CORRELATION OF BURN WOUND INFECTION AND MORTALITY OF BURN INJURY PATIENTS HOSPITALIZED AT KENYATTA NATIONAL HOSPITAL

Dissertation submitted as part fulfillment of the requirements for the award of Master of Medicine degree in General Surgery of the University of Nairobi.

Dr Moses Gitau Ngugi

MB ChB (UoN)

April, 2013

DECLARATION

Student's Declaration;

This research is my original work and has not been presented at any other University.

Signature ……. Date……

Dr. Moses G. Ngugi

Post-graduate student registration Number H58/70981/2009

Supervisors' declaration;

1) Signature ……. Date ……..

Dr. Joseph Kimani Wanjeri

MB ChB, MMed (Surg), IPTM (Tel Aviv)

Lecturer - Department of Surgery,

School of Medicine, University of Nairobi

Consultant - Plastic and Reconstructive Surgeon, Kenyatta National Hospital

2) Signature…….Date……..

Dr. Peter L.W Ndaguatha

MB ChB, MMed (Surg),FCS(ECSA), Fellow in urology (U.K)

Senior Lecturer - Department of Surgery

School of Medicine, University of Nairobi

Consultant Urology Surgeon - Kenyatta National Hospital

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ABBREVIATIONS

1. KNH ……. …..Kenyatta National Hospital
2. UoN ……University of Nairobi
3. TBSA ……Total Burn Surface Area
4. IPTM …….International Postgraduate Training in Medicine
5. SPSS …….Statistical Package for Social Sciences
6. IV …… Intravenous
7. ICU……Intensive Care Unit
8. KNH/UoN-ERC……Kenyatta National Hospital/ University of Nairobi- Ethics and Research Committee
9. STSG……. Split thickness skin grafting

STANDARD DEFINITIONS

1. **Research assistant**; the individual was clinically skilled to do aseptic burn wound evaluation and technically skilled to collect and transport the relevant samples to the laboratories.

2. **Electrolyte imbalance;** clinically significant derangement of sodium (Na^+) below 120mmol/l or above 160mmol/l and/ or potassium (K^+) below 3.0mmol/l or above 6.0mmol/l.

   Normal ranges are Na^+ 135-145mmol/l and K^+ 3.5- 5.0mol/l.

3. **Hypovolaemic (burns) shock;** defined by at least three of the features below which include tachypnoea >30 breaths/minute, tachycardia >100beats/minute, restlessness or stupor, mean arterial pressure < 60mmHg, hemoconcentration with packed cell volume > 30.

4. **Anemia;** hemoglobin level below 10gm/dl.

5. **Renal failure;** defined by serum Creatinine levels three times of the normal upper limit and urea level above 20mmol/l.

   Normal ranges are Creatinine 53-133mcmol/l and urea 2.9- 8.9mmol/l.

6. **Pneumonia;** defined by at least three of the features listed below which include tachypnoea > 30 breaths/minute, tachycardia > 100beats/ minute, fever > 38^0C or hypothermia < 36^0 C, intercostal and/or subcostal recession, white blood cell count above 10 * 10^9/l or below 4 * 10^9/l, chest x- ray showing consolidation or bronchopneumonic process.

7. **Multi-system organ failure**; - dysfunction of more than one organ system despite organ system support at the ICU. Respiratory failure; = requirement of mechanical ventilation > 72 hours. Cardiovascular failure; = ionotropic dependency to keep mean arterial pressure > 60mmHg. Renal failure; = continuous haemodialysis. Hepatic failure; = transaminase level > 15 times the normal. Hematological failure; = platelets < 100 000/µl.

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ABSTRACT

Background

Burn injuries are a common reason for admission at Kenyatta National Hospital (KNH) surgical wards, ranking 3rd behind road traffic accidents and head injuries in that order. Over the past two decades, burn wound infection and mortality associated with burn injury has declined tremendously worldwide. Burn wound infection is however still a common complication of burns and contributes significantly to the mortality of burn injury patients.

Objectives

The aim of this study was to determine the correlation of wound infection morbidity and mortality associated with burn injury at Kenyatta National Hospital (KNH).

Methodology

This was a prospective longitudinal analytic study involving burn injury patients admitted at KNH between 20th November 2012 and 17th February 2013. Presence or absence of infection was determined clinically as well as by microscopy, culture and sensitivity of swabs taken from the burn wounds. Other investigations such as blood cultures, tissue histology and x-rays were done where indicated.

Acute complications, including mortality, associated with burn injuries and the respective severity were documented.

Statistical Package for Social Sciences software version 20 was used for data analysis.
A confidence interval of 95%, Spearman's rho and Pearson's correlation coefficient were used in the analysis.

Results

Out of 93 burn patients admitted at KNH most got injured while at their homes either by hot water (45%) or dry flames (30%) from burning houses. This affected mostly children and young adults (75.2%). Children under 10 years of age made up about 27%.

All 56 patients who suffered from fluid and electrolyte imbalance had appropriate fluid and electrolyte replacement (100%) and therefore none of them suffered from any acute renal failure. Twenty nine patients (31%) had inhalational injuries with16 of them being intubated with endotracheal tube (ETT). Three patients had pneumonia which was appropriately treated. The incidence of pneumonia among patients intubated with ETT was 13% (2/16).

Among those patients who needed early surgical intervention (39) of escharectomy and skin grafting (within 14 days post-burn), only 2 (5.1%) had it done.

The overall rate of burn wound infection at KNH was 23.6% (22/93 cases) and the overall mortality rate among burn injury patients was 14% (10/93 cases).

From Spearman's and Pearson's correlation coefficient calculated, there was a 0.677 correlation coefficient of burn wound infection and mortality in burn injuries patients admitted at KNH.

This implied that if the infection rate in burn wound was high, then the mortality rate would be high as well.

Conclusion

The protocol of management in fluid and electrolyte replacement was well practiced; thus there was no patient who got acute renal failure. Those patients who were intubated with ETT were appropriately managed to prevent pneumonia associated with ETT and burn injury to airway.

The rate of burn wound infection in this study was higher than that of the previous retrospective study of 1995. The overall mortality rate had not changed over the last 40 years.

The results of this study showed that there was a strong relationship between burn wound infection and mortality associated with burn injuries in patients admitted a KNH.

1. INTRODUCTION

1.1 Background

1.1.1 Definition and causes of Burn Injuries

Burn wound results from tissue necrosis caused by application of or exposure to heat (thermal), cold, caustic chemicals or frictional force on the skin. In the case of thermal burns, extent of injury is proportional to the temperature applied, duration of contact and thickness of the skin. Causes of burns include hot liquids (scald burns), flames, explosions involving flammable gases or liquids (flash burns), electricity, radiation and hot surfaces/objects (contact). [1, 2, 3]

1.1.2 Pathophysiologic Response to Burn Injury

Burn injuries provoke an inflammatory response which results in increased cellular, endothelial and epithelial permeability, hypermetabolism and extensive microthrombosis. Most manifestations of this response disappear in 72 hours except for hypermetabolism which remains until wound coverage is achieved. [4, 5]

Associated clinical states include fluid and electrolyte imbalance leading to burn shock, nutritional deficiencies with muscle catabolism, immunologic and neuroendocrine response (elevated growth hormone levels, low levels of total T_3 and T_4). There is hypercortisolemia and elevated levels of glucagon. [6]

1.1.3 Evolution of burn care

Burn wound management has evolved substantially with ancient Egyptians using honey and resin salve as depicted in caves. [7] In his review paper of 1939, Adam F indicated that Hippocrates applied warm mixtures and avoided wound suppuration by simple cleanliness. Wounds were irrigated with clean water and an attempt was made to keep them dry. [3]

Fabricius Hildamus (1560-1613) wrote the first book devoted to burns and insisted that classification of burns should be a guide for treatment. In deep burns he made incisions to let the moisture escape = ‘escharotomy’. [8]

Dupuytren (1777 -1835) was the first to describe ulceration of the gastrointestinal tract in 1832 but it was in 1842 that Curling published his famous paper which resulted in eponym “Curling’s ulcers” which is now firmly established in medical literature.[3]

Skin grafting (auto graft) was first introduced by Pollock (1817 -1897). In 1848, Syme had an epidemic in his ward and he isolated burn patients thus forming the first Burn Hospital. [9]

In 1924, Berkow formulated the protocol to express size as a percentage of body surface area which was a determinant of the corresponding Pathophysiologic response. The importance of fluid replacement by surgeons was learnt when treating casualties of disaster accidents such as Rialto concert Hall fire of 1930, Coconut Grove fire of 1942 and the World War II. [7]

In 1968, Janzecovic developed the idea of early excision of eschar (escharectomy) and immediate autograft grafting. [3] This resulted in shortened hospital stay and better functional outcome. [10]

Basil et al in a review paper of 1998 indicate that before the advent of topical antibiotics, burn wound sepsis was responsible for 60% of burn patients who died. With routine utilization of silver nitrate and silver sulfadiazine, this mortality reduced to 28%. [11]

1.1.4 Classification and principles of treatment of burn injury

The extent of burn injuries is calculated according to the Lund and Browder chart whereby the Total body (skin) surface area (TBSA) is 100% and inhalational burn injuries account for a further additional 10%. [1]

Burns are classified according to the depth of injury and extent as described in tables 1 and 2 below;

Table 1; classification of burn wound by depth [5]

1st degree	Epidermis with erythema. Use analgesics only.
2nd degree superficial	Painful, weeping blisters that involve epidermis and papillary dermis. Treatment includes infusion of fluids according to Parkland's formula, cleaning and occlusive dressing with collagen or bactigras.
2nd degree deep	Don't blanch and are painful only on pressure involving up to reticular dermis. This requires topical antibiotics, early excision (<14 days) and biological closure autograft and/or allograft.
3rd degree	Painless, waxy, leathery grey or charred and black involving epidermis, dermis and hypodermis. May require tissue flaps or even tissue excision.
4th degree	All layers of the skin and inner tissues i.e. muscle, bone and viscera.

Table 2; Burn injury severity using partial thickness (superficial 2nd degree) [2]

Mild burn injury	1 - 14% TBSA
Moderate burn injury	15 – 25% TBSA
Severe burn injury	Above 25% TBSA

All burn injury patients require enteral feeding nutritionally tailored to their metabolic needs. [12] Suspected and proven inhalation injuries are treated by endotracheal intubation and mechanical ventilation. [5, 13]

At a burn center in Texas U.S.A, Basil A et al prescribe prophylactic antibiotics to those patients on artificial ventilation, repeated change of central line, confirmed bacteraemia and TBSA> 30%. [11] Patients with TBSA > 15% require gastric mucosal protection with proton-pump inhibitors. [14]

1.1.5 Complications of burn injuries

Acute complications include; -

(1) Fluid and electrolyte imbalance leading to burn shock. Hypovolaemia results in acute tubular necrosis which culminates in acute renal failure. Hypokalaemia causes arrhythmias and cardiac arrest.

(2) Burn wound infection.

(3) Gastric and duodenal ulceration (Curling's ulcers).

(4) Anemia from bleeding wound and thrombosis within the injured vessels. [15, 16]

Long term complications include; -

(1) Hypertrophic scars.

(2) Keloids.

(3) Chronic (Marjolin's) ulcer (squamous cell carcinoma).

(4) Heterotrophic ossification of joints which are painful and stiff. [17, 18]

1.2 Problem statement

Burn wound infection is known to be one of the commonest complications that increase morbidity and mortality in burn patients. There however are other complications of burns and it is important to either study them individually or collectively if improvement in burn care is to be achieved.

No study had been done at KNH to determine the incidence of burn wound infection in correlation with mortality associated with burn injuries.

2 LITERATURE REVIEW

2.1 Infection

2.1.1 Epidemiology

Burn wound provides a good environment for colonization and proliferation of micro-organisms. A retrospective study at Shriner Burn Hospital, Boston, concluded that chances of bloodstream infection increases as the burn wound size increases. [19]

Bloodstream infection rate in burn Intensive Care Unit (ICU) was found to be 8.8 per 1000 central-line venous catheter days as compared to 7.9 in trauma ICU, 7.9 pediatric ICU and 5.2 in surgical ICU. [20, 21]

In The U.S.A, the overall incidence of burns is more than 800 cases per 1 million per year. This is second only to motor vehicle accidents. [1]

Mozingo et al noted in the prospective study of 1997 at Philadelphia U.S.A that there was a bacteraemia rate of 12.5% in burn patients who underwent early wound cleaning and excision procedures. Occurrence of bacteraemia rose to 30% when the wound cleaning and excision procedures were delayed beyond 10 days. [10]

Basil et al, in the review paper of 1998, noted that Pseudomonas spp is the gram negative organism that most often causes invasive burn wound infection. Stage IIC is associated with risk of spread to remote tissues organs and has high mortality. [11]

A prospective study done in a Brazilian burn unit in 2006 showed burn wound infection rate of 17.6% (49/278). Common causative microorganisms were coagulase negative staphylococcus, Staph.aereus, Pseudomonas spp and Enterococcus spp. The median length of hospital stay was 25 days. [22]

At the Kenyatta National Hospital (KNH), a total of 1021 burn cases were admitted between January 1991 and December 1992. This was 3rd behind motor vehicle accidents (1275) and head injuries (1276). Infection of burn wounds was 18.7% (65 out of 347 cases). It also showed that Staph.aereus, Pseudomonas spp, Strept.pyogenes, and E.coli were the common microorganisms causing burn wound infection respectively. [3]

Current techniques of burn wound care have significantly reduced the incidence of invasive burn wound infection and increased burn patient survival. It has also altered the organisms causing infection that do occur, increase the interval between injury and onset of infection and reduced mortality. [4, 6, 11]

2.1.2 Risk Factors for Burn Wound Infection

The risk factors of burn wound infection are divided into patient and microbial.

Patient factors include age, extent of the burn, inhalational injuries, acidosis, premorbid conditions and secondary impairment of blood-flow. Septicemia is also determined by generalized immunosuppressive state involving both humoral and cellular immunity. [23]

Microbial factors include virulence, number of organisms, extracellular products such as proteases, collagenases, hyarulonidases, exotoxins and antimicrobial resistance. [7, 24]

Presence of inhalational injuries predisposes patients to pneumonia. [25, 26]

2.1.3 Clinical Manifestation and Diagnosis of Burn Wound Infection

All burn wounds are colonized within 72 hour after the injury by patient's own flora or any endemic organisms from the treatment facility.[1, 27] The flora immediately after burn is predominantly gram positive but one week post-burn, gram negative organisms are the predominant inhabitants. Staphylococcus aureus is the most common early wound colonizer which penetrates the eschar and invades the underlying tissues forming many small abscesses. Pseudomonas spp have toxins (endotoxins and exotoxins), proteolytic enzymes, extracellular polysaccharides and microbial motility imparted by flagellum. [22]

Burn wound infection is diagnosed using combination of clinical, bacteriological and histological findings. Infected wounds have purulent material and easy separation of eschar from viable tissue. Features of sepsis in burn patients include; hypothermia, thrombocytopenia (less than 100,000/mm^3) and a sudden feeding intolerance. Specimen of pus, blood, urine and/or tissue biopsy are taken for bacterial cultures. [1, 11]

Burn injuries cause a physiologic response similar to the physiologic response to sepsis. Invasive devices such as endotracheal tubes, IV and urinary catheters are of particular concern since they bypass the body's normal defense mechanism. Micro-organisms migrate to the bloodstream along the catheters from the site of insertion and colonize catheter tip. [20]

2.1.4 Classification of Infected Burn Wounds

Various histological signs of invasive infection include presence of microorganisms in viable tissue, small vessel thrombosis with ischemic necrosis, inflammation of unburned tissue after 72 hours post-burn, dense growth in the sub-eschar space and intracellular viral inclusions.

Table 3; histological stages [6, 28]

1A	Superficial; microorganisms present only on the wound surface.
1B	Penetrating; microorganisms deep into the eschar.
1C	Proliferation; microorganisms at the sub-eschar space.
IIA	Micro-invasion; microorganism on the viable tissue subjacent to the sub-eschar space.
IIB	Deep invasion; microorganisms at various depths within viable subcutaneous tissue.
IIC	Micro-vascular involvement; microorganisms within small blood vessels and lymphatic (thrombosis of vessels).

Pneumonia in inhalational injuries develops in about 25% of patients intubated with endotracheal tubes. Smoke inhalation causes reactive airway dysfunction syndrome with bronchiolitis obliterans, chronic bronchitis, and bronchiectasis. Diagnosis of pneumonia is made by clinical findings, radiological and/or culture of bronchoscopy washout.

Management includes consistent infection control practice e.g. suction and broad spectrum antibiotics. [29, 30]

2.2 Mortality

In 1975, mortality in the U.S.A for TBSA of 50% was 50% while in the year 2000; the mortality had declined to 10 %.[1]

In India, Sharma, in his review paper of 2006, reported that burn injuries are ranked 15th in order of causes of death. [7]

Vindenes et al, in their review paper of 1995 reported 75% of all deaths following burns are related to infection. [29]

In the Netherlands, a prospective study done in 2008 of 1946 cases had overall mortality of 6.9%. Multiorgan failure accounted for 64.9% of which 45.9% was due to infection. [4]

The Brazil study of 2006 showed an overall mortality of 5.0% (14/278). [22]

A retrospective study done at the KNH covering the year 1976 by Wokabi showed an overall mortality of 14.7% from burn injuries. [31]

In the western world, the overall mortality following burn has decreased to 5 - 6%. This is attributed to established specialized burn centers, improved critical care techniques, vigorous fluid resuscitation and appropriate nutritional management [4, 32, 33 and 34]

2.3 Research question

Is there a relationship between burn wound infection and mortality associated with burn injuries in patients admitted at Kenyatta National Hospital?

2.4 Study justification

The last two decades have seen advances in the sphere of medical care of burn patients. These include early excision of eschar and skin grafting or flaps in deep burns and occlusive dressing of superficial burns with collagen or bactigras. Specialized burn centers have been established with advanced therapeutic, critical care and anesthetic interventions. This has resulted in reduction in morbidity and mortality of burns patients especially in the developed world e.g. in The Netherlands, the mortality rate was 6.9% in 2008. [4]

Burn injuries are commoner and more severe in the developing world and their care is still less than optimal with many becoming maimed or succumbing to their injuries. [17]

In view of the advances made, this study aimed at establishing the current rates of burn wound infection and mortality at KNH. It also identified common microorganisms responsible for burn wound infection at KNH and the infection was correlated with mortality of burn injury patients.

Identifying the role played by infection in the morbidity and mortality of these patients is useful in planning for improved care in burns unit.

3:1 PURPOSES AND OBJECTIVE OF THE STUDY

3.1.1 Main Objective

Correlate burn wound infection and the mortality in burn injury patients hospitalized at KNH.

3.1.2 Specific Objectives

1. Determine the demographic characteristics of patients admitted at KNH with burn injuries.
2. Determine the frequency of wound infection and bacteriological etiology in burn injury patients.
3. Assess the complications and mortality rate associated with burn injury in patients admitted at KNH.

3.2: METHODOLOGY

3.2.1 Study Design

This was a prospective analytic study running for a period of three months from 20th November 2012 to 17th February 2013.

3.2.2 Location of Study

The study was carried out in ward 4D, Burns Unit and the ICU of Kenyatta National Hospital, which is the national referral centre in Kenya and a few neighboring countries.

3.2.3 Study Population

Burn patients admitted at KNH during the study period, met the inclusion criteria and gave consent, were recruited over the period of 4 months.

3.2.4 Sample size determination

The study used cluster type of non-randomized sampling method.

Wanjeri J.K did a retrospective study of burn wound infection at KNH (1991 -1992) and found infection prevalence of 18.7%. [3]

A retrospective study done at KNH (January- December 1974) showed an overall mortality of 14.7% among burn injury patients. [31]

Sample size (n) = $\frac{z^2 \times p\,(1-p)}{D^2}$

P = mortality among burn injury patients =0.147

z = standard error from the mean with 95% confidence interval =1.96

D = margin of error (absolute precision of 5%) = 0.05

N = $\frac{1.96^2 \times 0.143 \times 0.857}{0.05^2}$ = 92 patients.

At completion of the study, the sample size was 93 patients.

3.2.5 Sampling

Non-random purposive sampling was utilized whereby patients who met the inclusion criteria were recruited until the sample was realized.

3.2.6 Study instrument

Participants recruited into the study gave and signed an informed consent administered by the principal investigator. The critically ill and minors had the informed consent given and signed by the guardian and/or their next of kin.

Each participant was informed that participation was voluntary and they could withdraw from the study at any point without interruption of services from the hospital.

Each case was evaluated by the principal investigator and the clinical progress notes entered into a structured questionnaire.

Demographic data; age, sex, residence, time, place, extent (TBSA) and depth of burn was documented.

Surgical and resuscitative interventions were documented; Cleaning and occlusive dressing, fluid and electrolyte replacement, escharotomy, endotracheal intubation (ETT), escharectomy and skin grafting, blood transfusion, renal dialysis.

All burn wounds had swabs taken for microscopy, culture and sensitivity by the chief investigator or his research assistant on day 3, 14 and 21 post-burn. Those with signs of deep invasive infection had additional blood samples taken for culture and sensitivity.

All acute complications were documented; fluid and electrolyte imbalance, hypovolaemic shock, infection, renal failure, pneumonia and anemia. The respective outcome was documented; recovery, persistent complication/awaiting STSG or mortality.

A total of 93 patients were recruited. None of the data collection sheets was returned without being filled.

The data collected was anonymous and confidential. Filled questionnaires were solely utilized for this study. Data analysis was done using Statistical Package for Social Sciences (SPSS) version 20.

3.2.7 Data collection techniques

At direct patient contact, a protective gown and disposable gloves were used. Hands were washed with conventional soap and disinfected with 70% ethanol.
TBSA was determined using Lund and Browder chart. Depth of the injury was determined by clinical appearance and presence or absence of pain.

Presence or absence of infection was determined clinically by inspection and pus swabs taken from the wounds on 3rd, 14th and 21st day after the injury. This study period for each patient was arrived at in reference to the prospective study of 2006 in a Brazil burn unit by Jefferson LSM and Joao BS which showed median hospital stay of 25 days. [22]

All laboratory investigations were carried out at the KNH microbiology laboratories. The swabs were dipped in Stuart's transport medium, and then plated on blood agar, chocolate agar, MacConkay and Sabaraund's dextrose agar media. After incubation for 18-48 hours at 37^{0}c, the isolates were identified using conventional protocols.

Death occurred upon certification and documentation by the respective clinician working in the unit. Clinical progress notes and diagnosis made before death were used to determine the cause of death.

3.3.1 Inclusion criteria

All burn patients admitted with burn injuries at the KNH within the study period of 3 months.

3.3.2 Exclusion criteria

Any burn patient with co morbidity that is known to directly influence burn wound healing i.e. Diabetes mellitus, malnutrition or connective tissue disorders or one who declined to give consent.

Co-morbidities were identified using past medical history and clinical examination including body weight and random blood sugars.

3.3.3 Study limitations and biases

Adult patients having partial thickness burns (TBSA) less than 15% or children having TBSA less than 10% were not admitted into the burn wards. Patients with full thickness burns TBSA less than 5% were treated as outpatients. There was therefore an element of bias because only hospitalized burn patients were recruited into the study.

Assessment for presence or absence of infection on day 3, 14 and 21 was a source of bias since infection which occurred at any other time and treated could have been missed.

Any one of the acute complication that occurred after the three week period could have been missed.

Fungal cultures were not carried out due to lack of the appropriate culture medium. Thus any fungal infection on the wounds and/or systemic was missed.

3.4 Ethical considerations

Approval to conduct the study was obtained from the Kenyatta National Hospital/University of Nairobi Ethics and Research Committee (KNH/UoN-ERC) on 30th May 2012. (Appendix 6.6)

4: RESULTS

4.1. Demographic data

4.1.1 Sex

Table 3; gender

GENDER		
	Frequency	Percentage proportion
MALE	53	57
FEMALE	40	43
Total	93	100

Table 3 shows the number of males and females who suffered from burn wounds. Of the 93 patients, 53 were males and 40 were females
Ratio of male: female is approximately 5:4

From the above presentation, more males suffer burn wounds as compared to females.

4.1.2 Age

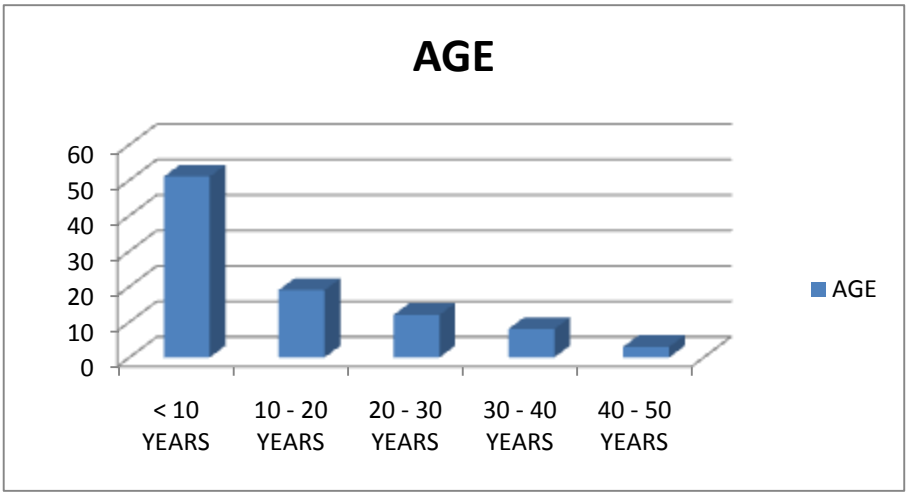
Table 4; ages

AGE	
N	93
Mean	13
Median	7

Table 5; age distribution

AGE		
Range	Frequency of burn injuries	Percentage proportion of burn injuries
< 10 YEARS	51	54.8%
10 - 20 YEARS	19	20.4%
20 - 30 YEARS	12	12.9%
30 - 40 YEARS	8	8.6%
40 - 50 YEARS	3	3.2%
Total	93	100%

Figure 1; age distribution



From table 4 above, N is the number of respondents. Out of the 93 patients that were admitted and treated in Kenyatta national hospital as a result of burn wounds, their mean age was 13 years and median age was 7 years.

Most of the victims of burns are children. There was no patient above 50 years of age admitted with burn injuries during the study period.

Table 5 presents the number of patients for every age category and their percentages. The information has been presented in figure 1 above.

Weight was used to determine and calculate dosages of medications given during intervention at the hospital.

4.1.3 Residence

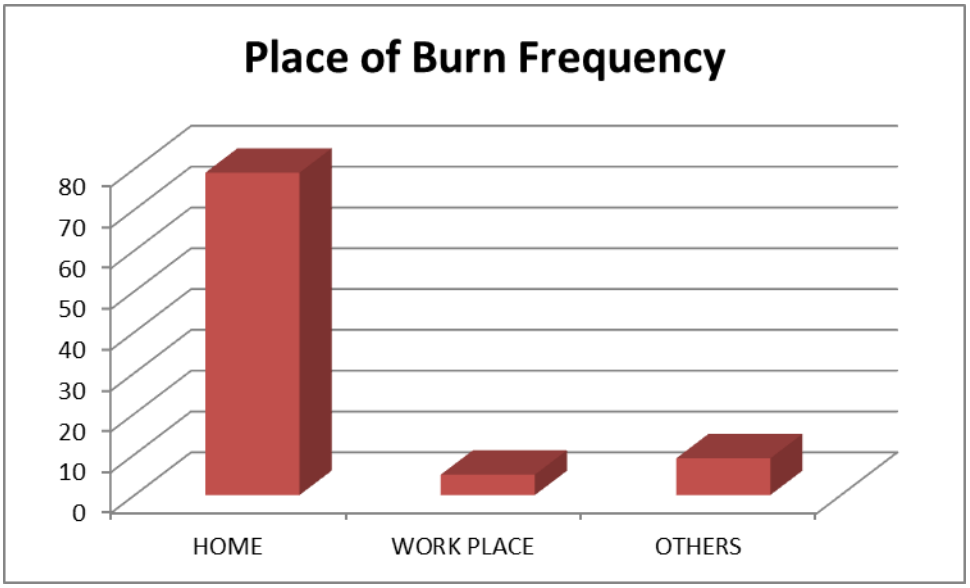
Table 6; residence

RESIDENCE		
	Frequency of burn injury patients	Percentage proportion of burn injury patients
WITHIN NAIROBI COUNTY	61	65.6%
OUTSIDE NAIROBI COUNTY (REFERRALS)	30	32.3%
RESIDENCE NOT CAPTURED AT ADMISSION	2	2.2%
Total	93	100%

Of the total patients that were admitted at The Kenyatta National Hospital during the study period, 61 of them were from within Nairobi County. Thirty patients came in as referrals from outside Nairobi County. The residence of two patients was not captured during the study.

4.1.4 Place of Burn

Figure 2; place of burn



The histogram above presents the place where burns occurred. Seventy nine patients sustained burns at home, 4 patients at their work place and 10 patients at various places other than home or workplace.

Burns occurred at home more than any other place.

4.2 Nature of burn injury

4.2.1 Cause of Burn

Table 7; cause of burn

CAUSE OF BURNS		
	Frequency of burn injuries	Percentage proportion of burn injuries
DRY FLAMES	28	30.1%
HOT WATER	42	45.2%
FLASH BURNS	11	11.8%
FRICTIONAL BURNS	1	1.1%
ELECTRICAL BURNS	8	8.6%
OTHERS	3	3.2%
Total	93	100%

Table 7 shows causes of burns. Dry flames burnt 28 patients and this gives a percentage of 30.1 percent. Hot water burnt 42 patients giving a percentage of 45.2 percent. Patients who were burnt through flash burns were 11 patients with a proportion of 11.8 percent. Frictional burns caused burns on 1 patient with a 1.1 percent proportion on the total respondents. Electrical burns were on 8 patients with a proportion of 8.6 percent. Other causes of burns that the researcher did not categories were on 3 patients and this had a proportion of 3.2 percent

4.2.2 Total Burn Surface Area

Table 8; burn surface area

TOTAL BURN SURFACE AREA (TBSA)		
	Frequency of burn injuries	Percentage proportion of burn injuries (%)
< 10%	25	26.9
15 - 25 %	38	40.9
26 - 50 %	19	20.4
51 - 70 %	7	7.5
> 70 %	2	2.2
Total	91	97.8
Surface Area not indicated	2	2.2
Total	93	100

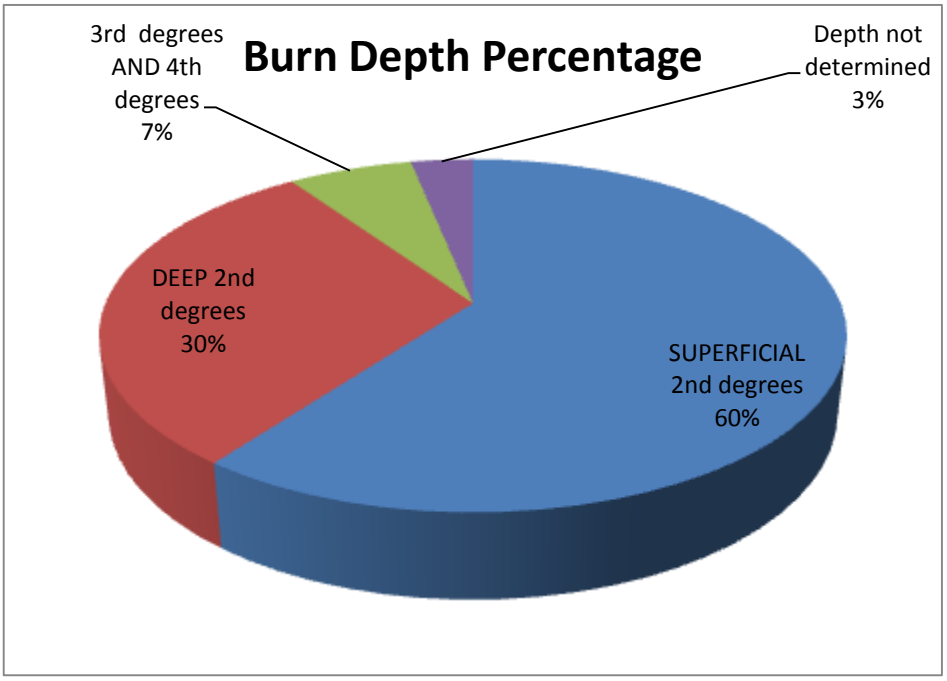
During the study, the researcher placed total burn surface area (TBSA) into five categories according to severity. Those whose total burn surface area was less than 10% were 25 patients, 15% - 25% were 38 patients, 26% - 50% were 19 patients, 51% - 70% were 7 patients and more than 70% were 2 patients. Two patients had their total burn surface area not specified.

4.2.3 Depth of burn

Table 9; burn depth

BURN DEPTH	Frequency of burn injuries
SUPERFICIAL 2nd degrees	56
DEEP 2nd degrees	28
3rd degrees and 4th degrees	6
Depth not determined	3
Total	93

Figure 3; burn depth



Patients with burn wounds were assessed and the depth of burn wounds determined.

Table 9 shows that patients with superficial 2nd degrees burns were 56 patients and deep 2nd degrees were 28 patients while 3rd degrees and 4th degrees were 6 patients making a total of 90 patients. There were 3 patients whose burn depths were not determined.

Figure 3 represented portions of burn depths in percentages. Superficial 2nd degrees were 60.22 percent, deep 2nd degrees were 30.11 percent, 3rd degrees and 4th degrees were 6.45 percent. The portion that represented those patients whose burn depth was not indicated was 3.23 percent.

4.3 Complications and Intervention after burn injuries

4.3.1 Inhalational Burns

Figure 4; inhalational burn injuries

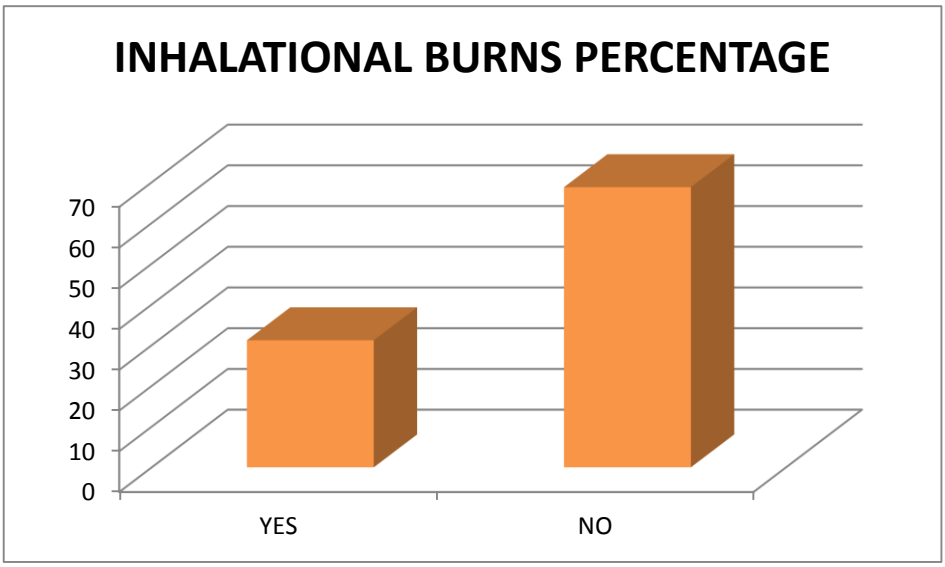


Table 10; inhalational injuries and endotracheal intubation

	Endotracheal Intubation done after the injury	No Endotracheal Intubation done after the injury
Inhalational burns	55% (16 patients)	45% (13 patients)

Of the 93 patients who were undergoing treatment in Kenyatta National Hospital during the study period, 31.18 percent (29) suffered from inhalational burns and 68.82 percent (64) did not suffer from inhalational burns.

Of the patients who suffered from inhalational burns, 55% (16 patients) of them were intubated with endotracheal tubes (ETT) and 45% (13 patients) were not intubated with ETT. These figures are presented in the table below.

4.3.2 Pneumonia in burn patients

Table 11; burn injuries and pneumonia

	With pneumonia	No pneumonia	Total	Proportion of patients with pneumonia	*P* – value
Patients inhalational injuries and intubated with ETT	2	14	16	13%	0.0624
Patients with inhalational injuries but not intubated with ETT	0	13	13	0%	0.0584
Patients without inhalational injuries	1	63	64	2%	0.0627
Total	3	90	93	3%	

Figure 5; burn injuries and pneumonia

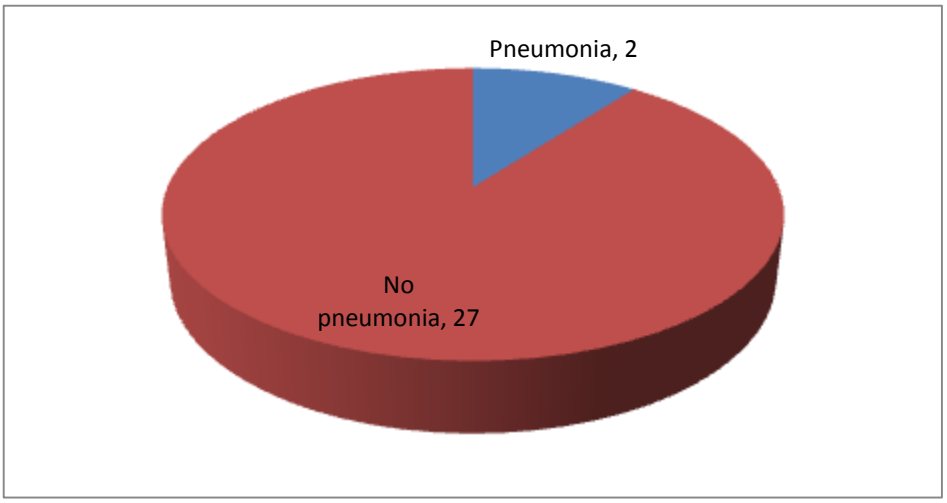


Table 11 above presents inhalational burn injury in relation to pneumonia as a complication. Inhalational injuries occurred in 29 patients out of which 2 had pneumonia (7%). All the patients (2) with inhalational injuries who went down with pneumonia were in the category of those intubated with endotracheal tube (ETT). Only one case had pneumonia among patients without inhalational injuries (2%).

Figure 5 above shows the portion of patients with inhalation burns who suffered from pneumonia. Twenty nine patients suffered from inhalational burns out of whom 2 patients had pneumonia and 27 patients did not.

Analysis was done to determine the level of statistical significance intubation with ETT had on development of pneumonia. Inhalational injuries and intubation with ETT did not reach statistical significance threshold in relation to incidence of pneumonia among patients with burn injuries (p – value 0.0624 at 95% confidence interval).

4.3.3 Patients with electrolyte Imbalance and Hypovolaemic Shock

Table 12; correction of fluids and electrolytes after burn injuries

	Correction of fluids & electrolytes done	Correction of fluids & electrolytes not done	Total	Proportion of patients done correction of fluids & electrolytes
Patients with fluids & electrolyte imbalance	42	0	42	100%
Patients with Hypovolaemic shock	14	0	14	100%
Total	56	0	56	100%

Table 12 above gives the number of patients who had fluids and electrolyte imbalance and also those with hypovalaemia shock. All the 56 patients got intervention of fluids and electrolyte correction. Fourteen patients suffered from hypovolaemic shock while 42 patients had fluids and electrolyte imbalance without shock.

All the 56 patients who required fluid resuscitation were given intravenous fluids and the electrolytes were corrected. Fourteen of them had hypovolaemic shock (25%) at commencement of fluid resuscitation and 42 (75%) were not in shock.

No patient suffered from acute renal failure during the study.

4.3.4 Escharectomy and Skin Grafting

. Table 13; escharectomy and STSG

	Done by day 14	Done between day 14 & day 21	Exited the study (day 21) waiting for the procedure	Total	Proportion of patients done procedure early (within 14 days)
Escharectomy	2	15	0	17	11.8%
Skin grafting (STSG)	0	3	19	22	0.0%
Total	2	18	19	39	5.1%

From the study done on patients who were hospitalized at Kenyatta National Hospital as a result of burn wounds, there were those who required escharectomy and skin grafting. Of these patients, some were done excision of eschar within 14 days while others exceeded this time still awaiting excision of the eschar.

By day 14 post-burn, only 2 patients out of 17 who required escharectomy had been operated on. One of these patients also required wound coverage with a regional which was done on day 13. The remaining fifteen patients had the surgery done between day 14 and day 21.

No STSG had been performed on any patient by day 14 and only three patients underwent the surgery between day 14 and 21 after burn injury. At termination of the study, there were 19 patients still awaiting STSG (21 days post-burn).

4.3.5 Infection of Burn Wounds

Figure 6; Infection Rate

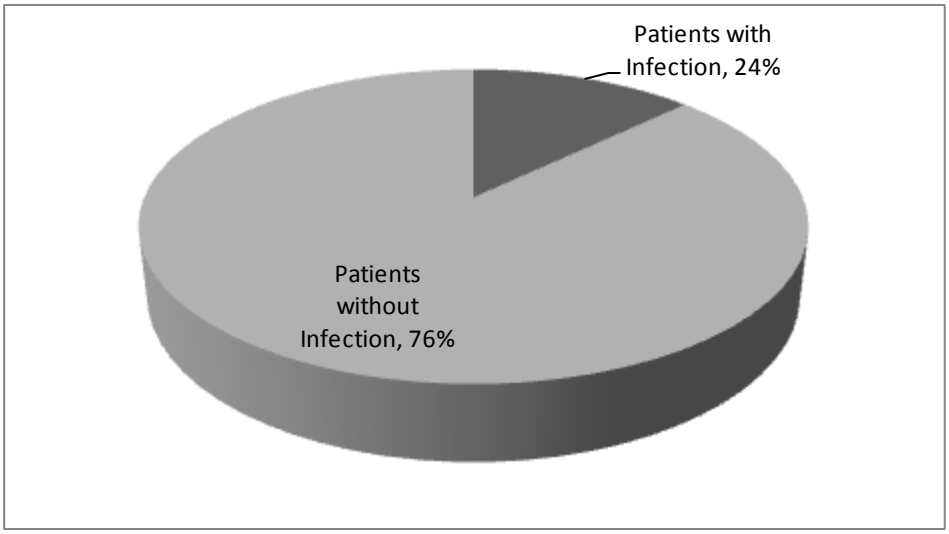


Table 14; wound infection

Burn injuries according to TBSA	INFECTED WOUNDS	WOUNDS NOT INFECTED	Total	PROPORTION OF INFECTED WOUNDS
< 10%	2	23	25	8,0%
15 - 25 %	8	30	38	21.0%
26 - 50 %	9	10	19	47.4%
51 - 70 %	3	4	7	42.9%
> 70 %	0	2	2	0.0%
TBSA NOT SPECIFIED	0	2	2	0.0%
Total	22	71	93	23.6%

Table 15; bacterial cultured from burn wounds

CULTURE GROWN FROM SWABS COLLECTED FROM BURN WOUNDS		
TYPE OF BACTERIA GROWN	NUMBER OF PATIENTS WITH GROWTHS	PROPORTION OF PATIENTS WITH BACTERIAL INFECTION OF BURN WOUND
PSEUDOMONAS	8	36.4%
STAPH. AUREUS	6	27.3%
E. COLI	3	13.6%
PROTEUS	2	9.1%
OTHERS INCLUDING MIXED GROWTHS	3	13.6%
TOTAL	22	100%

Management of burn wound was done by occlusive method with bactigras and topical antibiotics (silver sulfadiazine). Pus swab from all wounds were taken on day 3, 14 and 21 for culture and sensitivity.

Figure 6 presents the proportion of these results as percentages. 23.7 percent (22 patients) had infections and 76.3 percent (71 patients) did not suffer from any infection.

From table 14 above, 22 patients were infected. The highest infection rate of 9 patients (47.4%) was among the TBSA of 26 –50 %. Infection rate among the TBSA 51 – 70 % is second highest category with 3 patients (42.9%). There were 2 patients with TBSA more than 70% but none of them got infection.

There are two patients whose TBSA was not specified during the study period. Cultured results are presented on the table 15 above. From the 93 patients, 22 patients suffered from burn wound infection with positive growths of pus swabs cultured from the wound.

Pseudomonas had infected eight patients (36.4%), staph aureus six (27.3%), E coli three (13.6%), proteus two (9.1%) and mixed infections were in three patients (13.6%).

The overall infection rate was 23.6%.

4.3.6 Mortality

Table 16; mortality from burn injuries

MORTALITY BURN INJURY CATEGORIZED ACCORDING TO TBSA	MORTALITY CASES	ALL BURN INJURY CASES	PROPORTION OF MORTALITY (%)
< 10%	0	25	0.0%
15 - 25 %	4	38	10.5%
26 - 50 %	4	19	21.0%
51 - 70 %	4	7	57.1%
> 70 %	1	2	50%
TBSA NOT SPECIFIED	0	2	0.0%
Total	13	93	14%

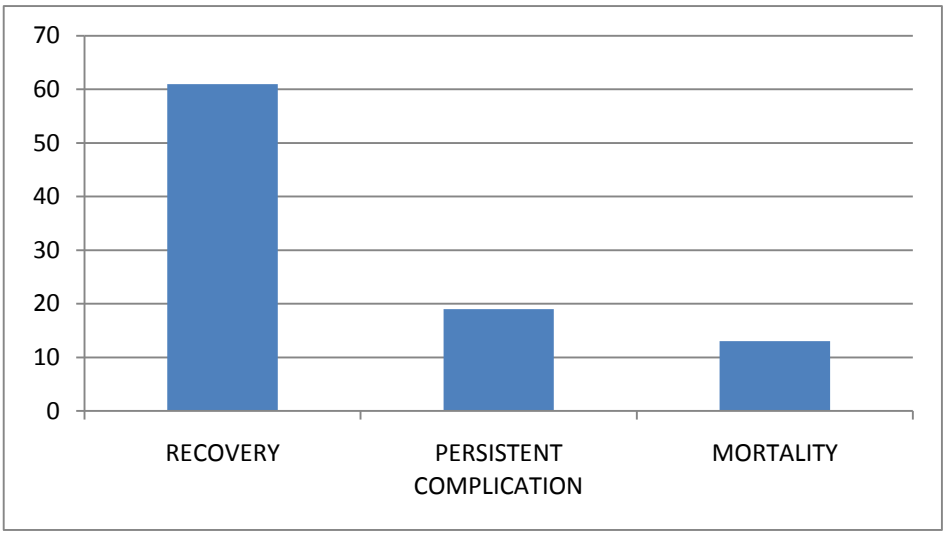
From table 16 above, 13 patients died.

The highest mortality rate was among patients with TBSA of 15 – 25 % with 4 cases out of 7 (57.1%). The second highest mortality rate is among TBSA > 70% with 1 case out of 2 (50%).

The overall mortality rate is 14%.

4.3.7 Outcome of burn wound

Figure .7; outcome after burn injuries



The outcome of the patients after the study was either recovery, persistent acute complications/awaiting surgical intervention (skin grafting) or died (mortality).

From the figure 7 above, 61 patients of burn wounds recovered from the burns, 19 patients exited the study awaiting surgical intervention (skin grafting) and the mortality number was 13 patients. Putting these figures in percentages, recovery rate was 65.6 percent (61 patients) while those with persistent acute complications or awaiting skin grafting was 20.4 percent (19 patients) and mortality with 14 percent (13 patients).

4.3.8 Correlation of Burn Wound Infection and Mortality Rate.

Table 17; correlation of burn injuries and mortality

INFECTION * MORTALITY RATE Cross tabulation				
		MORTALITY RATE		Total
		YES	NO	
INFECTION	YES	10	12	22
	NO	3	68	71
Total		13	80	93

Table 18; Pearson's and Spearman's correlation of burn injuries and mortality

Correlation		
		Value
Interval by Interval	Pearson's R	0.677
Ordinal by Ordinal	Spearman Correlation	0.677
N of Valid Cases		93

Table 17 shows the cross tabulation of infection and mortality of burn wound infection. Of the 22 patients who had infection, 10 of them died while 12 of them recovered (45.5%).

Of the 13 patients who died, 10 of them had infection (77%) while 3 died due multisystem organ failure (23%).

This is shown in the correlation of burn wound infection and mortality in table 18 above.

Pearson's and Spearman's Correlation were used.

From the Spearman's correlation coefficient and Pearson's correlation coefficient calculated above, there is a 0.677 correlation coefficient.

This implies that there is a strong relationship between infection of burn wounds and mortality. If infection rate of burn wound is high, then mortality rate will also be high. Likewise, if infection rate of burn wound is low, then the mortality rate will be low.

5: DISCUSSION

Demographic characteristics

Despite KNH being a national and regional referral centre, majority of burn injury patients admitted (65.6%) were from its environs within Nairobi County. Those with mild (TBSA< 10%) and moderate (TBSA between 15 -25%) burns constituted 68% (63/93). The referral system contributed 32% of all admissions with burn injuries, majority of who had severe burns. The referring peripheral health facilities were able to manage mild and moderate burn injuries.

More males were admitted at KNH with burn injuries than females (57% vs. 43%) giving a male to female ratio of 5:4. Children <10 years were the most affected comprising 54.8% of all burn injuries (median 7 years and mean 13 years). Hot water (45.2%) and dry flames (30.1%) were the commonest causes of burn injuries with a burden of more than75% (70/93).

Management and outcome

Patients with superficial 2nd degree burns constituted 60% (56/93), majority of who were children. They required active conservative management to prevent complications without need for surgical intervention. The current protocol of fluid and electrolyte replacement in burn injury patients was well practiced at KNH (100%).

The standard management of suspected and/or proven inhalation injuries required intubation with ETT and mechanical ventilation. [20] At KNH, 55% (16/29) of the patients with inhalational injuries were intubated with ETT whereas 45% (13/29) were not intubated. Other studies done showed that patients intubated with ETT had about 25% chances of contracting pneumonia. [5, 29] Patients intubated with ETT at the KNH had 13% (2/16) incidence of pneumonia. These results indicated that there was excellent consistent infection control practice in the Burns Unit of suction, chest physiotherapy and administration of broad spectrum antibiotics on patients intubated with ETT. Inhalational injuries were found to be clinically but not statistically significant in the incidence of pneumonia among burn patients intubated with ETT (p value 0.0624 at 95% confidence interval). A larger sample size was needed in order to achieve a threshold for statistical significance.

A study done showed a bacteraemia of 12.5% in burn patients which rose to 30% when wound cleaning and excision of eschar was delayed beyond 10 days. [10] At KNH, 2 out of 17 patients (11.5%) had excision of eschar done before day 14. The rest had the procedure done between day 14 and 21. Among the 22 patients who needed STSG, none had the procedure done before day 14. Only three cases (13.6%) had STSG between day 14 and 21. The delay in surgical intervention among burn patients at the KNH contributed significantly to burn wound infection.

In 1991, the rate of burn wound infection at KNH was 18.7% (65/347 cases).[3] A study done in a Brazilian burn unit in 2006 showed 17.6% (49/278 cases) rate of burn wound infection.[22] In this study, the overall infection rate at KNH was 23.6% (22/93 cases). The rate of burn wound infection adjusted according to extent of burns (TBSA) was highest at 47.4% (9/19 cases) among moderate burn injuries (15 – 25% of TBSA). This was a prospective study where the principal investigator was actively involved in assessment, identification and documentation of infection of burn wounds. The 1991 study at KNH was a retrospective one and therefore could have missed on cases of burn wound infection which may have been inappropriately documented in the patient's progress notes.[3]

Delay in appropriate surgical intervention was noted to be the main contributing factor to the high rate of wound infection (23.6%). Prompt surgical intervention was realized in only 5.1% (2/39) of the cases.

Pseudomonas remained the commonest micro-organism infecting burn wounds (8/22), followed by Staph Aureus (6/22). Mixed infections were third (3/22) followed by E.coli (3/22) and Proteus (2/22) in that order. The appropriate culture sensitive antibiotics were given to the respective patients.

In the Netherlands, a prospective study done in 2008 of 1946 cases had overall mortality of 6.9%. Multiorgan failure accounted for 64.9% of which 45.9% was due to infection.[4] The Brazil study of 2006 showed an overall mortality of 5.0% (14/278).[22] A KNH study of1974 showed an overall mortality of 14.7% from burn injuries.[31] In this study, the overall mortality rate was 14% (13/93 cases). Mortality rate in categories according to extent of burns (TBSA) was highest among very severe injuries (TBSA > 50%) at 56% (5/9).

This study showed that mortality rate among burn patient at KNH had not changed over the last 40 years. The overall mortality rate was higher at the KNH (14%) compared to other centers cited (5.0%). Bias could have occurred because it focused on inpatients only excluding burn patients managed on outpatient basis.

A review paper of 1995 reported 75% of all deaths following burns are related to infection.[29] In this study, deaths associated with burn wound infection were 10/13 (77%) while the remaining 3/13 (23%) were as a result of multi-system organ failure directly associated with burn injuries. These results showed that mortality due to infection at KNH Burns Unit was similar to other burn centers in the world.

From the Spearman's correlation coefficient and Pearson's correlation coefficient calculation, there was a 0.677 correlation coefficient. This implied that there was a strong relationship between infection of burn wounds and mortality at KNH. If infection rate of burn wound rose, then mortality rate would rise as well.

During the study period, 93 patients were admitted at KNH with burn injuries.
Sixty one (66%) of them recovered and were discharged home within 21 days post-burns, 19 (20%) exited the study awaiting surgical intervention (STSG) while fatalities were 13 (14%).

CONCLUSIONS

Most burn patients were children who got the injuries at home from either hot water or flames from burning houses. More than 2/3 of burn patients admitted at KNH were from within Nairobi County.

The protocol of management in fluid and electrolyte replacement was well practiced; thus there was no patient who got acute renal failure. Those patients who were intubated with ETT were appropriately managed to prevent pneumonia associated with ETT and burn injury to airway.

The practice of early escharectomy and STSG was poor with about 5% success rate. The rate of burn wound infection was higher than that of the previous retrospective study of 1995. [(3)] This was partly due to the active search for infection in all the patients by the principal investigator.

The overall mortality rate had not changed over the last 40 years.

The results of this study showed that there was a strong relationship between burn wound infection and mortality associated with burn injuries in patients admitted at Kenyatta National Hospital (KNH).
Therefore, active and effective infection prevention and control together with early escharectomy and wound closure by STSG or regional flaps are major factors that will reduce mortality rate among burn patients at KNH.

RECOMMENDATIONS

There is need for a major policy overhaul on human settlement in Kenya, especially in urban areas, in order to reduce the rate of fire accidents at home. This will reduce the cases injured by hot water and dry flames at homes from 45% and 30% respectively.

As a referral center, the KNH need not be burdened by cases of burns that can be handled by other health facilities within Nairobi County. They should be adequately equipped like those in other Counties.

Active management of patients with inhalational injuries by intubation with ETT needs to be improved from the current 55%. Good care offered to those intubated with ETT should be maintained. This was shown by low incidence of pneumonia (13%).

The good practice of appropriate replacement of lost fluids and electrolytes in burn patients should be maintained.

There is need for early surgical intervention to be enhanced from the current 5.1% (2/39). This has been shown to reduce infection and mortality as well.

Areas for further research

This study focused on correlation between burn wound infection and mortality associated with burn injuries.

However, it is important to study each complication associated with burn injuries individually in order to improve burn care at KNH.

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6: Appendices

6.1 Appendix I - Data collection sheet

Study statistical retrieval form; Correlation of burn wound infection and mortality of burn injury patients hospitalized at the KNH.

(a) Demographic data

Study number……

Age……
Sex……

Weight……Residence……
…

Date and time of burn……..

Date and time of admission……..

Place of burn; Home ☐ ork place ☐ s ☐

Cause of burns; Dry flames ☐ t water ☐ burns ☐

Frictional burns ☐ ectrical burns ☐ s ☐

Burn depth; superficial2^{o} ☐ ep 2^{o} ☐ d 4^{o} ☐

Percentage of burns; up to 10% ☐ - 25% ☐ 0% ☐

51 -70% ☐ bove 70% ☐

☐ ☐ ☐

Body part affected; head upper limbs trunk

Lower limbs ☐ enitalia ☐

Inhalational burns; yes ☐ no ☐

(b) Intervention

	Day 1	Day 3	Day 14	Day 21
Fluids and electrolytes				
Endotracheal intubation(ETT)				
Blood transfusion				
Parenteral nutrition				
Cleaning and occlusive dressing				
Topical antibiotics				
Systemic antibiotics				
Renal dialysis				
Escharotomy				
Escharectomy				
Skin grafting				
Regional flaps				

c) Complications

	Day 1	Day 3	Day 10	Day 21	Outcome (recovery, persistent complication or mortality)
Electrolyte imbalance					
Hypovolaemia shock					
Infection					
Renal failure					
Pneumonia					
Anaemia					
Others					

(d) Pus swab culture results from infected wounds

Microorganisms	Day after injury when infection is noted
Pseudomonas	
Staph. Aureus	
E. coli	
Proteus	
Others	

6.2 Appendix II - Consent form

English version

This Informed Consent form is for patients of all ages hospitalized at the Kenyatta National Hospital with burns during the study period. We are requesting these patients to participate in this research project whose title is "Correlation of burn wound infection and mortality of burn injury patients hospitalized at the Kenyatta National Hospital".

Principal investigador: Dr. M. G. Ngugi

Institution: School of Medicine, Department of surgery- University of Nairobi

Supervisors: Dr Joseph Kimani Wanjeri & Dr Peter L.W Ndaguatha

This informed consent has three parts:

1. Information sheet (to share information about the research with you)
2. Certificate of Consent (for signatures if you agree to take part)
3. Statement by the researcher

You will be given a copy of the full Informed Consent Form.

Part I: Information sheet

My name is Dr. Moses Gitau Ngugi, a Post-Graduate student at the University of Nairobi's School of Medicine. I am carrying out a study to determine correlation of infection and mortality for burn injuries seen at the Kenyatta National Hospital. Burns are a common cause of injuries in Kenya like in most other developing countries but the correlation of infection and mortality has not been studied. This study aims at finding ways of preventing infection and associated mortality in burn injuries occurring in our set up after which recommendations for reducing their incidence will be made.

I am inviting you to participate in my study and you are free to either agree immediately after receiving this information or later after thinking about it. You will be given the opportunity to ask questions before you decide and you may talk to anyone you are comfortable with about the research before making a decision. After receiving this information concerning the study, please seek for clarification from either myself or my assistant if there are words or details which you do not understand.

If you agree to participate, you will be asked to provide personal information and other details related to burn injuries. If infection is suspected, pus swab from the wounds and/or blood samples shall be collected and analyzed in the laboratories using the standard protocol. All the information which you provide will be kept confidential and no one but the researchers will see it. The information about you will be identified by a number and only the researchers can relate the number to you as a person. Your information will not be shared with anyone else unless authorized by the Kenyatta National Hospital/University of Nairobi – Ethics and Research Committee (KNH/UoN-ERC).

Your involvement in this research will be through an interview and clinical evaluation and you will not expose yourself to any risks if you consent to participate. Your participation is voluntary and refusal to participate in the research or withdrawal from it will not affect the treatment which you receive at this hospital. All the information that you give us will be used for this research only.

All patients hospitalized with burns during the study period are being invited to participate.

This proposal has been reviewed and approved by the KNH/UoN-ERC which is a committee whose work is to make sure research participants like your self are protected from harm. It was submitted to them through the Chairman of the Department of Surgery at School of Medicine of the University of Nairobi with the approval of the two university supervisors. The contact information of these people is given below if you wish to contact any of them for whatever reason;

- Secretary, KNH/UoN-ERC
  P.O. Box 20723 KNH, Nairobi 00202
  Tel 726300-9
  Email: KNHplan@Ken.Healthnet.org

- Chairman,
  Department of Surgery, School of Medicine– University of Nairobi
  P.O. Box 19676 KNH, Nairobi 00202
  Tel # 0202726300

- University of Nairobi research supervisors
  - Dr Joseph Kimani Wanjeri,
    Department of Surgery, School of Medicine, University of Nairobi
    P.O. Box 19676 KNH, Nairobi 00202
    Tel # 0202726300

  - Dr. Peter L.W Ndaguatha,
    Department of Surgery, School of Medicine, University of Nairobi
    P.O. Box 19676 KNH, Nairobi 00202
    Tel # 0202726300

- Principle researcher:
  Dr. Moses G Ngugi,
  Department of Surgery, School of Medicine, University of Nairobi
  P.O. Box 19676 KNH, Nairobi 00202
  Mobile phone # 0722740300

Part ii: Consent certificate

I……..freely give consent of myself or for my proxy (Name…….) to take part in the study conducted by Dr. Moses G Ngugi, the nature of which has been explained to me by him/his research assistant. I have been informed and have understood that my participation is entirely voluntary and I understand that I am free to withdraw my consent at any time if I so wish and this will not in any way alter the care being given to me or my proxy. The results of the study may directly be of benefit to me or my proxy and may assist in preventing burn injuries.

……

Signature/left thumb print (Participant/Next of kin)

Date……

Day/Month/Year

Thumb print of participant if illiterate (a witness must sign below)

Statement by the witness if participant is illiterate

I have witnessed the accurate reading of the consent form to the participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Name of witness……

Signature of witness……..

Date……

Day/Month/Year

Part iii: Statement by the researcher

I have accurately read out the information sheet to the participant, and to the best of my ability made sure that the participant understands that the following will be done:

- Refusal to participate or withdrawal from the study will not in any way compromise the care of treatment.
- All information given will be treated with confidentiality.
- The results of this study might be published to facilitate prevention of infection and/or mortality resulting from burn injuries.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this Informed Consent Form has been provided to the participant.

Name of researcher taking consent……

Signature of researcher taking the consent……

Date……

Day/Month/Year

Fomu ya idhini

(i) Sehemu ya kwanza – Maelezo:

Mimi ni Dkt Moses G Ngugi, kutoka shule ya Afya ya upasuaji ya Chuo Kikuu cha Nairobi (University of Nairobi). Ninafanya utafiti wa maumivu na vifo kutokana na majeraha ya kuchomeka ambaye huonekana katika hospitali kuu ya Kenyatta. Ningependa kukuchagua wewe ama mgonjwa wako katika utafiti huu wangu. Lengo ni kutambua jinsi ya kuzuia maumivu na vifo kutotokana na majeraha ya kuchomeka. Katika utafiti huu utatakiwa kutoa taarifa yako binafsi na tarifa kuhusu hali ya mazingira kwenye ajali ilitokea. Maumivu yakibashiriwa, uzaha kutoka kwa vidonda na/au damu zitachukuliwa na kuchunguzwa katika maabara kwa mujibu wa mikakati iliyowekwa. Habari zote zitakazo kusanywa zitashughulikiwa kwa siri na hazitatambazwa ila tu kwa ruhusa kutokana na mkurughenzi mkuu wa utafiti wa chuo kikuu cha Nairobi na hospitali kuu ya Kenyatta.
Sababu ya utafiti huu ni kutafuta jinsi za kuzuia madhara haya ili kuinua hali ya maisha ya jamii. Kuhusika kwako kwenye utafiti huu hauna malipo yeyote ila ni kwa hiari yako mwenyewe na pia unaweza kujiondoa kwa utafiti wakati wowote bila kuhatarisha matibabu yako katika Hospitali Kuu ya Kenyatta. Naomba mimi ama wasaidizi wangu wakuulize maswali ambayo yatajibiwa kwa fomu maalum. Habari yote ambaye utatuarifu ni ya siri kati yako nasi watafiti na haitaenezwa kwa watu wengine.

Unaweza kuuliza maswali yeyote kuhusu utafiti huu na ukiridhika tafadhali jjaze fomu ya idhini iliyopo hapa chini. Unaweza pia kuuliza swali lolote baadaye kwa kupiga simu ya mtafiti mkuu ama mkuu wa idara ya upasuaji katika chuo kikuu cha Nairobi ama walimu wasimamiza utafiti ukitumia nambari za simu zifuatazo;

- Katibu wa utafiti, Hospitali kuu ya Kenyatta na Chuo kikuu cha Nairobi. Sanduku la Posta 20723 KNH, Nairobi 00202. Nambari ya simu 726300-9.
- Mwenye kiti, Idara ya upasuaji katika chuo kikuuu cha Nairobi. Sanduku la Posta 19676 KNH Nairobi 00202. Nambari ya simu: 0202726300
- Walimu wasimamiza wa Chuo kikuu cha Nairobi:

1. Dkaktari Joseph Kimani Wanjeri, Sanduku la Posta 19676 KNH, Nairobi 00202. Nambari ya simu: 0202726300
2. Daktari Peter L.W Ndaguatha, Sanduku la Posta 19676 KNH, Nairobi 00202. Nambari ya simu:0202726300

- Mtafiti: DaktariMoses G Ngugi, Idara ya Upasuaji ya Shule ya Utabibu – Chuo kikuu cha Nairobi, Sanduku la Posta 2678 KNH Nairobi 00202. Nambari ya simu ya mkononi 0722740300

(ii) Sehemu ya pili - Idhini:

Mimi (Jina)……..kwa hiari yangu ama kwa hiari ya mgonjwa wangu (Jina la Mgonjwa.....
…….) nimekubali kushiriki katika utafiti huu unaofanywa na Daktari Kimani Wanjeri kutokana na hali ambazo nimeelezwa na sio kwa malipo ama shurutisho lolote.

Nimeelewa kwamba nina weza kujiondoa wakati wowote nitakapo na hatua hii haita hatarisha matibabu ninayopata ama anayoipata mgonjwa wangu. Matokeo ya utafiti yaweza kuwa ya manufaa kwangu ama kwa wagonjwa wengine kwa jumla na yaweza kusaidia kuzuia majeraha ya kuchomeka inchini Kenya.

Kidole cha gumba kwa wale wasiojua kwandika (Shahidi atie sahihi hapa chini)

…….

Sahihi/ama alama ya kidole cha gumba katika sanduku →

Tarehe…….....

Siku/Mwezi/Mwaka

Jina la shahidi……

Sahihi…….

Tarehe…….

(Siku/Mwezi/Mwaka)

(iii) Sehemu ya tatu – Dhibitisho la mtafiti

Hii nikuidhinisha ya kwamba nimemueleza mshiriki ama msimamizi wake kuhusu utafiti huu na pi nimempa nafasi yakuuliza maswali. Nimemueleza yafuatayo;

- Kwamba kushuriki ni kwa hiari yake mwenyewe bila malipo.
- Kushuriki hakutasababisha madhara ama kuhatarisha maisha kamwe.
- Anaweza kujiondoa kutoka kwa utafiti huu wakati wowote bila kuhatarisha matibabu anayo ipata katika hospital kuu ya Kenyatta.
- Habari ambazo atapeana hazita tambazwa hadharani bila ruhusa kutoka kwake (mshiriki) na pia kutoka kwa mdhamini mkuu wa utafiti wa hospital kuu ya Kenyatta na chuo kikuu cha matibabu.

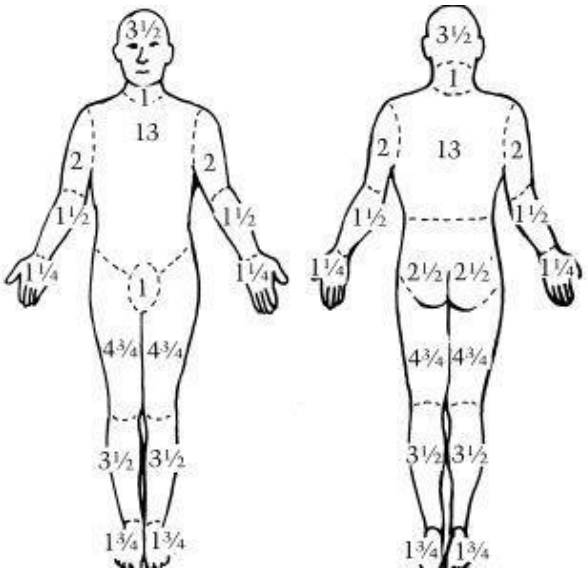
Jina la mtafiti ama msimamizi wake……

Sahihi……..

Tarehe…….

(Siku/Mwezi/Mwaka)

6.3 Appendix III - Lund and Browder Chart



Age: _____
Sex: _____
Weight: _____

Area	Birth–1 yr	1–4 yr	5–9 yr	10–14 yr	15 yr	Adult	Partial thickness 2°	Full thickness 3°	Total
Head	19	17	13	11	9	7			
Neck	2	2	2	2	2	2			
Anterior trunk	13	13	13	13	13	13			
Posterior trunk	13	13	13	13	13	13			
Right buttock	2½	2½	2½	2½	2½	2½			
Left buttock	2½	2½	2½	2½	2½	2½			
Genitalia	1	1	1	1	1	1			
Right upper arm	4	4	4	4	4	4			
Left upper arm	4	4	4	4	4	4			
Right lower arm	3	3	3	3	3	3			
Left lower arm	3	3	3	3	3	3			
Right hand	2½	2½	2½	2½	2½	2½			
Left hand	2½	2½	2½	2½	2½	2½			
Right thigh	5½	6½	8	8½	9	9½			
Left thigh	5½	6½	8	8½	9	9½			
Right leg	5	5	5½	6	6½	7			
Left leg	5	5	5½	6	6½	8			
Right foot	3½	3½	3½	3½	3½	3½			
Left foot	3½	3½	3½	3½	3½	3½			
						Total			

6.4 Appendix IV - Budget

Item	Amount(Ksh)
Research fee (KNH/UON-ERC)	1500
Statistician; design and data analysis	27000
Research Assistant	20000
Stationary;- questionnaire	4000
-consent forms	2000
Dissertation printout	10000
Swab for pus collection	10000
Bottles for blood cultures provided by KNH lab routinely	0
Miscellaneous	8500
Contingencies (15%)	9000
TOTAL	**92000**

Funding of the research is by the investigator.

6.5 Appendix V - Study Timetable (Good Gantt chart)

ACTIVITY	OCT 2011	NOV 2011	DEC 2011	JAN 2012 to MAY 2012	NOV 2012	DEC 2012	JAN 2013	FEB 2013	MAR 2 013	APR 2013
PROPOSAL DEVELOPMENT										
ETHICAL APPROVAL										
DATA COLLECTION										
DATA ANALYSIS										
SUBMISSION OF REPORT										

UNIVERSITY OF NAIROBI

Declaration of Originality Form

This form must be completed and signed for all works submitted to the University for examination.

Name of Student: ____**Dr. Moses Gitau Ngugi**_____

Registration Number: ___**H58/70981/2009**_____

College **Of Health Sciences**_____

Faculty/School/Institute **of Medicine**_____

Department of **Surgery**_____

Course Name: **Master of Medicine in General Surgery**_____

Title of the work: **"Correlation of burn wound infection and mortality of burn injury patients hospitalized at KNH".**

DECLARATION

1. I understand what Plagiarism is and I am aware of the University's policy in this regard
2. I declare that this _**Dissertation**_____ (Thesis, project, essay, assignment, paper, report, etc) is my original work and has not been submitted elsewhere for examination, award of a degree or publication. Where other people's work or my own work has been used, this has properly been acknowledged and referenced in accordance with the University of Nairobi's requirements.
3. I have not sought or used the services of any professional agencies to produce this work
4. I have not allowed, and shall not allow anyone to copy my work with the intention of passing it off as his/her own work
5. I understand that any false claim in respect of this work shall result in disciplinary action, in accordance with University Plagiarism Policy.

Signature _____

Date _____

6.6 Appendix VI – Approval by KNH/UoN -ERC

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
(254-020) 2726300 Ext 44355
Ref: KNH-ERC/A/141

KNH/UON-ERC
Email: uonknh_erc@uonbi.ac.ke
Website: www.uonbi.ac.ke
Link:www.uonbi.ac.ke/activities/KNHUoN

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi
30th May 2012

Dr. Moses Gitau Ngugi
Dept.of Surgery
School of Medicine
Kenyatta University

Dear Dr. Ngugi

Research proposal: "Correlation of Burn wound infection and mortality of Burn Injury patients hospitalized at the Kenyatta National Hospital" (P29/01/2012)

This is to inform you that the KNH/UoN-Ethics & Research Committee (ERC) has reviewed and **approved** your above revised research proposal. The approval periods are 30th May 2012 to 29th May 2013.

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 severe 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) Clearance for export of biological specimens must be obtained from KNH/UoN-Ethics & Research Committee for each batch of shipment.
g) 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.

For more details consult the KNH/UoN ERC website **www.uonbi.ac.ke/activities/KNHUoN**

Yours sincerely

PROF. A.N. GUANTAI
SECRETARY, KNH/UON-ERC

c.c. The Deputy Director CS, KNH
The Principal, College of Health Sciences, UoN
The Dean, School of Medicine, UON
The Chairman, Dept.of Surgery, UON
The HOD, Records, KNH
Supervisors: Dr. Joseph Kimani Wanjeri, Dept.of Surgery, UON
Dr. Peter L.W. Ndaguatha, Dept. of Surgery, UON

"Protect to Discover"