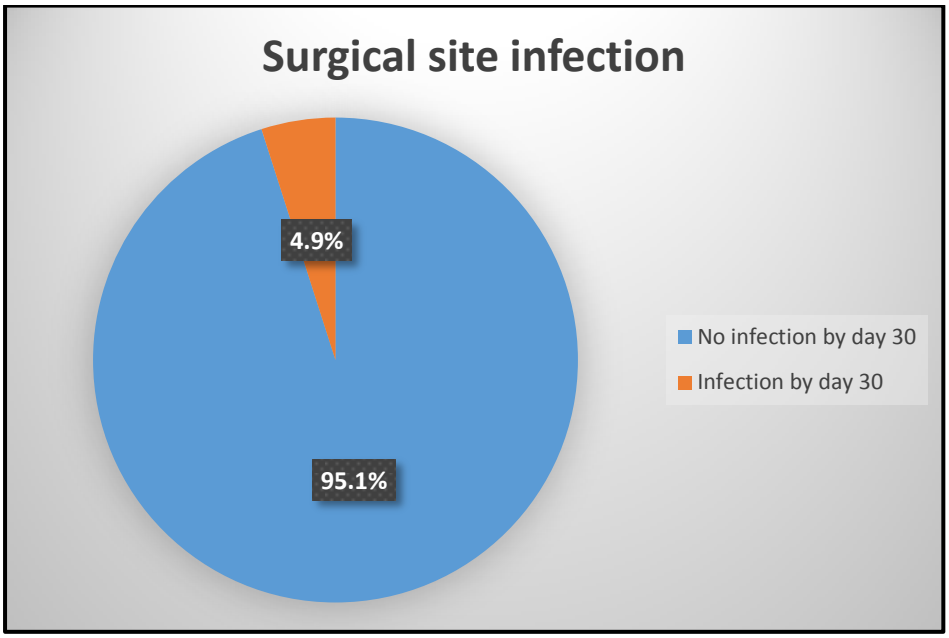

Figure 1: Incidence of superficial surgical site infection after elective orthopaedic surgery

The incidence of surgical site infections was 6.5% among male patients compared to 3.7% among females (table 5). The differences in the incidence of SSI among male and female patients were however not statistically significant ($p = 0.31$). There was no SSI reported in three patient age groups: < 10 years, 11-20 years and 81-90 years. The incidence of SSI ranged from 3.5% to 8.5% in different age groups between 21 and 80 years (table 5).

Table 5: Patient incidence of surgical site infection according to age and sex

	Surgical site infection by day 30		
Patient age	**Infected n(%)**	**Not infected n(%)**	**P value**
<10 years	0(0)	25(100)	0.85
11-20 years	0(0)	18(100)	
21-30 years	1(3.5)	28(96.6)	
31-40 years	2(5.3)	36(94.7)	
41-50 years	4(8.5)	43(91.5)	
51-60 years	2(5.4)	35(94.6)	
61-70 years	2(6.5)	29(93.6)	
71-80 years	1(6.7)	14(93.3)	
81-90 years	0(0)	3(100)	
Sex			
Female	7(6.5)	100(93.5)	0.31
Male	5(3.7)	131(96.3)	

Procedure specific incidence rates

There were no cases of SSI in the patients undergoing Arthroscopy (table 6). The prevalence of SSI were: 2.6% in the soft tissue surgery group, 5.6% in ORIF group and 5 .8% in arthroplasty group. Overall, the type of surgery did not show a significant association with surgical site infection (p = 0.78), table 6.

Table 6: Prevalence of surgical site infection according to surgical procedure

	Surgical site infection by day 30		
Surgical procedure	**Infected n(%)**	**Not Infected n(%)**	**P value**
ORIF	8(5.6)	136(94.4)	0.78
Arthroplasty	3(5.8)	49(94.2)	
Soft tissue surgery	1(2.6)	37(97.4)	
Arthroscopy	0(0)	9(100)	

Effect of comorbidities on SSI prevalence

Among the four comorbid conditions investigated namely: hypertension, diabetes, HIV and long term steroid use, only diabetes was significantly associated with surgical site infection ($p < 0.001$). The prevalence of SSI in patients with diabetes was 25% (5 out of 20).

Table 7: Effect of comorbid illness on incidence of surgical site infection

	Surgical site infection by day 30		
Comorbid illness	**Infected n(%)**	**Not infected n(%)**	**P value**
Hypertension	4(7.1)	52(92.9)	0.4
Diabetes	5(25)	15(75)	<0.001
HIV	1(33.3)	2(66.7)	0.02
Long term steroid use	0(0)	2(100)	0.75

Causative organisms of SSI

Out of the 12 specimens that yielded organisms on culture, 11 (91.7%) were ***Staphylococcus aureus***. There was one culture that isolated ***Klebsiellla ssp*** (figure 2).

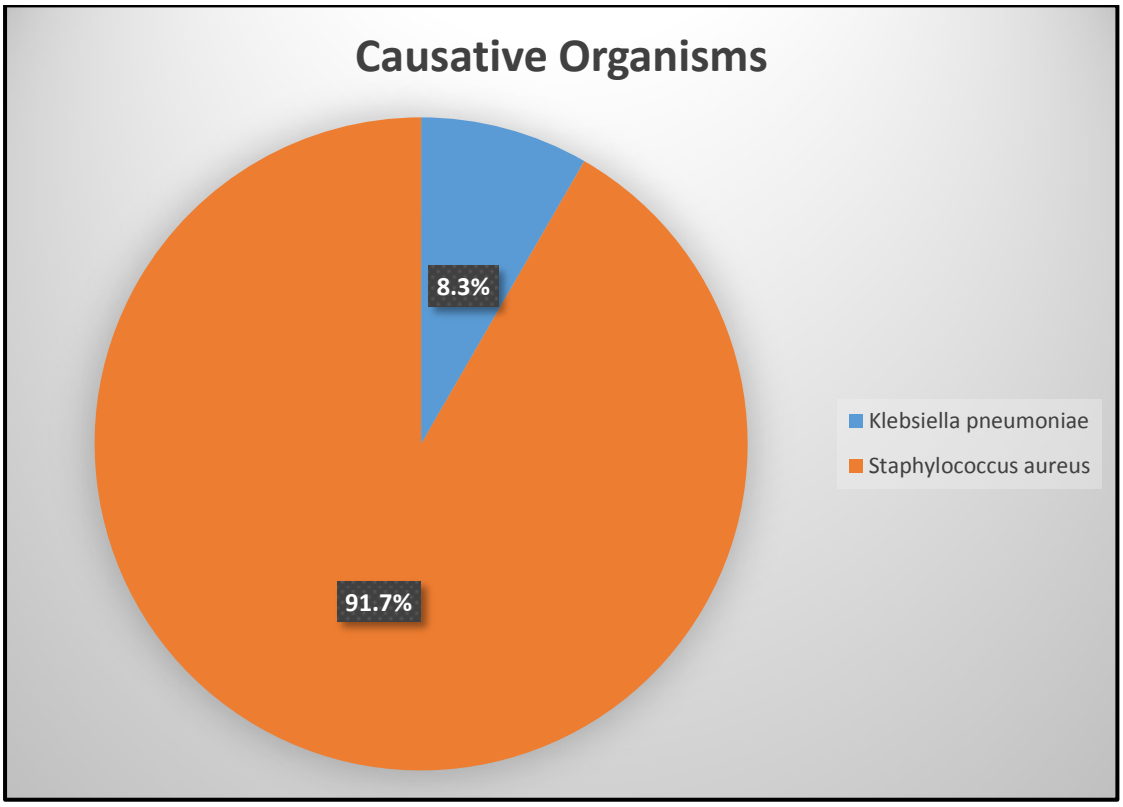

Figure 2: Causative organisms for SSI in post-surgical orthopaedic patients at PCEA Kikuyu Hospital

Antibiotic sensitivity profile

Antibiotic sensitivity profiles were reported for the organisms isolated from surgical incision sited in patients with SSI (figure 4). Both the organisms were sensitive to clindamycin, amoxi-clav and cefuroxime. The sensitivity tests showed that a single organism was sensitive to flucloxacillin, amoxil, ciprofloxacin and augmentin.

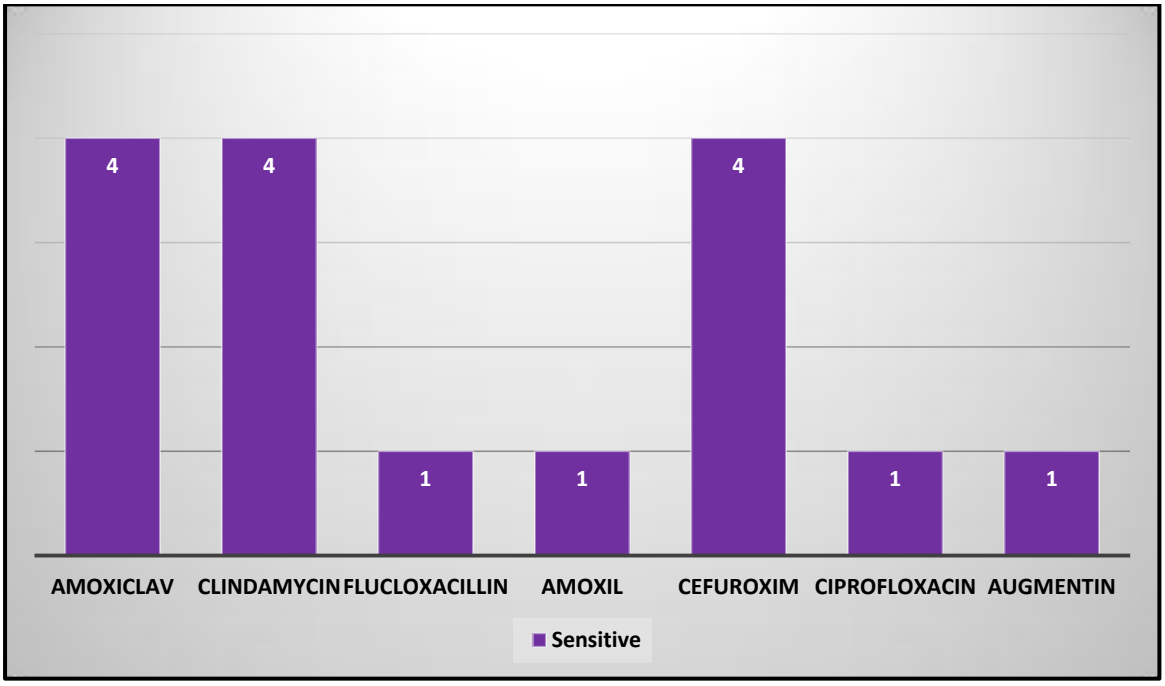

Figure 3: Antibiotic sensitivity findings in surgical site infections in Kikuyu Hospital

Antibiotic resistance

Antibiotic resistance in organisms isolated from surgical sites are shown in figure 4.

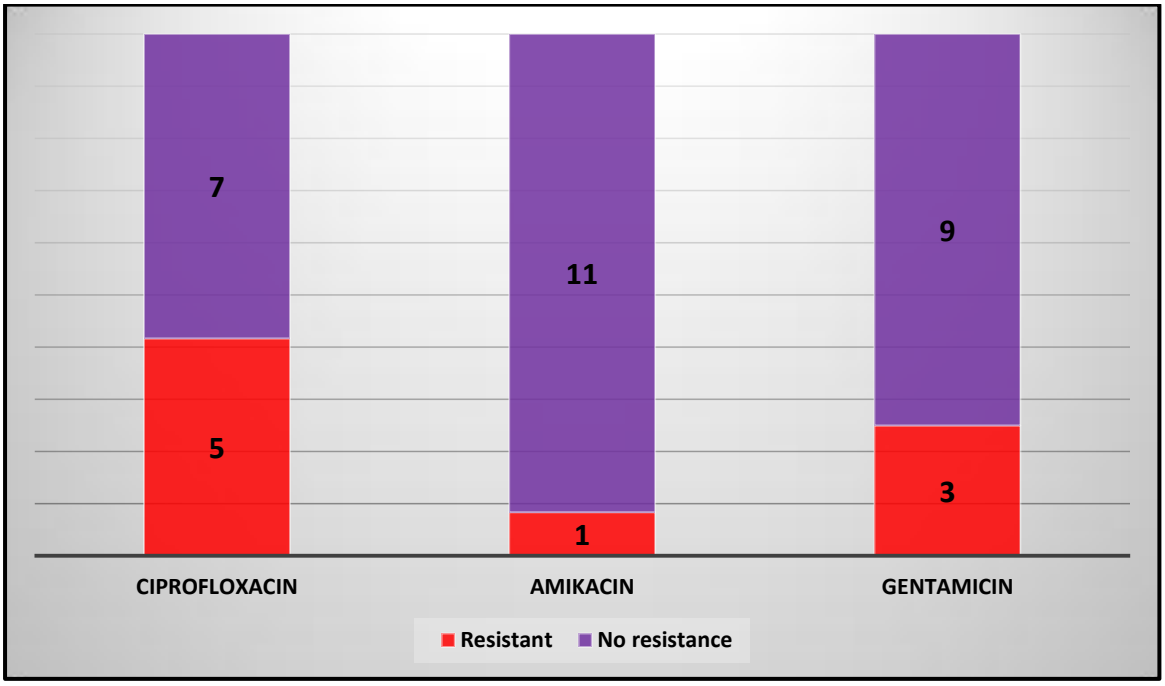

Figure 4: Antibiotic resistance in surgical site infection in Kikuyu Hospital

DISCUSSION

The prevalence of surgical site infections at The P.C.E.A. Kikuyu rehabilitation center was noted to be lower than the international prevalence rates, at 4.9% compared to the 20% noted in USA in the year 2002 by Klevens et al [10].

Advanced age is usually associated with SSIs,[5] though in my study most infection occurred between the age of 30 and 70years most occurring between 41-50 years (4 out of 12 [8.5%])

The routine use of **cefuroxime** as a prophylactic antibiotic usually given 1 hour pre-operatively and prior to inflation of tourniquet for forearm and leg surgeries, and then for three days post operatively at The Kikuyu P.C.E.A. orthopaedic rehabilitation center can also be the reason for the low infection rates and noted was that no patient reported any allergy to cefuroxime making it a safe choice of prophylactic antibiotic.

No significant association was found between infection rates and sex of the patient with p value of 0.31 but comparing the rates there were more male patients than female patients with SSI,and as per the literature by Gottrup et al on Overview of surgical site infections the male gender was noted to have a higher risk factor for SSI.[5]

Longer procedures and procedures that require more dissection is known to be a procedure specific risk factor for SSI[5] though there was no significant association noted between the type of procedure and occurrence of SSI in our

study. There was no infection noted in patients who underwent arthroscopy and despite the long operation time, this could be associated to the reduced soft tissue dissection and small incision made for the surgery as well as the constant flow of sterile saline through the joint. Despite the large number of patients who underwent ORIF and Arthroplasty the number of patients that developed SSI were 11 out of 197 patients (5.6%) which is not statistically significant (p=0.78) and there could be other confounding factors in the patients who got SSI like comorbidities, poor skin preparation technique or poor wound care by patients post operatively .

In our study diabetes was significantly associated with SSI which confers with what is mentioned in the overview of SSI done by Gottrup et al[5], although no data is available on how well controlled the blood sugars of the diabetic patients were before and after the surgery.

Staphylococcus aureus was isolated in 11 out of the 12 wounds that developed SSI making it the commonest isolated organism from SSIs which is also the case in many international studies and as well as local studies except for one study conducted by Sohn. A (2002) in a hospital in Vietnam, where the commonest organism isolated was *Pseudomonas aeruginosa*. The duration of pre-operative hospital stay for the patients and the circumstances around the pre-operative and post-operative times were not described in the study which

could have explained the higher prevalence than *Staphylococcus aureus*.[6, 11, 12, 13, 14, 16, 17, 18]

This can be attributed to the fact that it is a very commonly occurring organism in the environment, and occurrence of the infections could have been due to poor skin preparation during surgery or poor wound care by the patient post operatively as we didn't standardize the skin preparation method and no particular wound care instructions were given to the patients post operatively, although these parameters were not evaluated in our study.

Point of note is that all the isolated organisms were **sensitive to cefuroxime** which is the antibiotic that was used as prophylaxis pre-operatively and post operatively for three days. The question we asked ourselves was how could these infections occur despite use of a prophylactic antibiotic that the bacteria was sensitive to? The only explanation that we could come up with was that the wound contamination was heavy enough not to be cleared significantly with only 3 days of antibiotic use or that the dose was not adequate to achieve therapeutic levels.

CONCLUSION

The study has shown that use of cefuroxime as prophylaxis pre-operatively and three days post operatively significantly reduces the occurrence of SSIs after elective orthopaedic surgeries. We have also concluded that diabetes increases the chances of SSIs, but more studies need to be done regarding the sugar control and infection rates among diabetics. Since ***Staphylococcus aureus*** was the most commonly isolated organism we can use that information to improve skin preparation methods and also include nasal clearance of the organism prior to surgery but after conducting a proper study to verify the significance of doing so in reducing the rates of SSIs.

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APPENDIX 1:

DATA SHEET SAMPLE

INFECTION PATTERNS IN ORTHOPAEDIC SURGERY IN KIKUYU P.C.E.A. ORTHOPAEDIC REHABILITATION CENTER 2013-2014

Patient serial No._____ Date of Surgery:_____
AGE:_____SEX:_____
___

COMORBIDITIES	YES	NO
1. Diabetes		
2. Hypertension		
3. Long term steroid use		
4. HIV		
5. Other: (specify)		

TYPE OF SURGERY

Open Reduction Internal Fixation ❑ Arthroplasty ❑ Soft tissue surgery ❑ Arthroscopy ❑

PROPHYLACTIC ANTIBIOTIC USED:

ANTIBIOTIC	DOSE	DURATION
AMOXICILLIN+CLAVULINIC ACID------❑ FLUCLOXACILLIN----------❑ CEFTRIAXONE----------❑ GENTAMYCIN----------❑ METRONIDAZOLE----------❑ CEFUROXIME----------❑ OTHER (SPECIFY)_____		

Infection noted in 30 days: YES ❑ NO ❑

WOUND SWAB CULTURE REPORT

ORGANISM(s) ISOLATED	ANTIBIOTIC SENSITIVITY	
	SENSITIVE	RESISTANT

APPENDIX 2:

CONSENT FORM

PATTERN OF SUPERFICIAL SURGICAL SITE INFECTION AFTER ELECTIVE ORTHOPAEDIC SURGERY AT KIKUYU P.C.E.A. ORTHOPAEDIC REHABILITATION CENTER.

Study No._____

Hospital No._____

Research Study

You are invited to participate in a research study on the pattern of superficial surgical site infection after elective orthopaedic surgery at Kikuyu P.C.E.A. orthopaedic rehabilitation center being conducted by **Dr. Alihussein Saifuddin Tarwadi** a postgraduate student in the Department of Orthopaedic surgery at the University of Nairobi.

Purpose of the study

The purpose of the study is to determine the infection rates after orthopaedic surgery and the information derived from this study will be used to better the practice of surgery and improve outcomes for the benefit of the patients.

Risks and benefits

There are no risks of participating in this study.

You will be asked some questions regarding your health (or your Child's health) on the day of admission and then you shall proceed for your surgery as schedules. You will be examined and the wound inspected after surgery on daily basis while you will be in the ward and then in the clinic during routine scheduled visits which will be no different than the visit dates given to patients who don't take part in the study. If you have any signs of wound infection the wound will be sampled using a sterile swab (cotton bud like stick) and the sample taken to the lab for analysis **on the researcher's expense** and your wound infection will be managed in the best way. No compromise will be made in your treatment before, during or after surgery.

Alternatives to participating in the study

You/ your child will not be denied medical attention should you not decide to participate in the study.

Confidentiality

Information related to you (your child) will be treated with strict confidence to the extent provided by law. You / your child's identity will be coded and will not be associated with any published results. The records of this study will be kept private in a locked file and any written results will discuss group findings and will not include information that will identify you/your child. Research records will be stored securely and only the researchers and individuals responsible for research oversight will have access to the records.

CONTACTS

You should feel free to ask questions now or at any time of the study you can contact the researcher:	If you have any questions concerning the rights of human research participants contact:
DR. ALIHUSSEIN S. TARWADI	**THE CHAIRPERSON**
Mobile No: 0734 774 631	**KNH Ethics & Research Commitee**
Email: tarwadi13@gmail.com	**Tel: 020 2726300**

I have read and fully understood the consent form. I sign it freely and voluntarily.

Patient's signature / Left Thumb Print:	If patient Minor then Parent / Guardian Signature / Left Thumb print
Date:_____	Date:_____
_	_
Phone No._____	Phone No._____

FOMU YA MAKUBALIANO

UTARATIBU WA MAAMBUKIZI KATIKA SEHEMU YA JUU BAADA YA UPASUAJI WA MIFUPA KATIKA HOSPITALI YA P.C.E.A. YA KIKUYU.

Nambari ya uchunguzi._____

Nambari ya Hospitali._____

Utafiti

Unaalikwa kushiriki kwenye utafiti wa utaratibu wa maambukizi katika sehemu ya juu baada ya upasuaji wa mifupa katika hospitali ya P.C.E.A. ya Kikuyu, itakayoongozwa na **Dr. Alihussein Saifuddin Tarwadi** ambaye ni mwanafunzi katika idara ya upasuaji wa mifupa katika chuo kikuu cha Nairobi

Madhumuni ya utafiti

Malengo ya uchunguzi huu ni kubaini viwango vya maambukizi baada ya upasuaji wa mifupa na matokeo kutokana na uchunguzi huu yatatumiwa kuboresha mbinu ya upasuaji kwa manufaa ya wagonjwa

Faida na Madhara

Kushiriki kwenye uchunguzi huu haina madhara yoyote

Utaulizwa maswali kuhusu afya yako /ya mtoto wako siku ya usajili kisha utaendelea na upasuaji wako jinsi ilivyopangwa. Utachunguzwa na kidonda kichunguzwe kila siku utakapokuwa kwenye wodi, na kiliniki kila utakapukuwa ukihudhuriwa kulingana na ratiba iliyo sawa na ile ya wagonjwa wengine. Ukiwa na dalili ya maambukizi ya kidonda, sampuli ya kidonda itachukuliwa kwenya pamba safi na kupelekwa kwenye maabara kuchunguzwa zaidi **kwa gharama ya mtafiti** na maambukizi ya kidonda yatatibiwa kwa njia ifaayo. Matibabu yako yatachukuliwa kwa uzito kabla, katika na baada ya upasuaji.

Njia mbadala za kutoshiriki kwenye uchunguzi

Wewe/ mtoto wako hamtanyimwa huduma ya kiaafya ikiwa mtaamua kutoshiriki katika uchunguzi

Usiri

Maelezo yanayokuhusu wewe ama mtoto wako yatahifadhiwa kwa siri kulingana na sharia. Utambulisho wako /mtoto wako utapewa nambari ya siri na hautahusishwa na matokeo yaliyochapishwa. Rekodi za uchunguzi zitahifadhiwa kwa siri kwenye faili na matokeo yatajadiliwa kwa ujumla na hayatashirikisha maelezo yatakayokutambua /yatakomtambua mtoto wako. Rekodi za utafiti zitahifadhiwa chini ya ulinzi na watafiti pamoja na wahusika wasimamizi ndio watakayoruhusiwa kufikia rekodi peke yao.

NJIA YA KUWASILIANA

Uwe huru kuuliza maswali sasa hivi ama wakati wowote wa ucunguzi unaweza kuwasiliana na mtafiti:	Kama una maswali yoyote kuhusu haki za watafiti wa kibinadamu, wasiliana na:
DR. ALIHUSSEIN S. TARWADI	**Mwenye kiti**
Nambari ya simu: 0734 774 631	**KNH Ethics & Research Commitee**
Barua pepe: tarwadi13@gmail.com	**Nambari ya simu: 020 2726300**

Nimesoma na kuelewa malezo kwenye fomu hii. Ninatia sahihi kwa hiari na bila kushurutishwa.

Sahihi ya mgonjwa / Alama ya kidole gumba wa kushoto:	Kama mtoto, sahihi ya mzazi/ Alama ya kidole gumba wa kushoto:
Tarehe:_____ _	Tarehe:_____ _
Nambari ya simu._____	Nambari ya simu._____