POINT PREVALENCE SURVEY OF ANTIBIOTIC USE AMONG BURN PATIENTS AT KENYATTA NATIONAL HOSPITAL

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DECLARATION OF ORIGINALITY

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This is to certify that this research proposal has been submitted for examination with our approval as University supervisors.

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DEDICATION

To the Almighty God who gave me the strength to do all things and was faithful to complete the good work.

To my loving Family

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ABBREVIATIONS AND ACRONYMS

ABA	American Burn Association
DALYs	Disability Adjusted Life Years
EML	Essential Medicines List
GLOBAL-PPS	Global Point Prevalence Survey of Antimicrobial Consumption and Resistance
KNH	Kenyatta National Hospital
LMICs	Low and Middle Income Countries
MOH	Ministry of Health
MRSA	Methicillin Resistant *Staphylococcus aureus*
MTRH	Moi Teaching and Referral Hospital
NHS	National Health Service
PPS	Point Prevalence Surveys
SFETB	French Society for Burn Injuries
TBSA	Total Body Surface Area
U.S	Unites States
WHO	World Health Organization

OPERATIONAL DEFINITION OF TERMS

Antibiotics: Medicines used to prevent and treat bacterial infections

Burns: Are injuries to the skin or other organic tissue primarily caused by heat or due to radiation, radioactivity, electricity, friction or contact with chemicals

Guideline compliance: Conforming to antibiotic use as outlined in the guideline for antimicrobial therapy

Irrational use of antibiotics: injudicious use of an antibiotic to treat non-bacterial infections and use of incorrect drug, dose, frequency, duration or route of administration

Prophylactic antibiotic therapy: Use of antibiotics to prevent infections

Rational use of antibiotics: Prescribing of the correct choice of antibiotic only where it is necessary, at the correct dose, frequency, duration and route of administration

Targeted antibiotic therapy: A specific bacterium is identified by laboratory test and a specific antibiotic is prescribed for that infection and follow up over time is done to monitor and adjust the therapy as needed.

ABSTRACT

Background: Burns are a global public health problem (ranked fourth of all injuries), accounting for an estimated 180,000 deaths annually. Infection is common in burns and can delay wound healing and encourage scarring. Infection remains the leading cause of death in people with a burn wound and can independently cause death. Antibiotics can be used prophylactically or to treat confirmed burn wound infections. Antibiotics are the most prescribed drugs globally but most of their use is irrational. This causes the emergence of resistance and poor treatment outcomes. There is scarce local data on patterns of antibiotic prescribing in Kenya and specifically among burn patients, thus the impetus for the study.

Study Objective: To assess the antibiotic prescribing patterns among burn patients admitted to the Kenyatta National Hospital (KNH).

Methods: This was a cross-sectional study involving burn inpatients admitted at KNH. A total of 68 participants were recruited through universal sampling and patient files that met inclusion criteria selected. Data was abstracted from patient medical records. The data included socio-demographic characteristics of the patients and the cause and type of burn. The indication, name, dose, route of administration, duration and frequency of antibiotic were also noted. The raw data was coded and entered into Microsoft Excel version 2010 to create a database, then exported to STATA version 13 for analysis. Data was presented in frequency tables and charts. Associations between predictor variables and outcome variables were determined using Fisher's exact. Logistic regression was done to determine the independent predictors of various causes of burns. Statistical significance was set at 95% confidence interval and values with $p \leq 0.05$ were considered statistically significant.

Results: The major cause of burns at KNH was open fire (48.5%) followed by scald burns (32.4%). Scald burns were predominant in children under five. Electricity and chemical burns constituted 13.2% and 5.9% of the burns respectively. Majority of the patients sustained 2nd degree (83.8%) and 3rd degree (41.2 %) burns and many of the patients had mixed burns. The percentage of total burnt subsurface area (% TBSA) ranged from a minimum of 3% to a maximum of 65% with a mean TBSA of 21.4%. Participants aged ≥13 years had 7 times the likelihood of having electricity or chemical burns (COR=7.0; 95% CI 1.44-35.12 p=0.016). The prevalence of antibiotic use among burn patients at KNH was 91.2%. Topical antibiotics (69.1%)

followed by cephalosporins were the most prescribed antibiotics. Penicillins (30.9%) were third most prescribed class. The antibiotics were mainly used for prophylaxis (67.6%) of burn wound infections. Silver sulfadiazine (69.1%) was the most prescribed antibiotic while cefuroxime (41.2%) was the most prescribed cephalosporin followed closely by ceftriaxone (38.2%). Amoxicillin clavulanate (25.2%) was the most prescribed penicillin. There was 59.9% rational prescribing of antibiotics among burn patients at KNH.

Conclusion: There was high prevalence of antibiotic prescribing among burn patients at KNH and average rational use of antibiotics in compliance to local and international antimicrobial use guidelines

Recommendation: There is need to lower the prevalence of antibiotic prescribing among burn patients because recent guidelines do not advocate their use due to lack of evidence to prove that they are efficacious and they can induce resistance. A KNH burn anti-bio-gram should also be developed based on antibiotic susceptibility and resistance profiles in the burns unit.

CHAPTER ONE: INTRODUCTION

1.1 Background

1.1.1 Burns

A burn refers to skin injury or injury to other organic tissue that is majorly caused by heat or because of radioactivity, electricity, contact with chemicals, radioactivity or friction (1). Burns are categorized based on depth and severity based on total surface area burnt. Depth is characterized as 1st, 2nd and 3rd degree burns. The total burnt surface area (TBSA) is used to classify burns depending on the severity (2).

Burns are a global public health problem (ranked fourth of all injuries), and is responsible for approximately 180,000 deaths per year. Non-fatal burns are a major cause of morbidity, including increased hospital stay, disability and disfigurement, and often results in stigma and rejection. In low- and middle- income countries (LMICs), burns highly contribute to disability- adjusted life years (DALYs). Nearly 11 million people were severely burned in the year 2004, necessitating medical attention. Approximately 67% of these burns occur in Africa and South East Asia as per the World Health Organization (WHO) and developing countries bear the greatest burden of these burns (1,3).

For instance, in a local study on burn injuries among inpatients at Moi Teaching and Referral Hospital (MTRH), by Lelei et al, 2005, the mortality rate of burn injuries was 5%. This is consistent with studies done in Africa (range of 3-17%) but differ from studies done in Europe where the mortality rates are lower (0.9%-4.5%). The mortality rate of burns is however higher in the Asian countries (7.2-9.5%). In a study done at Kenyatta National Hospital (KNH) by Nthumba et al, 2011, the overall mortality was found to be 14.4%, this is higher when compared to the 4 to 10% reported from the West, depending on the patient demographic characteristics of the study (4).

Burn injuries can be intentional or unintentional and vary across global regions, age groups, gender and income brackets. There has been a reducing pattern in burn prevalence, length of hospitalization, burn severity and death rates over the last several

years among high income countries (5). Severe burns affect young healthy adults and children and are an important health burden worldwide (6). Among the forms of trauma, burns are one of the commonest. To minimize morbidity and mortality, burn patients require specialized treatment. There has been a decline in deaths associated with burn injuries in the past forty years as result of better burn management. This can be attributed to practice advancement such as resuscitation using intravenous fluids, taking good care of burn wounds, employing techniques that are aseptic in burn patient management and proper equipping of burn centers (7,8).

1.1.2 Burn wound infections

Infections of burn wounds are common because the injured skin loses its protective barrier to pathogens thus allowing microbes to enter directly into the wound. The high amounts of exudate produced by burn wounds encourage bacterial growth. A moist environment that's nutrient rich suitable for bacterial growth is created by the exudate and can result in infections which can result in delayed wound healing and may encourage wound scarring (9,10).

Serious complications can develop if inappropriate infection treatment is initiated or if an infection is left untreated. These complications include: dysfunctional multi-organ syndrome, infections that are invasive in nature for example sepsis and bacteremia. Serious complications can develop if burn wound infections are not treated appropriately. These complications include sepsis, bacteremia and multi-organ dysfunction. According to data from a French burns center, 19% of burn inpatients developed infections (9). Apart from being the number one cause of death among burn wound patients, an infection can independently cause death (9,11). Infections of burn wounds are of several types. These include burn wound impetigo, infected surgical wound that is associated with burns, cellulitis due to burn wounds and infections that are invasive in un-excised burn wounds (12).

There are multiple sources of infections in burn patients. Gram positive bacteria especially *Staphylococci,* rapidly infect burn wounds. They are normal flora inhabiting areas exposed by the burn such as the hair follicles and sweat glands. At the time of burn, there is decreased mesenteric blood flow and gram negative bacteria translocate from the

colon resulting in bacterial infection. Furthermore, burn patients also have decreased immune response (6).

The gram-positive bacteria that is mostly implicated is the *Staphylococcus aureus*. Others include the *Methicillin resistant Staphylococci aureus* and the *Enterococcus spp*. The most isolated gram-negative bacteria is the *Psudomonous aeruginosa*, others include *Escherichia coli* and *Acinetobacter species*. (12). *Pseudomonous aeruginosa* and *S. aureus* are implicated in causing cross infection among burn patients. (13).

Burn patients are prone to nosocomial infections and this is a major concern. These hospital acquired infections are associated with prolonged hospitalization, meaning the cost incurred will increase (14). The health care provider, the patients environment and his own normal flora are the sources of microscopic organisms that cause hospital acquired infections (8). There are steps that can be taken to prevent infection in burn patients. They include instrument sterilization, sterilization of bed linen and staff members observing good hygiene. Several factors may influence wound infections: age of the patient, patient's sex, underlying medical conditions such as kidney or liver problems, and nutritional status (15). Dressing of the wound regularly and making timely surgical interventions can aid in reducing the hospitalization period thus minimizing hospital bills for the patient (8).

1.1.3 Antibiotics and Burns

Antibiotics may either kill bacteria (bactericidal) or stop bacterial growth (bacteriostatic) The introduction of antibiotics in managing burn patients has crucially led to a significant reduction in morbidity and mortality attributed to injuries caused by burns (8). Bacterial strains that are not sensitive to antibiotics have emerged. This leads to prolonged hospitalization, high economic costs and the morbidity and number of deaths will rise. It is against this backdrop that there is on-going research that will provide effective treatment of burn patients infected with resistant bacterial strains (16).

Antimicrobials can reduce morbidity and mortality among burn patients when used to treat underlying conditions. The French Society for Burn Injuries (SFETB) recommends use of antimicrobials if the presence of an infection has been confirmed (9).

Topical antimicrobial therapy is commonly used for prophylaxis and treatment of burn wound infections. They can also be used as an adjunct to other interventions like systemic antibiotics and surgical treatment. The species causing the infection should be identified and the antibiotic the species is sensitive to, should be used to prevent emergence of drug resistance (9). The topical antimicrobial agents commonly used worldwide are silver nitrate, silver sulfadiazine (most commonly used), mafenide acetate and the new silver nanocrystalline dressing (12).

The use of systemic antibiotics for prophylaxis does not have a clinical advantage or benefit over topical prophylactic therapy or surgical excision studies have shown. This is because there are no demonstrated improved outcomes when compared against topical therapy in terms of reduction of incidences of burn wound infections. Bacterial culture and sensitivity results guide the of antibiotic regimen used to treat an infection.(12).

Some of the commonly used systemic antibiotics used in burn patients include; amoxicillin clavulanic acid, colistin, Meropenem, sulbactam, amikacin Linezolid, cloxacillin, ampicillin and imipenem(2).

Controversy is still there over the use of antibiotics for prophylaxis in severe burns. Recent guidelines do not advocate for their use due lack of evidence to prove that they are efficacious or can induce resistance. Patients with known infections should be treated with antibiotics (17,18).

Prophylactic antibiotic use may be risky. This is because it may cause diarrhea like some toxigenic strains of *Clostridium difficile* may multiply and cause secondary infections. The drug may also precipitate allergic reactions and bone marrow suppression may be an unnecessary result. Antibiotic resistance may also emerge making treatment more complicated and expensive (17).

1.2 Problem Statement

Burn injuries are a world-wide public health problem and major burden to the health care system. Morbidities and mortalities associated with burn injuries are quite significant. World-wide, approximately 300,000 people die from fire related burn injuries. The majority of burn injury victims come from third world/developing countries (1,12).

There is greater morbidity, disability and mortality related to burn injuries in third world countries compared to developed countries because of lack of specialized care and limited resources to build functional burn care centers (19).

Severely burnt patients are exposed or are more likely to contract systemic or local infections. Burn patients are prone to infections which in turn lead to death. There is a world-wide increase in burn wound infections, sepsis and related death due to emergence of resistant strains of fungi and bacteria (11).

Adverse outcomes and death are associated with hospital acquired infections independently with or without burn injuries (6). Topical antimicrobial drugs are important in treatment and prophylaxis of burn wound infections. Systemic antibiotics are not recommended for infection prevention but are indicated for confirmed infection (20).

It is estimated that half of all medicines in Africa are used irrationally including up to two thirds of antibiotics (21). This leads to emergence of antibiotic resistant bacteria. Hospital acquired infections due to bacteria are a major problem in burn care. They can become resistant to antibiotics and therefore the choice of antimicrobial agent to use is key when managing burn patients. It is important to know when to use or not, correct antibiotic combination, treatment duration and the dose regimen (22).

KNH has developed antimicrobial use guidelines for the medical and surgical wards but there are no guidelines for antibiotic use among burn patients, the study sought to gather data that will inform guideline development for this section. It aimed to find out the current prevalence and patterns of antibiotic use among burn patients to provide benchmarking data and identify targets for improvement.

1.3 Purpose of the Study

The purpose of this study was to investigate antibiotic use and prescribing patterns among burn care patients at Kenyatta National Hospital. The study also sought to establish the causes and types of burns among patients admitted at KNH.

1.4 Research Questions

1. What are the causes and types of burns among burn patients at KNH?

2. What is the prevalence of antibiotic prescribing at KNH?

3. Is the prescribing of antibiotics for burn patients at KNH rational or irrational??

1.5 Study Objectives

1.5.1 General objective

To assess the antibiotic prescribing patterns among burn patients at Kenyatta National Hospital.

1.5.2 Specific objectives

1. To determine the causes and types of burns among burn patients at KNH

2. To estimate the prevalence of antibiotic prescribing among burn patients at KNH

3. To find out whether antibiotics are used rationally or irrationally and according to existing guidelines at KNH

1.6 Study Significance

Among the types of trauma world-wide, burns are ranked fourth by the WHO after falls inter-personal violence and traffic accidents. Burn injuries result in over 300,000 deaths yearly globally. Developing countries contribute to the majority of the deaths (1). Burns predispose the victims to infections as the skin loses its natural barrier to microbes and pathogens easily enter the wound (9). Infections of burn wounds are the major factors contributing to morbidity and mortality in patients who sustain burn injuries and they pose a lot of challenges to the health care providers (10).

When managing a patient with burn injuries, the choice of systemic antibiotic treatment should be considered with a lot of thought in order to avoid emergence of resistant microorganisms. Susceptibility patterns of specific organisms should be known so that antimicrobial therapy will be is prescribed for a specific infection and not presumptive. If antimicrobial therapy is absolutely necessary, there should be awareness of possible super-infection with other organisms that may be resistant or yeasts/fungi (10). This study sought to recommend the establishment of a local facility anti-bio-gram that help in choosing the correct prophylactic and empiric therapy based on the most common causes of nosocomial infections at KNH (23).

The study is therefore significant as burn patients will benefit if the local anti-bio-gram is established. It is also of importance to the health workers since the guidelines will help when choosing the antimicrobial to use for a particular pathogen.

1.7 Study justification

This study provided baseline data on the use of antibiotics among patients with burn injuries at KNH and can be used as a guideline for optimization of antibiotic use. It will also identify gaps for quality improvement in the prescribing and use of antibiotics leading to development of various interventional programs to promote rational antibiotic use among burn patients. This will help in better management of the burn patients.

CHAPTER TWO: LITERATURE REVIEW

2.1 Burns

2.1.1 Definition

Among the injuries that occur in many households are burns that normally affect children more than adults. Burns characteristically severely damage the skin causing death of the affected skin cells. Heat, electricity, chemical contact, radiation and friction are some of the causes of burns. Hot liquids (scalds), open fire/flames and hot solids (contact burns) cause thermal burns and destroy some or all skin cells or other tissues. Depending on degree of burn injury and also the cause, many patients can recover from burn injuries without severe consequences to their health. Complications due to severe burns can be prevented by offering immediate medical intervention (1,24).

2.1.2 Epidemiology of burns

Injuries caused by burns are a major public health crisis globally and of all injuries can be the most devastating with serious consequences. Worldwide, burns are ranked 4th most common trauma type after falls, interpersonal violence and traffic accidents. Developing countries contribute nearly 90 percent of burns that occur worldwide. This is because they do not have the infrastructural capacity necessary to combat the severity and incidence of burns (25). Burns account for 180,000 deaths annually, 67% of which take place in South East Asia and Africa according to the WHO. Burn death rates have been on a rapid decline especially in countries that have high income. Developing countries have higher rates of child death than developed countries, approximately 7 times higher (1,26). In the year 2004, about 11 million people world-wide were victims of severe burns and needed medical attention. Every year, nearly 1 million people are severely or moderately burned in India. In Bangladesh, about 173,000 children are moderately or severely burnt annually. Seventeen percent of burnt children in Egypt, Bangladesh, Pakistan and Colombia have temporary disability while 18% sustain permanent disability. Burns are the 2nd most common injury in rural Nepal and accounts for up to 5% of all disabilities. In the United States of America, over 410,000 injuries caused by burns occurred in 2008, out of which 40,000 required hospitalization (1).

Local studies have shown burns to constitute at least 3% of all injuries seen in hospital and 16-37% of all injuries seen in children (27). In a study on the epidemiology of operative burns at Kijabe Hospital, it was established that burn injuries in Kenya show similarities with other LMIC in etiology and pediatric predominance (28).

2.1.3 Burn classification

Burns are categorized according to depth of the burn and severity based on the surface area of the body totally burnt. Depth is characterized by the 1st, 2nd, and 3rd degree burns. Severity depends on total body surface area burnt (2).

2.1.3.1 Burn depth

The injury depth caused by burns can be stated as 1st, 2nd, or 3rd- degree. Injuries due to 1st- degree burns are the most superficial (can be described as the shallowest). The epidermis is the only affected layer of the skin. 2nd-degree burns also referred to as partial-thickness burns; affect both the epidermis and the dermis (causes deeper burns). 2nd- degree burns are most often described further as superficial meaning they affect the shallow part of the dermis or deep meaning even the deep parts of the dermis are burnt. When all the three layers of the skin, the fat layer, dermis and epidermis are burnt, then, this is referred to as full thickness burns (3rd- degree burns). Burns also destroy the nerve endings, hair follicles and the sweat glands (2,29,30).

2.1.3.2 Burn severity

Burns can be referred as minor, moderate, or severe based on severity. The depth and the percentage of body surface that has 2nd degree or 3rd degree are used to determine the burn severity (31).

All burns of 1st degree are referred to as minor burns. 2nd- degree burns can also be referred to as minor burns if the total burnt body surface area is less than 10%. Burns that involve the genitals, upper limbs, lower limbs, or the face, burns of 2nd- degree that involve >10% of the total burnt body surface area, and all 3rd- degree burns that involve >1% of the body are categorized as moderate or severe burns. The burn severity is determined by approximating the percentage of the body's surface area having 2nd-

degree or 3rd- degree. The rule of nines method is used to do this. In this method, the body is divided into sections of 9% or of 2 times 9% (18%) (31).

2.2 Burn wound infections

The skin has several functions. Among them is the protection against external environment, maintaining the temperature of the body and also maintains fluid homeostasis. It provides immunological and metabolic support and at the same time provides sensory information. Burn injuries damage the barrier function of the skin leading to increased bacterial infection susceptibility and disruption of the innate immune system. Burn wound infection occurs in progression. First, burn wound colonization takes place followed by invasion into subjacent tissues, then tissue of granulation destruction. Hematogenous lesions that are visceral then develop. Lastly, leukopenia, hypothermia and death occur. This progression was illustrated in a *P. aeruginosa* inoculated rat (29).

Infection of burn wounds complicates burn injury. Burn patients are uniquely at risk of wound infection complications (32). Burn patients are predisposed to various complications because the injuries induce metabolic and inflammatory changes hence the difference from other types of injuries. This population of patients have high morbidity and mortality incidences when the burn wounds are infected (33). *P. aeruginosa* and *S. aureus* bacteria are notorious at causing cross infection (13). Burn patients are predisposed and at more risk to hospital acquired infections. If they get these infections, their stay in the hospital is prolonged and they may incur extra costs (14).

Following a burn injury, skin wounds that are open rapidly get colonized by bacteria. Patient's own normal flora that inhabit the skin, respiratory tract and the gastrointestinal tract are responsible for colonizing the open wound (34). Gram positive bacteria rapidly colonize a burn wound following an injury. These bacteria originate from patient's own normal flora of the skin or from the external environment (34). The wound is also colonized a few days after injury by gram negative bacteria that are found in the gastrointestinal tract but are transported to the site of the open wound (35). Use of broad spectrum antibiotics for therapy in burn wounds predisposes to colonization of the wound way later by yeasts and fungi microorganisms (36).

The following are the factors predispose patients to develop infections of burn wounds; co-morbidities like diabetes and obesity, use of invasive devices like catheters, burns of >30% TBSA, full thickness burns, age extremities, burns not taken well care of early, burns that are not covered or skin grafting failure leading to prolonged open wounds and suppression of immune system like in AIDS (33).

The **gram-positive micro-organisms** causing invasive wound infection are: *S. aureus,* Methicillin-resistant *S. aureus, Coagulase-negative staphylococci, Enterococcus species.* and Vancomycin-resistant *enterococci.* The most common gram-positive bacteria is *Staphylococcus aureus* causing morbidity and death in burn wounds (37). A study done In France identified *Staphylococci aureus* as the most implicated organism in burn wounds, with a methicillin-resistance rate of 68.1% (38). *S. aureus* is the most frequent species in burn units worldwide (11).

Gram-negative micro-organisms causing burn wound infection include: *Pseudomonas aeruginosa* which is the most frequent and *Escherichia coli.* Others are *Enterobacter spp., Acinetobacter spp., S. marcescens, Proteus species., Klebsiella pneomoniae* and *Bacteroides spp.* (33,39).

Streptococcus pyogenes used to be the major microorganism that infects burn wound wounds before the advent of antibiotics. It was the main cause of mortality In patients who sustained severe burns (40). After the introduction of Penicillin G in the mid of 20th century, *Staphylococcus aureus* emerged as the most implicated aetiological bacteria of infected burn wounds. In many burn centers all over the world, *Pseudomonas aeruginosa* is still a major cause of wound infections (41).

P. aeruginosa was found to be the most prevalent gram-negative bacteria strain in the United States of America, followed by *A. baumannii* and *Enterococcus species*. this is according to 44% of respondents in a survey conducted in 104 burn units. In Asian countries however, the situation is slightly different. For example in China, the most common causes of burn wound infections are *A. baumannii* and *Proteus mirabillis* with *P. aeruginosa* being ranked in 3rd place. The most common pathogens in Europe are *P.*

aeruginosa and *E. coli*, with a frequency of 13% for each of all gram-negative infections (11).

There are several types bacterial of burn wound infection. The criteria for wound infections and sepsis have been defined by the American burn association (ABA) colonization of the wound, invasive infection, cellulitis of burn wounds, fasciitis are some of the type of burn wound infections according to the ABA (33).

2.3Burn wound care

2.3.1 Inflammation

Inflammation is important in healing of burn wounds. Healing of burn wound may be delayed if anti-inflammatory treatments are used. They could also aggravate symptoms (29,42). Inflammation is sometimes accompanied by significant edema. Wound healing is impaired and pain exacerbated by inflammation and too much edema. Inflammation can be beneficial and at the same time be detrimental on burn wound healing. Therapeutic intervention should only be applied when there is excessive inflammation and edema (29,43). It is difficult to treat inflammation in large burns (44). Non-steroidal anti-inflammatory drugs or glucocorticoids possess a negative effect on the healing of wounds. However, several small studies have shown that administration of steroids has the potential to ease pain and inflammation and at the same time minimize the length of hospitalization among burn patients (29).

2.3.2 Nutrition

A hyper metabolic response that is persistent and prolonged has been noted following a severe burn injury. This response leads to immunosuppression and muscle catabolism as it augments the metabolic rate (45,46). Nutritional support should be started early and aggressively in severe burns because of loss of body mass. Prolonged hospitalization, impaired wound healing and higher infection incidence are associated with loss of body mass (29,45). Post-burn hyper-metabolic state can be managed effectively by use of early enteral nutrition (within 24 hours of admission) (33). Delays in initiation of enteral nutrition are associated with damage of the gut mucosa, reduced absorption, and translocation of bacteria, leading to poor outcomes (45).

2.3.3 Resuscitation

Severe burn patients who have sustained burns of > 20% TBSA require to be stabilized by use of resuscitation fluids. This is necessary in order to maintain perfusion of body organs (47). The fluids prevent extensive kidney damage by diluting the myoglobin in the blood. Sodium bicarbonate can sometimes be given intravenously to help dissolve myoglobin. This prevents further kidney damage (31).

2.3.4 Wound coverage and grafting

For decades, the standard of care has been early excision and grafting. Early excision (within 1-2 days after injury) according to most studies has clinical benefits. It leads to blood loss reduction, reduced hospitalization period, minimize infections, decline in mortality and favors uptake of graft (48,49). However, decrease in mortality may occur only in burn patients without inhalation injury (29). Dead tissue removal and infection prevention by closure of burn wound either temporarily or permanently are the early excision primary aims (12). Early excision was found to reduce mortality rates among burn patients who did not sustain inhalation injury according to a meta-analysis done in 2015 (6).

2.3.5 Infection

Infection prevention is the primary goal of medical care. This is because when a burn patient develops sepsis, the chances of death increase and therefore prevention of infection in severe burn patients is of primary concern. (29). There has been extensive reviews done on the management of infections of burn wounds (12,29). Systemic infections and mortality among burn patients have decreased after the sequential introduction of topical antimicrobials like mafenide acetate and silver sulfadiazine, and after the adoption of early excision and grafting (50). That notwithstanding, the most implicated causes of death among burn injury patients are infections due to gram-negative and gram-positive bacteria (51). Bacterial cultures can help in choosing the correct antibiotic. This is particularly important in circumstances of resistance to drugs by bacteria. There are pharmacokinetic changes in patients with burn injuries and this should be taken into consideration and dose adjustment should be done appropriately to enhance antibiotic effectiveness (52). It is important to note that there are no effective topical

antimicrobials for fungal infections that are invasive. The rates of mortality among burn patients with large burns of greater than 30% TBSA who are infected with fungi are particularly high (53).

Topical antibiotics that are used for prophylaxis and treatment of wound infections due to burns include, silver sulfadiazine (commonly used in KNH), silver nitrate solution , mafenide acetate and silver-impregnated dressings (33). Systemic antimicrobial treatment are used to treat documented infections like pneumococcal infections, genitourinary tract infections, wound infection and bacteremia (10). Empiric therapy should be initiated in cases of evidence of sepsis and invasive infections (33). Systemic antibiotics can also be used for prevention of infections among burn patients due for surgery with burns o >40% TBSA. They do not affect mortality but reduce the rate of infections (6). Systemic antibiotic use for infection prevention does not alter the prevalence of infection of burn wounds or sepsis in nonsurgical patients (17).

2.4 Antibiotics and the burn patient

Antibiotics are one of the most widely used therapeutic classes of drugs globally. They are used management of bacterial infections either for treatment or prophylaxis (54). Antibiotic emergence changed the history of medicine in that they reduced disease transmissions and controlled morbidity and death among humans. They saved lives. This has however changed due to emergence of resistance to antibiotics where the bacteria have become resistant to the commonly available and first line drugs. This is because of increased use and injudicious use of the antibiotics (54,55). There are three organisms that are of great concern worldwide: *S. aureus, K. pneumoniae and E. coli.* According to WHO estimates in 2014, these organisms were the most implicated causes of both community and hospital acquired infections (56).

Up to a third of hospitalized patients have been estimated to receive a course of antibiotics and up to 40% of the hospital's drug budget can be attributed to the cost of antibiotics. It is therefore very important to use antibiotics rationally as injudicious use can provoke the occurrence of resistance to antimicrobials, increase the cost of health care and adversely affect the patient (54). The consumption of antibiotics has increased significantly globally. There was an increase by 35% between the years 2000 and 2010.

This increase was notable in resource constrained countries. Nearly 60% of total consumption in 2010 was contributed by cephalosporins and penicillins, an upserge by 41% from 2000 (57).

In a study done in Kenya, for the period 1997 – 2001, penicillins were the majorly prescribed antimicrobials. Tetracyclines were second, with doxycycline being the most used in this group. There was increase in cotrimoxazole consumption from 1997 – 1999 due to its use in HIV infected population for prophylaxis against opportunistic infections(58).

Aminoglycoside consumption increased steadily after 1999 with gentamicin accounting for 75% of the mean annual amount. In 1998, Fluoroquinolone use increased by more than 18-fold. This was due to patent period expiry for novel tetracyclines, resulting in generic products that were affordable becoming readily available. Macrolide use was comparatively stable throughout the time of study. The mean annual use of cephalosporins of first generation was higher in comparison with the second and third cephalosporins during the study (58).

A study at Mbagathi District Hospital in 2015 found that the top five antibiotics prescribed were amoxicillin (17%), metronidazole (12.6%), amoxicillin/clavulanic acid (12%), cotrimoxazole (10%) and flucloxacillin (9.1%) in that order. The most prescribed class of antibiotics was penicillin at 39%, followed by fluoroquinolones (11.4%), metronidazole and aminosidine (11.4%), sulfonamides (10%), cephalosporins (7.9%), macrolides (6.1%) and tetracyclines (3.8%) (59).

2.5 Rational Use of Antibiotics and Antibiotic Prescribing Guidelines

Using antibiotics rationally is recommended to avoid emergence of antimicrobial resistance. Antibiotic resistance presents an obstacle of great concern major especially in Sub Saharan Africa where the range of antibiotics is already limited. This means that the resistance will lead to a near total loss of treatment choices for many infections (57). The WHO has documented the prevalence of resistance to antibiotic in various regions worldwide. *Klebsiella pneumoniae* has shown resistance to carbapenems, the last resort treatment worldwide. *Escherichia coli* has developed resistance to fluoroquinolones,, the

most used widely used agent in many parts of the world. *Neisseria gonorrhea* has also shown resistance to third generation cephalosporins. *Enterobacteriaceae* which are resistant to carbapenems have shown resistance to colistin, the last resort treatment in many countries and regions (55,60). Therefore rational use of antibiotics is inevitable in order to prevent further antibiotic resistance.

There are several phases that comprise rational prescribing of an antibiotic. These include the perception of the need of an antibiotic, choice of the antibiotic, choice of the regimen, timing initiation of the antibiotic and monitoring the efficacy of the drug (54).

Rational use of antibiotics involves the use of several documents to guide in the procurement, prescribing and dispensing of antibiotics. These include the essential medicines list, standard treatment guidelines (STGs) and hospital formularies. According to a health facility survey on Access to Essential in Kenya conducted in 2009 by the Ministry of Medical Services and the Ministry of Public Health and Sanitation, it was found that majority of these important documents were not available to health care professionals. It is estimated that 20-50% of total antibiotic use is irrational. Inappropriate use of antibiotics include: incorrect dose or duration, inappropriate route of administration, use of sub-optimal doses, unnecessary use of broad spectrum antibiotics and also using an antibiotic to treat a viral infection (61). Local studies have shown increased trends of irrational prescribing (59).

Clinical practice guidelines are systematically developed documents that assist practitioners and sometimes patients arrive at decisions about correct diagnosis, management and treatment for specific circumstances. The Ministry of Health in Kenya has developed several clinical guidelines for management of specific infectious diseases, For example the Clinical guideline for management and referral of common conditions at levels 4-6 and levels 2-3 hospitals (62).

There are limited guidelines on antibiotic use in Kenya. Recently, KNH developed the antimicrobial use guidelines for the surgical and medical wards. The standard dosages of commonly used antimicrobials in burns are as shown in next page (table 1). None has been developed for the burn unit. There are some international antimicrobial prescribing

guidelines like one by the National Health Service (NHS) that has detailed guidelines for antimicrobial prophylaxis and antimicrobial guidelines for management of Septicemia (63). There are guidelines for burn care that do not specifically deal with antimicrobial guidelines for burns but only mention a little bit of antimicrobial stewardship in burns for example the International Society for Burn Injuries (ISBI) Practice guidelines for Burn Care (64).

Table 1: Standard dosages of commonly used antimicrobials for burns at KNH

Antibiotic	Doses	Comments
Amikacin	Adult and Paediatric: 15-20mg/kg IV daily in 2 divided doses	Used together with meropenem for treatment of *P. aeruginosa* infection
Amoxicillin-clavulinic acid	Doses based on amoxicillin **Oral:** Adult: 250-500mg 8 hourly for 5 days Child: 20mg/kg/day in 3 divided doses **IV:** Adult: 1gm 8 hourly Child: 30-50mg/kg 8 hourly	Mainly used for treatment of infections in burns
Metronidazole	Adult: 400mg PO 8 hourly, 500mg IV 8 hourly Paediatric: 7.5mg/kg IV/PO 8 hourly	Treatment of gastroenteritis in burns
Meropenem	Adult: 1gm IV 8 hourly Paediatric: 10-20mg/kg IV 8 hourly	Used with amikacin in treatment of *p. aeruginosa* infection
Vancomycin	Adult: 1gm IV 12 hourly Paediatric: 10mg- 15mg/kg IV 16 to 8 hourly	
Flucloxacillin	Adult: 250-500mg PO/IM 6 hourly Paediatric: 62.5-125mg PO/IM 6 hourly for under 2 yrs and 125mg-250mg PO/IM 6 hourly for 2-10 yrs	For prophylaxis and treatment of infections in burns
Ciprofloxacin	500-750mg PO 12 hourly 200-400mg IV 12 hourly Child under 5 years: 4-8mg /kg daily and 10mg/kg daily for those above 5 yrs.	Treatment of infections in burns

Cefuroxime	**Oral:** Adult: 250-500mg 12 hourly Paediatric: 20-30mg/kg/day in 2 divided doses **IV:** Adult: 750-1.5mg 6-8 hourly Paediatric: 20-50mg/kg/day in 3-4 divided doses	Used I surgical prophylaxis and infection treatment in burns
Ceftriaxone	Adult: 2g IV daily Paeds:20-50mg/kg/day IV	Prophylaxis and treatment of infections in burns
Cefazolin	Adult: 1gm single IV or IM Paediatric: 25mg/kg as single dose IV or IM	For induction of anaesthesia
Ceftazidime	Adult: 1-2g IV 8 to 12 hourly	Treatment of sepsis in burns
Clindamycin	**IV:** Adult:600-2700mg/day in 2-4 divided doses Child:15-40mg/kg in 3-4 divided doses daily **Oral:** Adult: 150-300mg 6 hourly Paeds: 3-6mg/kg 6 hourly	

Table 2: Prophylactic guidelines for management of burns (NHS Guidelines) (63)

Indication	**Antibiotic – first line**	**Antibiotic - penicillin allergy/MRSA colonized**
Burns prophylaxis - Raised temperature only	None	None
Minor burns dressing changes	None	None
Minor burns excision/Grafting Prophylaxis for during Surgery	Flucloxacillin 1g IV at induction	Teicoplanin 600mg IV at induction
Major burns dressing changes	Choice of agents determined by results of previous surveillance cultures	Choice of agents determined by results of previous surveillance cultures

		in order to prevent septicaemia related to manipulation of the wound. If no cultures available empirical treatment with: Flucloxacillin 1g IV stat **plus** Gentamicin Prophylaxis 2mg/kg IV as a single dose		in order to prevent septicaemia related to manipulation of the wound. Teicoplanin 600mg IV **plus** Gentamicin 2mg/kg IV as a single dose

Table 3: Antimicrobial Guidelines for the Management of Burn Wound Infection (NHS Guidelines) (63)

No of days after burn	**Previous antibiotics**	**Likely pathogens**	**Antibiotic 1st line**	**Penicillin allergy**
< 5 days	No	*Staphylococcus aureus* Beta-haemolytic *Streptococcus* spp. Group A	Benzylpenicillin 1.2g to 2.4g IV 6 hourly plus Flucloxacillin 1g to 2g IV 6 hourly	Clindamycin 600mg IV 6 hourly For severe infection/sepsis Add Teicoplanin IV as per BNF**)**
< day 5	Yes	*Staphylococcus aureus* Beta-haemolytic *Streptococcus* spp. Group A	Flucloxacillin 2g IV 6 hourly plus Gentamicin Treatment IV 5mg/kg OD (dose	Clindamycin 600mg IV 6 hourly plus Gentamicin Treatment IV 5mg/kg OD

Day 6 onwards	Coliforms	according to levels)	(dose according to levels) For severe infection/sepsis add Teicoplanin IV as per BNF)
Toxic shock syndrome	Consult with microbiology		Consider fresh frozen plasma

CHAPTER THREE: METHODOLOGY

3.1 Research Design

This research was a cross-sectional study specifically a point prevalence survey. The aim of the study was to determine the causes and types of burns, the prevalence of antibiotic prescribing and to establish whether there was rational or irrational prescribing among burn patients at Kenyatta National Hospital. Point prevalence survey is a practical surveillance tool for finding information on antimicrobial consumption and evaluating effects of interventions like antibiotic policies. A point prevalence study informs and guides local and international antibiotic stewardship policies. The global point prevalence survey has been shown to be a practical surveillance tool for providing information about antibiotic use and for assessing the effects of antibiotic stewardship interventions

3.2 Location of the study

The study was conducted at the Burns Unit and Burns Ward 4D of Kenyatta National Hospital. This is the largest public referral hospital in East and Central Africa, offering quality healthcare services in the greater East African region. It also serves as the teaching hospital for the University of Nairobi (UON) and the Kenya Medical Training College (KMTC). It is located in Nairobi County, along Hospital Road, Upper Hill part of Nairobi. The hospital has a 2000 bed capacity with 50 wards, 22 outpatient clinics as well as 24 specialized theatres and an Accident and Emergency department. Approximately 70,000 inpatients are seen in the wards yearly. KNH is the study site because it admits relatively many burn patients due to its location in a large city and by virtue of it being a national referral hospital.

3.3 Target population

This comprised all patients admitted in the burns unit and burns ward 4D of KNH on the day of the study.

3.4 Eligibility criteria

3.4.1 Inclusion criteria

The medical records of burn unit and burns ward 4D inpatients were included if the patient was: admitted before or present at 8 AM and not discharged at the time of survey, admitted to the burn unit before 8 AM but transferred to another ward like the critical care unit after 8 AM and if the patient was temporarily out of burns unit for other procedures. All inpatient records of patients of any age, sex, and with complete records were included.

3.4.2 Exclusion criteria

Patient records were be excluded if the patient was admitted into the burns unit or ward 4D after 8.00am on the survey day, if the patient had been discharged, undergoing same day treatment or on observation. Medical records of patients that were incomplete were excluded from the study.

3.5 Sample size determination

Sample size determination was calculated using the Fischer formula (65):

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

Where n is the sample size, Z the statistic for level of confidence, P the expected prevalence and d the allowable error.

Z is set at 1.96 for the desired confidence interval of 95%. From a previous study conducted by the Ministry of Health in 2003, the prevalence of antibiotic prescribing was found to be 73% and therefore, P was estimated to be 73%(66).

$$n = \frac{1.96^2 * 0.73(1-0.73)}{0.05^2}$$

n = 302.8 ~ 303 patients

The degree of precision was 5% as the expected prevalence was between 10% and 90% (65). From the above equation therefore the minimum targeted sample was 303 patients.

The KNH burns unit and ward 4D had a finite population of patients.

Adjusting for a finite population, the expected sample size (n) was calculated as shown below:

$$n = \frac{n_{0} * N}{n_{0} + (N-1)}$$

Where N was the finite population size and n_0 the expected sample size as determined by the Fischer equation above. The KNH burns unit had a bed capacity of about 21 and ward 4D had a bed capacity of 36, giving a total bed capacity of 57.

N = 57 patients

Therefore:

$$n = \frac{303 \times 57}{303 + (57-1)}$$

n = 48.1 ~ 49 patients

A 10% over estimation was provided to cater for non-response or missing/incomplete/incorrect data,

$$n = \frac{49}{0.9}$$

n = 54.44 ~ 55 patients

Therefore the minimum target sample size was 55 patients. A total of 68 participants were sampled and the target sample size was therefore met.

3.6 Sampling technique

The sampling technique that was used is universal sampling also known as census sampling. Census sampling was selected because the total number of admitted patients at 8 am and the total number of 'eligible' beds for inpatients in the department at 8 am on

the day of survey was the important denominator. Secondly, given that not all patients were on antibiotics, it was important to sample all available files. The bed capacity of the burns unit is low, 21 and for ward 4D is 36 giving a total bed capacity of 57. Therefore all cases were sampled to obtain an adequate sample. The patient files were obtained from the nursing desk where they are usually kept while the patient is admitted. All treatment sheets were reviewed for all patients admitted in the burns unit and ward 4D and the patients on antibiotics and those not antibiotics identified.

3.7 Research instruments

Two data collection forms were used. These were the ward/department form (Appendix 1) and the patient details form (Appendix 2). These were adopted from the Global PPS protocol (67). The patient form was filled for only those patients on antibiotics. This form contained the patient demographics, the antibiotic name, the dose, frequency and route of administration. The form also contained the patient diagnosis, the type indication, and the reason given for in the notes, the type of treatment whether empiric or targeted.

The ward form contained details like the ward name and the department type, total number of eligible patients and the bed capacity in the ward or burns unit.

3.8 Pre-testing

During the study, the patient and ward forms were pre-tested. A total of four patient files were used for this study; two from the burns unit and another two from ward 4D. The data obtained was assessed for completeness and ability to accurately capture the study objectives. The pre-testing helped identify the gaps in the data collection tools. The data collection tools were modified based on the pre-test.

3.9 Data collection

Data collection was done using a department /ward form (Appendix II) and a patient form (Appendix III). The source of information for completing the data collection tool was from reviewing the patient records. This tool was adopted from Global prevalence survey protocol (67). The tool was modified and designed to obtain data on patient demographic characteristics, name of antibiotics prescribed, strength, route, frequency, duration of use and indications. It was also modified to include a section to indicate the

category of burn and % TBSA. Another tool (Appendix IV) was used to collect data on the causes of burn. This was also obtained from the patient medical records.

3.10 Data management

Data was recorded as anonymous by employing a study number for each of the study participants. The data was coded and then entered into Microsoft Excel version 2010. These data was validated for correctness and completeness. The electronic data was password protected and accessible to the principal investigator (PI). Any hard copy document containing patient raw data was kept under lock and key and was only accessed by the PI. The data was then be exported to STATA 13 for data analysis.

3.11 Study Variables

Independent variables

These included the patient demographics like age, gender, diagnoses, comorbidities and type of department (whether it is ward 4D or the burns unit).

Dependent variables

These comprised the type of antibiotic chosen, the indication, the dose, the frequency and dose, the route of administration and the duration of treatment.

3.12 Data analysis

Statistical analyses were conducted using STATA 13. Categorical data was be summarized as counts and percentages. The causes and types of burns were determined and information presented in form of tables. The overall prevalence of antibiotic use was calculated using the total number of patients admitted in the burns unit and burns ward 4D as the denominator and the total number of patients on antibiotics as the numerator. The most frequent class and type of antibiotic was determined and prevalence calculated. The information was presented in the form of tables and graphs.

The rational prescribing of antibiotics was assessed using the following various indicators: the appropriate choice of antibiotic, the correct frequency, the right dose and dosage form of drug, the appropriate route of administration and the correct duration. The KNH antibiotic use guidelines and the National Health Service (NHS) antimicrobial

guidelines for burn management were used. There are no local antimicrobial guidelines specifically developed for burn management. Empiric and prophylactic use of antibiotics was also assessed.

3.13 Ethical consideration

Ethical approval was sought from the KNH-UON Research and Ethics Review Committee whereas authorization to carry out the study was sought from the Kenyatta National hospital administration before starting the study. Consent was also sought from the custodian of the patient records on the ward to re-enforce the confidentiality of all stakeholders in the project. Consent from patients was waived as patient records only were used and there was no direct contact with the patients since they were not interviewed. There were minimal risks in terms of physical or physiological harm because only medical records were required. Confidentiality was maintained throughout the study: Unique patient identifiers that allow linkage to patient records were used and no names were used on the data collection forms. The data collection forms were kept safely with restricted access. The PI was the only one accessing electronic data which were password protected.

CHAPTER FOUR: RESULTS

4.1 Socio-demographic characteristics of study population

The study was conducted among 68 patients. There were more males (n=44, 64.7%) who sustained burn injuries than females (n=24, 35.3%). Children (≤12 years) formed the largest proportion (33, 48.5%) of the age category followed by adults ≥18 years (31, 45.6%) and the smallest age group was those between 13 to 17 years (4, 5.9%) (**Table 4**).

Table 4: Socio-demographic characteristics of the study participants

Characteristics	Participants (N = 68)	Percentage (%)
Gender		
Male	44	64.7
Female	24	35.3
Age (years)		
≤ 12	33	48.5
13-17	4	5.9
≥18	31	45.6

4.2: Clinical characteristics of study population

Majority of the burns were accidental (58, 85.3%) in nature. The rest were due assault (7, 10.3%) and suicide (3, 4.4%). Open fire caused majority of the burns (33, 48,5%) followed by scalds (22, 32.4) , then electricity (9, 13.2%) and chemical burns (4, 5.9%).

Majority of the patients had 2nd degree burns (57, 83.8%), followed by 3rd degree burns (28, 41.2%). Eight patients had 4th degree burns (11.8%) while 5 had 1st degree burns (7.5%). Some patients had mixed degrees of burns on different parts of the body. There was no patient admitted with only 1st degree burn, it occurred mixed with the other types of burns.

The mean % TBSA was 21.4%. The greatest % TBSA was 65% while the least was 3% TBSA. Majority of the patients (61.8%, n=42) had their % TBSA below the mean (**Table 5**).

Table 5: Clinical Characteristics of the study participants

Variable	Participants (N = 68)	Percentage (%)
Nature of Burn		
Accidental	58	85.3
Assault	7	10.3
Suicidal	3	4.4
Cause of Burn		
Open fire	33	48.5
Scalds	22	32.4
Electricity	9	13.2
Chemical	4	5.9
Category of Burn		
1st degree	5	7.4
2nd degree	57	83.8
3rd degree	28	41.2
4th degree	8	11.8
Percentage TBSA (%)		
≤21	42	61.8
>21	26	38.2

4.3 Association between Nature of Burn and the Age of patient

There was no statistically significant relationship between the nature of burn and the age of patient as determined using the Fisher exact test (Table 6).

Table 6: Association between nature of burn and age of Patient

Variable	≤12yrs n(%)	13-17yrs n(%)	≥18yr n(%)	P-value
Nature of Burn				
Accidental	30 (90.9)	4 (100.00)	24 (77.4)	
Assault	2 (6.1)	0(0.0)	5 (16.1)	0.605
Suicidal	1 (3.0)	0 (0.0)	2 (6.5)	

4.4: Relationship between cause of burn and various patient characteristics

Fisher's exact test was used to find association between the cause of burn and patient characteristics. There was a statistically significant relationship (p=0.016) between cause of burn and the gender of patient. There was also a statistically significant association between the cause of burn and the age of the patient (**Table 7**).

Table 7: Relationship between cause of burn and various patient characteristics

Variable	Open fire n (%)	Scalds n (%)	Electricity n (%)	Chemical n (%)	P value
Sex					
Male	17 (51.5)	14 (63.4)	9 (100.0)	4 (100.0)	**0.016***
Female	16 (48.5)	8 (36.4)	0 (0.0)	0 (0.0)	
Age					
≤12yrs	11 (33.3)	20 (90.9)	2 (22.2)	0 (0.0)	**<0.0001***
13-17yrs	3(9.1)	0 (0.0)	1 (11.1)	0 (0.0)	
≥18yrs	19 (57.6)	2 (9.1)	6 (66.7)	4 (100.0)	
Nature of Burn					
Accidental	26 (78.8)	20 (90.9)	8 (88.9)	4 (100.0)	0.831
Assault	4 (12.1)	2 (9.1)	1 (11.1)	0 (0.0)	
Suicidal	3 (9.1)	0(0.0)	0 (0.0)	0 (0.0)	

4.5: Independent predictors of Cause of burns

Forward logistic regression was done to identify independent predictors of the various causes of burns. The results are as in **Table 8.** The age of the participant was found to be an independent predictor of the cause of burn. For instance, participants aged ≥13 years had 7 times the likelihood of having electricity or chemical burns (COR=7.0; 95% CI 1.44-35.12 p=0.016). Furthermore, this relationship became more apparent after multivariate logistic regression (AOR=5.87; 95% CI 1.11-30.95; p=0.037). Nevertheless, there was no statistically significant relationship between the cause of burns and the gender of the study participants (**Table 8**).

Table 8: Independent predictors of cause of burns

Variable	Bivariate		Multivariate	
	COR (95% CI)	**P-value**	**AOR (95% CI)**	**P-value**
Age	7.0 (1.44-35.12)	**0.016***	**5.87 (1.11-30.95)**	**0.037***
Sex	1	-	-	-

Key: *COR-crude odds ratio; AOR-adjusted odds ratio; CI-crude odds ratio; *-statistically significant result.*

4.6: Prevalence of antibiotic use

4.6.1 Overall prevalence of antibiotic use

Most patients (62, 91.2%) were on antibiotics. This is because of the use of the use of frequent antibiotics for prophylaxis of burn wound infections achieved by use of topical antimicrobials particularly silver sulfadiazine. Only 8.8% of the patients (6) were not on antibiotics (Fig. 1).

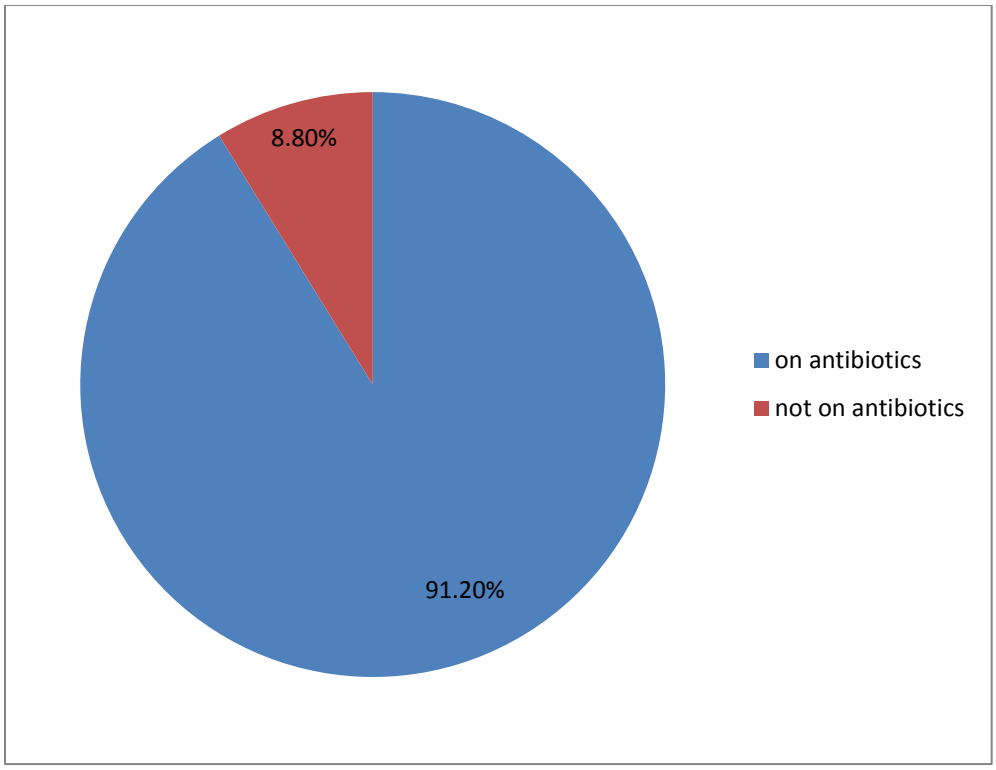

Figure 1: Overall prevalence of antibiotic use.

4.6.2 Prevalence of antibiotic classes

Topical antibiotics (47, 69.1%) had the highest proportion of prescribing among burn patients, followed closely by Cephalosporins (44, 64.7%) and Penicillins a distant third (21, 30.9%). Macrolide (1.5%) and glycopeptide (1.6%) antibiotics were the least prescribed. Nitro-imidazoles (14.7%), carbapenems (10.3%) and aminoglycosides (10.3%) were also significantly prescribed (**fig. 2**).

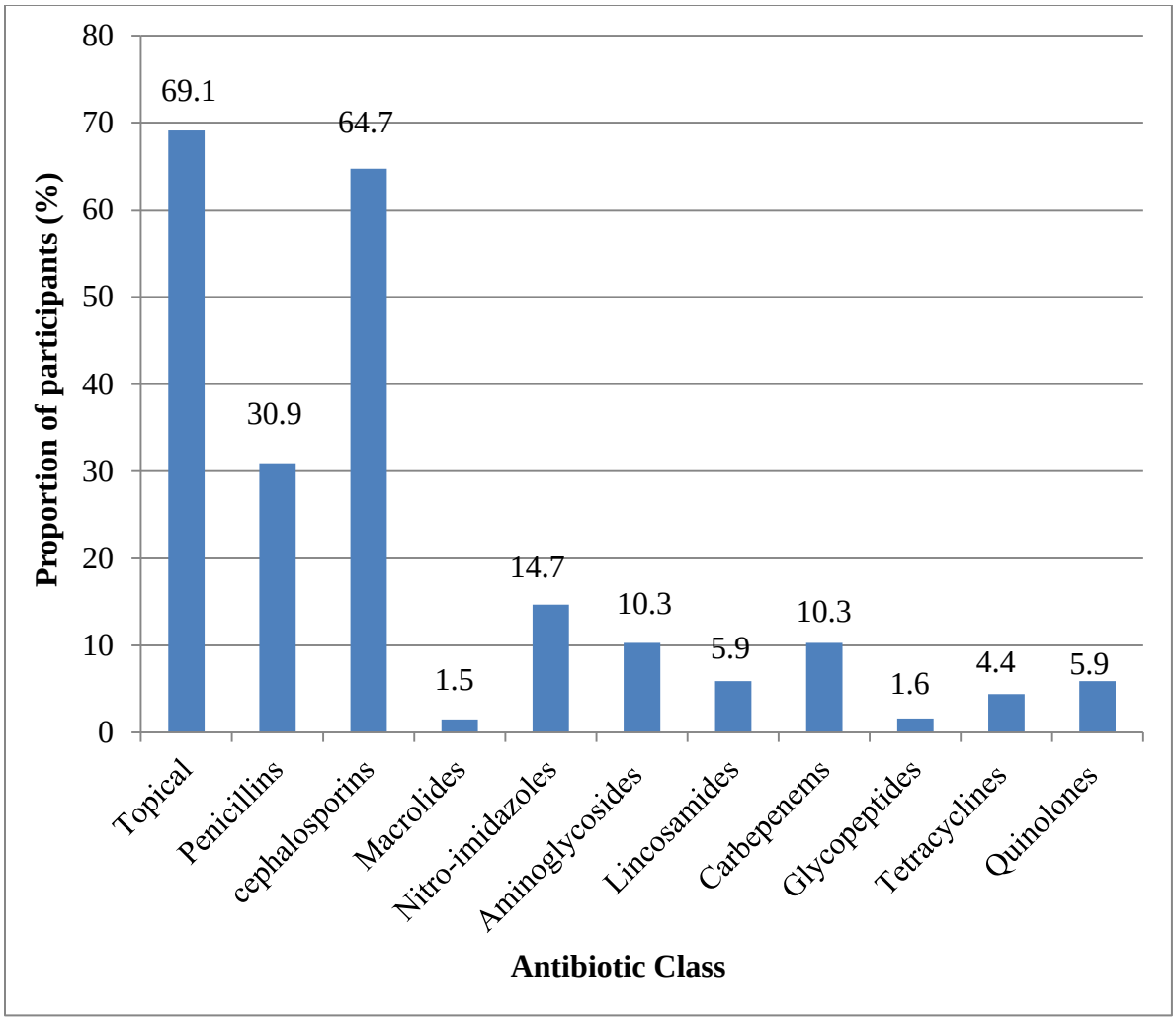

Figure 2: Prevalence of antibiotic by class.

4.6.3 Prevalence of Specific Antibiotics

Silver sulfadiazine had the highest proportion of use (47, 69.1%) followed by cefuroxime (28, 41.2) and Ceftriaxone (26, 38.2%). Amoxicillin clavulanic acid was also significantly prescribed (17, 25%). Ceftazidime (1, 1.5%), clarithromycin (1, 1.5%) and vancomycin (1, 1.5%) were the least prescribed (Table 9).

Table 9: Prevalence of specific antibiotics prescribed

Antibiotic	Participants N	Percentage %
Silver sulfadiazine	47	69.1
Cefazoline	8	11.8
Amoxicillin clavulanate	17	25

Ceftriaxone	26	38.2
Cefuroxime	28	41.2
Clindamycin	4	5.9
Ciprofloxacin	4	5.9
Amikacin	5	7.3
Meropenem	7	10.3
Vancomycin	1	1.5
Metronidazole	10	14.7
Clarithromycin	1	1.5
Flucloxacillin	4	5.9
Tetracycline eye ointment	3	4.4
Gentamicin	2	2.9
Mupirocin cream	2	2.9
Ceftazidime	1	1.5

4.6.4 Purpose of specific Antibiotic

Prophylaxis (67.6%) was the major reason for prescribing antibiotics among burn patients. 32.4% of the prescribed antibiotics were used for treatment.

Silver sulfadiazine (100%), tetracycline (100%), mupirocin cream (100%),and cefazoline (100%) were used for prophylaxis only. Clindamycin (100%), ciprofloxacin (100%), amikacin (100%), Meropenem (100%) and gentamicin (100%) were used for treatment only. Ceftriaxone, cefuroxime, metronidazole, Flucloxacillin and amoxicillin clvulanic acid were used for both prophylaxis and treatment of burn wound infections (**table 10**).

Table 10: Proportion of antibiotics

Antibiotic	**Prophylaxis**		**Treatment**	
	n	**%**	**n**	**%**
Silver sulfadiazine	47	100.0	0	0.0
Cefazoline	8	100.0	0	0.0
Amox. clavulanic acid	4	23.5	13	76.5
Ceftriaxone	25	96.2	1	3.8
Cefuroxime	23	82.1	5	17.9
Clindamycin	0	0.0	4	100.0
Ciprofloxacin	0	0.0	4	100.0
Amikacin	0	0.0	5	100.0
Meropenem	0	0.0	7	100.0
Vancomycin	0	0.0	1	100.0

Metronidazole	1	10.0	9	90.0
Clarithromycin	0	0.0	1	100.0
Flucloxacillin	2	50.0	2	50.0
Tetracycline eye oint	3	100.0	0	0.0
Gentamicin	0	0.0	2	100.0
Mupirocin cream	2	100.0	0	0.0
Ceftazidime	0	0.0	1	100
Total	**115**	**67.6**	**55**	**32.4**

4.6.5 Association between age and antibiotic class

The fisher exact test was used to determine if there is an association between the antibiotic class and age category of the burn patients. There was a statistically significant relationship between the age category and quinolones. The age of the patient was found to have influenced the choice of quinolone class of antibiotics (p=0.037) (Table 11).

Table 11: Association between age and antibiotic class

Antibiotic class	≤12years n (%)	13-17yrs n (%)	≥18yrs n (%)	P-value
Topical	26 (78.8)	2 (50)	19 (61.3)	0.217
Penicillins	7(21.2)	3(75.0)	11(35.5)	0.07
Cephalosporins	18(54.6)	4(100.0)	22 (71.0)	0.128
Macrolides	0 (0.0)	0 (0.0)	1 (3.2)	0.515
Nitroimidazoles	4 (12.1)	0 (0.0)	6 (19.4)	0.741
Aminoglycosides	3 (9.1)	1(25.0)	3(9.7)	0.519
Lincosamides	1(3.0)	0 (0.0)	3 (9.7)	0.491
Carbapenems	2(6.1)	1(25.0)	4(12.9)	0.247
Glycopeptides	0 (0.0)	0 (0.0)	1 (3.2)	0.515
Tetracyclines	0 (0.0)	0 (0.0)	3(9.7)	0.258
Quinolones	0 (0.0)	1(25.0)	3(9.7)	**0.037***

4.6.6 Relationship between antibiotic class and degree of burn

The Fisher exact test was also used to determine if there was an association between the antibiotic class and degree of burn of the patient. Penicillins were prescribed for patients with 4th degree burns (p=0.009). Cephalosporins were significantly prescribed for patients with 3rd degree burns (p=0.019) and 4th degree burns (p=0.043). Aminoglycosides were also significantly prescribed for patients with 3rd degree burns together with carbapenems (p=0.017). Lincosamides were prescribed for patients with 2nd degree burns (p=0.012) (**Table 12**).

Table 12: Relationship between antibiotic class and degree of burn

Class	2nd n (%)	P-value	3rd n (%)	P-value	4th n (%)	P-value
Topical	42(73.7)	0.082	19 (67.9)	1.0	4 (50.0)	0.24
Penicillins	15(26.3)	0.082	11 (39.3)	0.287	6 (75.0)	**0.009***
Cephalosporins	34(59.7)	0.082	23 (82.1)	**0.019***	8 (100.0)	**0.043***
Macrolides	1(1.8)	1.0	1 (3.6)	0.412	0 (0.0)	1.0
Nitroimidazoles	9 (15.8)	1.0	3 (10.7)	0.507	1 (12.5)	1.0
Aminoglycosides	7 (12.3)	0.588	6 (21.4)	**0.017***	1 (12.5)	1.0
Lincosamides	1 (1.8)	**0.012***	2 (7.1)	1.0	2 (25.0)	0.065
Carbapenems	6 (10.5)	1.0	6 (21.4)	**0.017***	2 (25.0)	0.188
Glycopeptides	1 (11.8)	1.0	0 (0.0)	1.0	0 (0.0)	1.0
Tetracyclines	3(5.3)	1.0	1 (3.8)	1.0	1 (12.5)	0.317
Quinolones	2 (3.5)	0.120	4 (14.3)	**0.025***	2 (25.0)	0.065

4.7 Rational antibiotic prescribing

Rational antibiotic prescribing was evaluated based on five main indicators: appropriate choice of antibiotic, correct dose, correct frequency, duration and route of administration. These were assessed using the KNH antibiotic guidelines and international guidelines.

4.7.1 Right Drug Choice

Out of the 170 antibiotic encounters, 93.5% (n=159) were appropriate choices for their indications while 6.5% (n=11) were inappropriate choices (**Table 13**).

Table 13: Evaluation of choice of antibiotic

Antibiotic	Correct n (%)		Incorrect n (%)	
Silver-sulfadiazine	46	97.9	1	2.1
Cefazoline	8	100.0	0	0.0
Amox. clavulanic acid	16	94.1	1	5.9
Ceftriaxone	24	92.3	2	7.7
Cefuroxime	27	96.3	1	3.6
Clindamycin	2	50.0	2	50.0
Ciprofloxacin	3	75.0	1	25.0
Amikacin	5	100.0	0	0.0
Meropenem	7	100.0	0	0.0
Vancomycin	0	0.0	1	100.0
Metronidazole	10	100.0	0	0.0
Clarithromycin	1	100.0	0	0.0
Flucloxacillin	3	75.0	1	25.0
Tetracycline eye oint.	3	100.0	0	0.0
Gentamicin	1	50.0	1	50.0
Mupirocin cream	2	100.0	0	0.0
Ceftazidime	1	100.0	0	0.0
Total	**159**	**93.5**	**11**	**6.5**

4.7.2 Evaluation of Dose

Of the 170 antibiotic encounters, 87.6% (n=149) had the correct doses prescribed according to the indication while 12.4 had incorrect doses or the dose was not indicated in the treatment sheet (**Table 14**).

Table 14: Evaluation of dose of antibiotic

Antibiotic	Correct n (%)		Incorrect n (%)		Missing n (%)	
Silver-sulfadiazine	45	95.7	0	0.0	2	4.3
Cefazoline	7	87.5	1	12.5	0	0.0
Amoxicillin cluvalanate	13	76.5	2	11.8	2	11.7

acid						
Ceftriaxone	24	92.4	1	3.8	1	3.8
Cefuroxime	24	85.7	3	10.7	1	3.6
Clindamycin	3	75.0	1	25.0	0	0.0
Ciprofloxacin	3	75.0	1	25.0	0	0.0
Amikacin	4	80.0	1	20.0	0	0.0
Meropenem	6	85.7	1	14.3	0	0.0
Vancomycin	1	100.0	0	0.0	0	0.0
Metronidazole	8	80.0	1	10	1	10.0
Clarithromycin	1	100.0	0	0.0	0	0.0
Flucloxacillin	3	75.0	1	25.0	0	0.0
Tetracycycline eye ointment	3	100.0	0	0.0	0	0.0
Gentamicin	1	50.0	1	50.0	0	0.0
Mupirocin cream	2	100.0	0	0.0	0	0.0
Ceftazidime	1	100.0	0	0.0	0	0.0
Total	**149**	**87.6**	**21**	**12.4**		

4.7.3 Evaluation of Route of Administration

Out of the 170 times that antibiotics were prescribed, 83.5% (n=142) had the correct route of administration while 16.5% (n=28) had wrong route of administration or the route of administration was missing in the treatment sheet (**Table 15**).

Table 15: Evaluation of route of administration of antibiotic

Antibiotic	**Correct n (%)**		**Incorrect n (%)**		**Missing n (%)**	
Silver-sulfadiazine	41	87.2	0	0.0	6	12.8
Cefazoline	6	75.0	1	12.5	1	12.5
Amoxicillin clavulanate	13	76.4	2	11.8	2	11.8
Ceftriaxone	23	88.5	0	0.0	3	11.5

Cefuroxime	23	82.2	2	7.1	3	10.7
Clindamycin	4	100.0	0	0.0	0	0.0
Ciprofloxacin	4	100.0	0	0.0	0	0.0
Amikacin	4	80.0	0	0.0	1	20.0
Meropenem	7	100.0	0	0.0	0	0.0
Vancomycin	0	0.0	1	100.0	0	0.0
Metronidazole	7	70.0	2	20.0	1	10.0
Clarithromycin	1	100.0	0	0.0	0	0.0
Flucloxacillin	3	75.0	0	0.0	1	25.0
Tetracycline eye ointment	2	66.7	0	0.0	1	33.3
Gentamicin	2	100.0	0	0.0	0	0.0
Mupirocin cream	1	50.0	0	0.0	1	50.0
Ceftazidime	1	100.0	0	0.0	0	0.0
Total	**142**	**83.5**	**28**	**16.5**		

4.7.4: Evaluation of Duration of Antibiotic Use

Of the 170 antibiotic encounters, 81.2% (n=138) had correct duration of use while 18.8% (n=32) had incorrect duration of use or the duration was not indicated (Table 16).

Table 16: Evaluation of duration of antibiotic use

Antibiotic	**Correct n (%)**		**Incorrect n (%)**		**Missing n (%)**	
Silver-sulfadiazine	40	85.1	1	2.1	6	12.8
Cefazoline	7	75.0	1	12.5	1	12.5
Amox. clavul. Acid	13	76.4	2	11.8	2	11.8
Ceftriaxone	21	80.8	2	7.7	3	11.5
Cefuroxime	22	78.6	5	17.9	1	3.8
Clindamycin	4	100.0	0	0.0	0	0.0
Ciprofloxacin	2	50.0	1	25.0	1	25.0
Amikacin	5	100.0	0	0.0	0	0.0
Meropenem	7	100.0	0	0.0	0	0.0

Vancomycin	1	100.0	0	0.0	0	0.0
Metronidazole	7	70.0	1	10.0	2	20.0
Clarithromycin	1	100.0	0	0.0	0	0.0
Flucloxacillin	2	50.0	1	25.0	1	25.0
Tetracyc. eye oint.	1	33.3	0	0.0	2	66.7
Gentamicin	2	100.0	0	0.0	0	0.0
Mupirocin cream	2	100.0	0	0.0	0	0.0
Ceftazidime	1	100.0	0	0.0	0	0.0
Total	**138**	**81.2**	**32**	**18.8**		

4.7.5 Evaluation of Frequency

Out of the 170 antibiotic encounters, 85.7% (n=146) had the right frequency of administration while 14.3% (n=24) had the frequency missing or incorrect (**Table 17**).

Table 17: Evaluation of frequency of antibiotic

Antibiotic	Correct n (%)		Incorrect n (%)		Missing n (%)	
Silver-sulfadiazine	43	91.5	0	0.0	4	8.5
Cefazoline	6	75.0	0	0.0	2	25
Amox. Clavul. acid	15	88.2	2	11.8	0	0.0
Ceftriaxone	21	80.8	3	11.6	2	7.6
Cefuroxime	22	78.6	3	10.7	3	10.7
Clindamycin	4	100.0	0	0.0	0	0.0
Ciprofloxacin	4	100.0	0	0.0	0	0.0
Amikacin	3	60.0	2	40.0	0	0.0
Meropenem	5	71.4	1	14.3	1	14.3
Vancomycin	1	100.0	0	0.0	0	0.0
Metronidazole	10	100.0	0	0.0	0	0.0
Clarithromycin	1	100.0	0	0.0	0	0.0
Flucloxacillin	4	100.0	0	0.0	0	0.0
Tetracycline eye oint	3	100.0	0	0.0	0	0.0
Gentamicin	2	100.0	0	0.0	0	0.0
Mupirocin cream	1	50.0	0	0.0	1	50.0
Ceftazidime	1	100.0	0	0.0	0	0.0
Total	**146**	**85.7**	**24**	**14.3**		

4.7.6 Rational use of antibiotics

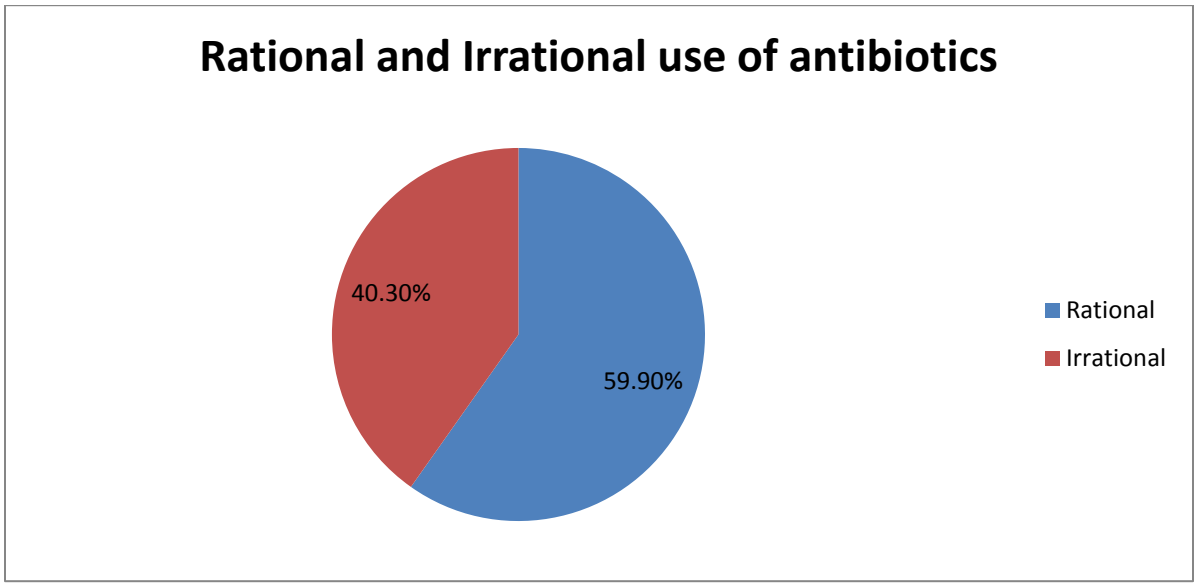

Figure 3: Rational use of antibiotics.

There was rational use of antibiotics in 59.9% (n=37) of the burn patients and irrational use in 40.3% (n=25) of the patients (fig. 3).

4.7.7 Relationship between rational antibiotic use and socio-demographic factors

Table 18: Relationship between rational antibiotic use and sociodemographic factors

Variable	Rational n (%)	Irrational n (%)	P value n (%)
Age			
≤12yrs	21 (67.7)	10 (32.3)	0.833
13-17yrs	2 (50.0)	2 (50.0)	
≥18yrs	14 (51.9)	13 (48.2)	
Gender			
Male	24 (61.5)	15 (38.5)	0.791
Female	13 (56.5)	10 (43.5)	

There was no statistically significant association between the rational use of antibiotics and the patient socio-demographic characteristics as determined using the Fisher exact test (Table 18).

4.7.8 Relationship between rational prescribing and antibiotic class

The Fisher exact test was used to determine if there was an association between the rational use and the antibiotic class. There was no relationship between the rational use of antibiotics and antibiotic class (Table 19).

Table 19: Relationship between rational prescribing and antibiotic class

Class	Rational n (%)	Irrational n (%)	P-value
Topical	27 (57.5)	20 (42.5)	0.564
Penicillins	10 (47.6)	11 (52.4)	0.184
Cephalosporins	26 (59.1)	18 (40.9)	0.558
Macrolides	0 (0.0)	1 (100.0)	0.403
Nitroimidazoles	5 (50.0)	5 (50.0)	0.506
Aminoglycosides	2 (28.6)	5 (71.4)	0.107
Lincosamides	2 (50.0)	2 (50.0)	0.53
Carbapenems	3 (42.9)	4 (57.1)	0.425
Glycopeptides	0 (0.0)	1 (100.0)	0.403
Tetracyclines	1 (33.3)	2 (66.7)	0.56
Quinolones	2 (50.0)	2 (50.0)	0.53

CHAPTER FIVE: DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 Discussion

5.1.1 Causes and types of burns

A total of 68 burn patients were admitted at the KNH on the days of survey, 64.7% being male. Open fire was the major cause of burns among the patients (48.5%). These open fires were caused by paraffin stove explosions, being doused with paraffin, house fires and self-ignition. Scalds were the second leading cause of burns (32.4%) especially among children where hot tea, hot water and cooking oil were the causes. Electricity was responsible for 13.2% of the burns while the least cause chemical heat accounted for 5.9%. This was in contrast to a study done at MTRH by Lelei et al, 2005, where scalds (67.5%) was the leading cause of burns followed by open fire (26.2%) while burns due to chemicals was the least (2%) just like the case was in this study (68).

Most burns were accidental (85.3%) while a few were assault (10.3%) and suicidal (4.4%) cases. The accidental cases were mostly scalds on children while the suicidal and assault burns were due to open fires and majorly affected adult patients. This is comparable to a study done at KNH by Nthumba et al, 2011, where majority of the burns were accidental and a few assault cases (4) and another study at Kijabe Mission Hospital by Mutiso et al, 2014, where unintentional burns comprised 98.5% (19). Children constituted the highest proportion of burn patients (48.5%). This is comparable to the results of the studies done in MTRH and KNH where majority of the burn patients were children (4,68).

The depth of the burns sustained by the patients varied from 1^{st} to 4^{th} degree with a sizeable number having mixed burns. Majority of the patients sustained 2^{nd} degree burns (83.8%). 41.2% sustained 3^{rd} degree burns while 11.8% had 4^{rd} degree burns. some patients had mixed degrees of burns on different parts of the body. Only 7.5% had 1^{st} degree burns but this had to occur with other degree burn because no patient was admitted with only 1^{st} degree burn. This is comparable to a study done at KNH by Ndiritu et al, 2006, where majority of the patients sustained second degree burns (55.7%) followed by third degree burns (27).

The total burnt surface area (TBSA) ranged from 3% to 65% with a mean of 21.4%. This is comparable to the results of the study at KNH by Ndiritu et al, 2006, where the mean TBSA was 22.3% (27) but quite high compared to the mean TBSA (16.4%) of the study conducted at MTRH by Lelei et al (68).

Predictors of burns

There was significant association between the cause of burn and the gender of the patient (p=0.016). This is because of the 9 patients (100%) with electricity burns and 4 patients (100%) with chemical burns, all were of male gender. This may be due to occupational exposure where more men work in industries as casual labourers thus exposed to chemical burns and in the electricity sector hence electric burns. This could also be attributed to risk taking behavior associated with men

There was also statistically significant relationship between cause of burn and the age of patient as determined by Fisher exact ($p<0.0001$). For example for scald burn patients, 90.9% were children while 9.1% were adults. This is comparable to the other studies done at MTRH and KNH already cited (4,68). Of the patients who sustained chemical burns, all were adults (100%). This could be due to the fact that adults are more exposed to chemical burns because of the nature and environment of work especially the male gender.

Age was found to be an independent predictor of cause of burn. For instance, when forward logistic regression was done, participants aged ≥13 years had 7 times the likelihood of having electricity or chemical burns (COR=7.0; 95% CI 1.44-35.12 p=0.016). The relationship become more apparent after multivariate logistic regression (AOR=5.87; 95% CI 1.11-30.95; p=0.037). Nevertheless, there was no statistically significant between the cause of burns and gender of participants.

5.1.2 Prevalence of antibiotics

Of the 68 burn patients sampled, 62 were on antibiotics. This translated to a prevalence of 91.2%. The high antibiotic prevalence is due to the common use of topical antimicrobials for infection prophylaxis among burn patients. This prevalence is significantly higher than the prevalence of antibiotic use (68.0%) among outpatients at Mbagathi District

Hospital (59) and 67.7% antibiotic use prevalence among medical and surgical inpatients at Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH). There no local studies on antibiotic use among burn patients thus the comparison with antibiotic use in the medical and surgical wards of (JOOTRH).

There were 11 classes of antibiotics prescribed. Among them, topical antibiotics (69.1%) were the most prescribed. This is because the most antimicrobial therapy prescribed for burn patients is administered topically (69). They were exclusively used for prophylaxis. Cephalosporin antibiotics (64.7%) were the second most prescribed class of antibiotics. They are majorly prescribed for prophylaxis immediately before, during or after surgical intervention but they are also prescribed for empiric therapy. Penicillins (30.9%) were prescribed majorly for treatment and sometimes for prophylaxis. The carbapenems (10.3%), fluoroquinolones (5.9%) and lincosamides (5.9%) were prescribed for empiric therapy.

There were a total of 17 specific antibiotics prescribed. The study found that the most common indication for antibiotic use among burn patients was prophylaxis (67.6%) while 32.4% was for treatment. Silver sulfadiazine was the single most prescribed (69.1%) agent. It is the most widely used topical antimicrobial agent in burns (69). It has a broad spectrum of antimicrobial activity including gram negative, gram positive and some yeast forms (70). Other specific antibiotics used were cefuroxime (41.2%) and ceftriaxone (38.2%) which were used majorly for perioperative prophylaxis and a few times for treatment. Amoxicillin clavulanic acid (25.2%) was used majorly for treatment. Cefazoline was 100% used for prophylaxis just before surgery. Meropenem and amikacin were used to treat suspected infection with *Pseudomonas aeruginosa* which is a common nosocomial pathogen among burn patients world-wide along with *Staphylococci aureus* and *Acinetobacter baumanii* (71). Tetracycline eye ointment was used for prophylaxis against eye infections in patients who sustained burns around the eye. Metronidazole was used for treating gastroenteritis in burns.

There was a significant relationship ($p=0.037$) between patient's age and the use of fluoroquinolone antibiotics. Ciprofloxacin was used among adult burn patients to treat

suspected bacterial infections. This is because of safety concerns when used in children. It has adverse musculoskeletal effects like tendinitis when used among children (72).

There was significant association between the degree of burn and antibiotic classes used. Lincosamide antibiotic clindamycin was used to treat suspected infections among patients who sustained superficial 2nd degree burns (p=0.012). Aminoglycoside, carbapenem, quinolone and cephalosporin classes of antibiotics were used majorly in patients with deep 3rd degree burns (all with p<0.05). Aminoglycoside (amikacin) and carbapenem (meropenem) were used to treat *Pseudomonas aeruginosa* infection in 3rd degree burn patients. Cephalosporin antibiotics were used for perioperative prophylaxis in 3rd degree patients. Penicillins had a significant association with 4th degree burns (p=0.09). Amoxicillin clavulanic acid was used to treat suspected sepsis in among the patients with 4th degree burns.

5.1.3 Rational use of antibiotics

It has been documented that up to two thirds of antibiotic use in Africa is irrational. This can lead to the development of antibiotic resistance(57). In this study, the choice of antibiotic, appropriate dose, duration, frequency and route of administration were used as the indicators for rational prescribing. If any of the above criteria was not met when prescribing an antibiotic, then that is considered irrational prescribing. In this study, there was rational use in 59.9% (n=37) of the burn patients. This is comparable to a study done in the Netherlands where 62.6% (n=587) of inpatients were on the correct antimicrobial therapy (AMT), while 32.4% (n=351) were on incorrect AMT (73). There are no local studies thus the above comparison.

Most of the antibiotics prescribed were the appropriate choices (93.5%). Due to incomplete records, either, the route of administration, the frequency, the duration or the dose was not indicated on the treatment sheet or they were incorrect when compared to the local (KNH) antibiotic use guidelines or available international guidelines. This led to the lowering of the rational use (59.9%) since as all the five indicators had to be correct for rationality to occur (61).

5.2 Conclusion

Open fire and scalds were the major causes of burns at KNH. Scalds were prominent among children especially those under five. Majority of the burns were accidental with a few assault and suicidal cases. Children formed a majority of the burn patients. Most of the patients sustained 2nd degree burns with a sizeable number sustaining 3rd degree burns. The % TBSA ranged from 3% to 65% with a mean of 21.4%. There were more male burn patients than female burn patients.

The prevalence of antibiotic consumption was high due to the frequent use of topical antimicrobials particularly silver sulfadiazine in majority of the patients for prophylaxis. Topical antibiotics were the most used class of antibiotics. Cephalosporins and penicillins were also frequently prescribed among the burn patients. Cefuroxime and ceftriaxone were the most prescribed cephalosporins while amoxicillin clavulinate was the most prescribed penicillin.

Rational prescribing was documented in approximately 60% of all the antibiotics prescribed. Incomplete records where the dose, duration, frequency or route of administration was missing contributed to irrationality.

5.3 Recommendations

There is need to lower the prevalence of antibiotic prescribing among burn patients because recent guidelines do not advocate their use due to lack of evidence to prove that they are efficacious and they can induce resistance. Controversy is still there over the use of antibiotics for prophylaxis in severe burns. Patients with signs of sepsis or confirmed infections should be treated with antibiotics. There are no local guidelines on the use of antibiotics in burns. Therefore, there is need to develop a local burn antibiogram to address this. This can be initiated and coordinated by a hospital antimicrobial stewardship committee. The hospital should promote continuous surveillance and dissemination of findings to prescribers on antibiotic susceptibility and resistance profiles in the burns unit in order to guide selection of antibiotics for use among burn patients.

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APPENDICES

Appendix I: Consent form

Study Title

POINT PREVALENCE SURVEY OF ANTIBIOTIC USE AMONG BURN PATIENTS AT KENYATTA NATIONAL HOSPITAL

INSTITUTION	Department of Pharmaceutics and Pharmacy Practice, School of Pharmacy, University of Nairobi. P.O Box 30197-00400, Nairobi.
PRINCIPAL INVESTIGATOR	Dr. Chepkonga Benjamin Chemitei P.O Box 17563-20100, Nakuru, Kenya. Phone number: 0722491483 Email: *mitei930@gmail.com*
SUPERVISORS	Dr. Eric M. Guantai Phone No. 0722955883 Email: eguantai@uonbi.ac.ke Dr. Sylvia A. Opanga Phone No. 0721296448 Email: Sylvia.adisa@gmail.com
ETHICAL APPROVAL	Kenyatta National Hospital/University of Nairobi Ethical and Research Committee P.O Box 20723-00100, Nairobi. Tel. 2726300/2716450 Ext 44102 Email: *uonknh_erc@uonbi.ac.ke*.

I am Dr. Chepkonga Benjamin Chemitei conducting the above study to partly fulfill the requirements for a Master's degree in Clinical Pharmacy of the University of Nairobi.

Study Background

Burns are a global public health problem ranked fourth of all injuries by the WHO. Infection is common in burns because the injury causes the skin to lose the natural barrier to microbes. Infection remains the leading cause of death in people with a burn wound and can independently cause death. Antibiotics are medications that kill bacteria or stop their growth. Its introduction in the management of burns has played much role in the decrease of mortality and morbidity associated with burns.

KNH has developed antimicrobial use guidelines for the medical and surgical wards but there are no guidelines for antibiotic use among burn patients and therefore the study seeks to gather data that will inform guideline development for this section. The study will aim to describe the current prevalence and characteristics of antibiotic use among burn patients to provide benchmarking data and identify targets for improvement

Broad objective

The overall objective of this study is to assess the antibiotic prescribing patterns among burn patients at Kenyatta National Hospital

Benefits of the study

This study will provide baseline data on the use of antibiotics among burn patients at KNH and can be used as a guideline for optimization of antibiotic use. It will also identify gaps for quality improvement in the prescribing and use of antibiotics leading to development of various interventional programs to promote rational antibiotic use among burn patients. This will help in better management of the burn patients.

Inherent risks

There are no foreseen risks associated with this study since it is non-interventional. All information obtained from patient records will be treated in confidence to prevent the risk of exposing patient identity.

Declaration of Confidentiality

I, the undersigned, will preserve and protect confidential patient information: Any individually identifiable information in possession or derived from a provider of health care regarding patient's medical history, mental or physical condition, treatment as well as test results and research records.

Investigator:

Name……. Signature……

Date……

Protection of Patient Identity

All data collected from the patients' files will be coded and entered into a password protected computer without access to the public in order to protect patient identity. Only the research investigator will have access to the personal information. At the end of the study, there will be no way to link patient name with the collected data. Any published work arising from the study will not bear patient name or any other direct identifier.

STATEMENT OF CONSENT

I confirm that I have read and understood the information given above for the study. I have had the opportunity to consider the information, asked questions and have had these answered satisfactorily. I have therefore given permission to the Principal Investigator to access the patient records for the purposes of conducting this research.

Nurse/Records Manager:

Name……Signature……Date……

Investigator:

Name……Signature……Date……

Appendix II: Global Point Prevalence Survey (2018 GLOBAL-PPS)

Modified Ward Form

Date of survey dd/mm/year	
Person completing form	
Hospital name	
Ward name (tick appropriately)	Ward 4D
	Burns unit
Total number of patients admitted on the ward present at 8:00 am on day of PPS	

Include only patients admitted before 08:00 hours on the day of the PPS

Appendix III: Modified Global Point Prevalence Survey Patient Form

Ward name	**Patient identifier**[1]	**Survey number**	**Patient age**[2]	**Weight (kg)**	**Gender M/F**
Burns unit[ ] Ward 4D [ ]					

Antimicrobial name[3]		**1**		**2**		**3**		**4**		**5**	
Single unit dose[4]	**Unit** (g, mg or IU)[5]										
Doses/day[6]	**Route** (P, U, R,I)[7]										
Diagnosis											
Type of indication											
Reason in notes (yes or no)[8]											
Guideline compliance (Y, N, NA, NI)[9]											
Is a stop/review date documented? (yes/no)											
Treatment (E: empirical, T: targeted, P: prophylaxis)											

Additional Comments:

1. Category of burn_____
2. % TBSA_____

[1] Patient Identifier: A unique patient identifier that allows linkage to patient records at local level for more detailed audit. This unique identifier will not be included in the online database.

[2] Patient Age: If the patient is 2 years old or older, specify only the number of years, if between 1 and 23 months specify only the number of months, if less than 1 month specify the number of days.

[3] Antimicrobial Name: Insert generic name.

[4] Single Unit Dose: Numeric value for dose per administration (in grams, milligrams or IU).

[5] Unit: The unit for the dose (g, mg or IU)

[6] Doses/day: If necessary provide fractions of doses: (e.g., every 16h = 1.5 doses per day, every 36h = 0.67 doses per day, every 48h = 0.5 doses per day)

[7] Route: Routes of administration are: Parenteral (P), Oral (O), Rectal (R), Inhalation (I).

[8] Reason in Notes**:** A diagnosis / indication for treatment is recorded in the patient's documentation (treatment chart, notes, etc.) at the start of antibiotic treatment (Yes or No)

[9] Guideline Compliance: Refers to antibiotic choice (not route, dose, duration etc) in compliance with local guidelines (Y: Yes; N: No; NA: Not assessable because no local guidelines for the specific indication; NI: no information because indication is unknown)

Appendix IV: Causes of burns

	Open fire	Scalds	Electricity	Chemical	Others
Gender					
Male					
Female					
Nature of burn					
Accidental					
Assault					
suicidal					
Age of patient					
≤12					
13-18					
>18					

Appendix V: Ethical Approval

KENYATTA NATIONAL HOSPITAL APPROVED 17 SEP 2018 KNH/UoN-ERC

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
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KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/338

17th September 2018

Benjamin Chemitei Chepkonga
Reg. No.U56/87326/2016
Dept. of Pharmaceutics and Pharmacy Practice
School of Pharmacy
College of Health Sciences
University of Nairobi

Dear Benjamin

RESEARCH PROPOSAL – POINT PREVALENCE SURVEY OF ANTIBIOTIC USE AMONG BURN PATIENTS AT KENYATTA NATIONAL HOSPITAL (P474/7/2018)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH- UoN ERC) has reviewed and approved your above research proposal. The approval period is 17th September 2018 – 16th September 2019.

This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH-UoN ERC before implementation.
c) Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
f) Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

Protect to discover

For more details consult the KNH- UoN ERC website **http://www.erc.uonbi.ac.ke**

Yours sincerely,

PROF. M. L. CHINDIA
SECRETARY, KNH-UoN ERC

c.c. The Principal, College of Health Sciences, UoN
The Director, CS, KNH
The Chairperson, KNH-UON ERC
The Assistant Director, Health Information, KNH
The Dean, School of Pharmacy, UoN
The Chairperson, Dept. of Pharmaceutics and Pharmacy Practice, UoN
Supervisors: Dr. Sylvia A. Opanga, Dr. Eric M. Guantai

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Appendix VI: Institutional Approval

KNH/R&P/FORM/01

KENYATTA NATIONAL HOSPITAL
P.O. Box 20723-00202 Nairobi

Tel.: 2726300/2726450/2726565
Research & Programs: Ext. 44705
Fax: 2725272
Email: knhresearch@gmail.com

Study Registration Certificate

1. Name of the Principal Investigator/Researcher
   DR CHEPKONGA BENJAMIN
2. Email address: Mitei930@gmail.com Tel No. 0722491483
3. Contact person (if different from PI).....
4. Email address: ..... Tel No. .....
5. Study Title
   POINT PREVALENCE SURVEY OF ANTIBIOTIC USE AMONG BURN PATIENTS AT KNH
6. Department where the study will be conducted Burns unit and ward 4D
   (Please attach copy of Abstract)
7. Endorsed by Research Coordinator of the KNH Department where the study will be conducted.
   Name: PRISCAH C. CHEGE Signature ..... Date 27/9/18
8. Endorsed by KNH Head of Department where study will be conducted.
   Name: DR WAWERU BENJAMIN Signature ..... Date 26/09/2018
9. KNH UoN Ethics Research Committee approved study number P474/7/2018
   (Please attach copy of ERC approval)
10. I CHEPKONGA BENJAMIN commit to submit a report of my study findings to the Department where the study will be conducted and to the Department of Research and Programs.
    Signature ..... Date 24/09/2018
11. Study Registration number (Dept/Number/Year) Burns Unit/55/2018
    (To be completed by Research and Programs Department)
12. Research and Program Stamp

KENYATTA NATIONAL HOSPITAL Research & Programs Centre P.O. Box 20723-00202 Nairobi
28 SEP 2018

All studies conducted at Kenyatta National Hospital **must** be registered with the Department of Research and Programs and investigators **must commit** to share results with the hospital.