PREHOSPITAL CARE OF PATIENTS WITH LOWER EXTREMITY FRACTURES PRESENTING AT MOI TEACHING AND REFERRAL HOSPITAL, ELDORET, KENYA

METHUSELAH TIROP KORIR

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER OF MEDICINE IN ORTHOPAEDIC SURGERY, MOI UNIVERSITY

DECLARATION

DECLARATION BY THE CANDIDATE:

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Signature _____ Date: _____

Methuselah Tirop Korir

SM/PGORT/02/15

DECLARATION BY SUPERVISORS:

This thesis has been submitted for examination with our approval as Moi University supervisors.

Dr. Elijah Muteti MBChB, MMed (Orthopaedic surgery)

Lecturer and Consultant Orthopaedic surgeon

Department of Orthopaedics and Rehabilitation

Moi University, College of Health Sciences, Eldoret, Kenya

Signature _____ Date: _____

Dr. Simiyu Tabu MBChB, MMed (Surgery)

Senior lecturer and Consultant surgeon

Department of Surgery and Anaesthesiology

Moi University, College of Health Sciences, Eldoret, Kenya

Signature _____ Date: _____

Dr. Christer Andersson MD, PhD

Senior lecturer and Consultant Orthopaedic surgeon

Department of Orthopaedic surgery

University Hospital, Linkoping, Sweden

Signature _____ Date: _____

ABSTRACT

Background: Prehospital trauma care of patients with lower extremity fractures, a common injury in Kenya, influences morbidity and mortality. Delayed presentation of patients with lower extremity fractures can lead to life and limb threatening complications. Prehospital care consists of resuscitation, splinting, analgesics and transport to a trauma center.

Objective: To assess the prehospital trauma care given to patients with lower extremity fractures presenting at Moi Teaching and Referral Hospital (MTRH).

Methods: This was a Cross-sectional study conducted between 1st January 2017 and 31st December 2017 on adult patients with lower extremity fractures presenting at the Emergency department (ED), within forty-eight hours of injury. Systematic sampling of 196 patients out of the 400 seen annually with lower extremity fractures was done by selecting every second patient. Data was collected using interviewer administered questionnaire and clinical examination on patients at various stages of hospital experience. Associations between categorical variables were assessed using Pearson's Chi Square and Fisher's exact test. Variables found to be significant at bivariate level were fitted in to a multiple binary logistic regression analysis.

Results: The male to female ratio was 5:1 with a median age of 35.5 (IQR 27, 50). The Injury severity scores (ISS) median was 9 (IQR 9, 13).

Out of the 196 patients, those with closed fractures were 133 (68%). Road traffic accidents (RTA) were responsible for 149 (76%) of the patients and falls in 31 (16%). Findings indicated that initial first aid and extrication from injury site was by: bystanders in 135 patients (69%), ambulance personnel 44 (22%) and police 16 (8%) patients. Only 96 of the victims (48%) were transported to hospital by ambulance, while the rest were moved by public service vehicle 59 (30%), private vehicle 20 (10%), motorcycle 12 (6%) and police vehicle 9 (4.6%).

Sixty seven (34%) patients arrived at ED within one hour after injury. Prehospital time was significantly lower (p=0.03) in those involved in RTA compared to other causes of injury. Most patients 141 (72%) had not received any analgesics before arrival. Haemorrhage control, dressing of open wounds and intravenous fluid resuscitation was carried out in 19 (30%), 28 (44%) and 12 (19%) patients with open fractures respectively. After multiple logistic regression, open fractures (p=0.003) and transport by ambulance (p=0.004) were significantly associated with adequate prehospital care.

Conclusion: Road traffic accident was the major cause of lower extremity fractures and affected mostly young men. Most patients with lower extremity fractures had multiple injuries. A third of patients with lower limb fractures presented within the "golden hour" of trauma and half of the injured patients were transported to hospital by ambulance.

Recommendation: The national, county governments and non-state actors establish a formal prehospital trauma protocol and service, for safe care and expeditious transport of patients with lower extremity fractures.

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DEDICATION

I dedicate this thesis to my family, friends, and colleagues. I also dedicate it to the patients who experienced trauma care from the public and the Medical teams for allowing us to interview them.

ABBREVIATIONS AND ACRONYMS

AIS	Abbreviated Injury Score
ATLS	Advanced Trauma Life Support
BLS	Basic Life Support
DALYs	Disability Adjusted Life Years
ED	Emergency Department
EMS	Emergency Medical Service
IREC	Institutional Research and Ethics Committee
ISS	Injury Severity Score
IVF	Intravenous Fluids
MTRH	Moi Teaching and Referral Hospital
OPALS	Ontario Prehospital Advanced Life Support
RTA	Road Traffic Accident
WHO	World Health Organisation

OPERATIONAL DEFINITIONS OF TERMS AND KEY CONCEPTS

Prehospital Trauma Care refers to the medical interventions provided to an injured patient before arrival to a health facility. These interventions include: resuscitation at the scene of injury, haemorrhage control, splinting of fractured limbs, treatment during transportation and communication with the intended destination hospital.

Lower Extremity Fractures are traumatic injuries leading to breakage of bone involving the femur, knee, tibia, fibula, ankle and foot bones.

Injury Severity Score is an anatomical sum score developed to assess the total severity of injury in the whole body (Palmer et al., 2016). It is based on the highest Abbreviated injury score (AIS) in each of the three most severely injured ISS body regions. The score is derived from the sum of the squares of the AIS scores (ISS = AIS2 + AIS2 + AIS2) and it ranges between 1 and 75.

Golden Hour is defined as the immediate time after injury, usually the first hour, when resuscitation and stabilization will be most beneficial to a severely injured patient.

Prehospital Time is the total time taken by an injured patient from injury to arrival at a trauma center and it includes response time, scene time and transport time.

Disability Adjusted Life Years (DALYs) is a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death.

Traumatic injury is damage to body tissues caused by various forces from outside of the body, which can either be blunt or penetrating. Blunt trauma includes falls, road traffic crashes; crush injuries and assaults.

CHAPTER ONE: INTRODUCTION

1.1 Background

Injury represents a growing global health crisis. The World Health Organization estimates that 5.8 million deaths annually are attributable to injuries (WHO, 2008). According to the global burden of disease study of 2010, injury accounted for 10% of deaths worldwide and 11.2% of all disability-adjusted life years (DALYs) and that the global burden of injuries will surpass the total burden of all infectious diseases by 2030. A disproportionate amount of the burden exists in low and middle income countries, with some of the highest injury related mortality and morbidity estimates being found in sub-Sahara Africa (Hofman et al., 2005). Industrial injuries and RTAs in these developing countries are expected to further increase because of increased infrastructure development and increased motorization.

Trauma care is a time-sensitive emergency. Prehospital and in-hospital initial care are the two necessarily interlaced crucial phases in the management of severe traumatic limb injuries, with potential impact on the survival of patients and the clinical outcome of the fractured extremity (Baez et al., 2006).

Lower extremity fractures are common injuries in Kenya (Bachani et al., 2012). They exhibit a wide variety of injury patterns which depend on the patient's age and mechanism of injury. They are caused mainly by road traffic accidents (Lee & Porter, 2005).

In general, care of the injured patients is often viewed as a ''chain of survival'', stretching from the site of injury to the emergency department and from there to the operating room, the intensive care unit, and beyond to the rehabilitation centre (Bouillon, 2014). The prehospital arena is considered by many to be the most

challenging because of its propensity for adverse environmental factors (Søreide, 2012). Factors active in the decision making process include the prevailing environment, equipment, distance and the clinical competence of the care giver. The current study is focusing on trauma care from site of injury to arrival at emergency department (ED).

Prehospital trauma care is the first link in the chain of life support. These are medical interventions provided to an injured patient before hospitalization including: extrication at scene, resuscitation at the scene of injury, transportation, treatment during transportation and communication with the trauma centre (Liberman & Roudsari, 2007). Adequate prehospital trauma care of patients with musculoskeletal injuries including lower extremity fractures has been shown to improve outcome in severely injured patients (Worsing, 1984).

The goals of prehospital trauma care are survival of the injured patient and reduction of morbidity to improve quality of life post injury. Early management of patients with lower limb fractures in the field and at lower level facilities can significantly impact patient and limb outcomes. Prompt detection and appropriate management of lower extremity fractures and dislocations with the application of splints, simple reductions, administration of analgesics and antibiotics is critical in preventing fracture complications like compartment syndrome, fat embolism and infections (Nielsen et al., 2012). Prehospital analgesia is also important (Alonso-Serra & Wesley, 2003). The relief of pain and suffering of the injured patients must be a priority and therefore every prehospital trauma system should have a clinical care protocol to address pain management. Early immobilization in patients with high risk for spine injury is mandatory to prevent exacerbation of existent spinal cord injury during extrication,

initial treatment and transport. Effective, advanced and detailed communication of the nature of the injury and anticipated emergency interventions necessary is crucial in enabling the team at the ED of the intended receiving hospital to adequately prepare for the incoming patient.

Prehospital trauma care systems differ throughout the world. According to the WHO (2005) guidelines, the implementation of the principles of Basic Life Support (BLS) and Advanced Trauma Life Support (ATLS) are the standard of care in the prehospital setting. The providers can be paramedics, nurses, and/or physicians and the type of transportation ground or airborne ambulance (Liberman & Roudsari, 2007). Basic life support consists of noninvasive interventions such as wound dressing, immobilization, fracture splinting, oxygen administration, and noninvasive cardiopulmonary resuscitation. ATLS encompasses all of the BLS techniques in addition to invasive procedures, including intubation, initiation of intravenous access with fluid substitution and administration of medications where deemed necessary (Ali et al., 1993). The rationale for the use of on-site ATLS in trauma is that these interventions will reduce the rate of physiologic and hemodynamic deterioration, thus stabilizing the patient before arrival at the hospital (Potter et al., 1988). There are important components in the physiology of trauma that affect the outcome of the primary injury (the actual accident), the secondary injuries (interventions, treatment, and events and complications after the primary injury) and the individual biological response to the trauma (Haagsma et al., 2016).

Prehospital care is aimed at mitigating the secondary injuries and complications and is an important factor in the overall outcome of injury.

The mode of transport used to the hospital from the injury site is important. This is because it affects the quality of prehospital intervention; time to hospital; and safety and comfort of patients while en-route. It is a key factor in being able to provide early intervention and improve clinical outcomes (Band et al., 2014). A fully equipped Ambulance is the standard and the desired mode of transport of the injured patient (Johnson et al., 2013).

In the overall management of lower extremity fractures, the time from injury to hospital discharge can be segmented into three main treatment intervals: injury to arrival at ED, ED to surgery and surgery to discharge. These are easily measurable and may be useful in evaluating the efficiency with which a trauma system treats an injured patient (Lee & Porter, 2005). This study set out to assess first segment.

The initial injury to admission interval is representative of the presence and efficacy of prehospital emergency medical systems (EMS), such as ambulance services. Prehospital time has been reported as a valid quality indicator (Chowdhury et al., 2016). The admission to surgery interval is affected by in-hospital variables such as the availability of human resources and essential equipment and the hospital infrastructure (Lerner et al., 2003).

Intervals from injury to arrival at ED can be good indicators of the general quality of prehospital trauma services and can be validated as indicators against national economic and health system parameters, which are the best available data for such validation. While the goal of prehospital care is to match the needs of the patients to the available resources so that optimal, prompt, and cost-effective care can be given (Anand et al., 2019)

The aim for prehospital trauma care is to deliver quality care to the patient in the briefest period of time following injury, regardless of system design or level of care. In developing countries, there is inadequacy of the public health infrastructure and poor access to health services, including prehospital trauma services; therefore there is high burden of traumatic injuries in developing countries (Kobusingye et al., 2005).

As the majority of trauma deaths in developing countries occur in the prehospital setting (Mock et al., 2003), it is suggested that access to an effective prehospital trauma care may reduce injury related mortality and morbidity. In the absence of well-organized prehospital care, injured people are often cared for by untrained lay people and transported to the nearest medical facility in commercial vehicles, taxis, bicycles or motorcycles (Haghparast-Bidgoli et al., 2010; Moini et al., 2013).

Many studies have shown that improvements in prehospital care may decrease trauma mortality during the first few hours after injury, and may also reduce the long-term mortality and morbidity rates due to RTAs (Bagher et al., 2017; Dharap et al., 2017; Esmaeliranjabar et al., 2016). Few studies have been done to evaluate prehospital trauma care for the injured people in Kenya.

1.2 Problem Statement

According to the global burden of disease study of 2010, injury accounted for 10% of deaths worldwide and 11.2% of all disability-adjusted life years (DALYs) and that the global burden of injuries will surpass the total burden of all infectious diseases by 2030. Trauma is a leading cause of death and disability especially among young people in Kenya and fifteen percent of trauma patients in Kenya have lower extremity fractures (Botchey et al., 2017). It disproportionately affects the most productive members of the society and imposes a major burden on the health care services. The

resulting death and disability causes economic loss both to the family of the injured and the society as a whole. In Kenya, injury is a significant indication for hospitalization accounting for 21% of all hospitalized cases (Saleeby et al., 2019). In spite of this burden, Kenya currently has no organized prehospital trauma care system (Saidi, 2003). Despite increased awareness of the global impact of injury and existing system, it has been highlighted that the field of prehospital trauma care and emergency medicine has not progressed uniformly in the country.

Assessment of prehospital care is essential in order to guide future efforts to strengthen the trauma care system in the region. This study was set out to assess the prehospital trauma care, mode of transport and prehospital time interval of patients with lower extremity fractures presenting at MTRH.

1.3. Justification

Currently there is lack of an organized prehospital emergency care system in Kenya. There is lack of proper equipment and personnel to ensure adequate prehospital care of patients with lower limb fractures. Prehospital trauma care has been shown to influence lower limb fracture morbidity and mortality.

The research findings will create information valuable in policy formulation and decision making in the area of prehospital care at MTRH and nationally. The study will identify the gaps in prehospital care of patients with lower extremity fractures. This will be useful for MTRH, county and national government in coming up with protocols on prehospital care of patients with lower extremity fractures. The standards and protocols will include; mode of transport, prehospital time and prehospital trauma care.

There is paucity of published local data on level of prehospital trauma care in Kenya and the research findings will give baseline data, important for future research projects.

1.4 Research Question

What prehospital trauma care is given to patients with lower extremity fractures presenting at MTRH?

1.5 Objectives

1.5.1 Broad Objective

To assess the prehospital trauma care given to patients with lower extremity fractures presenting at MTRH.

1.5.2 Specific Objectives

1. To find out the mechanism and severity of injury of patients with lower extremity fractures presenting at MTRH.
2. To determine the time taken from injury to arrival at MTRH by patients with lower extremity fractures.
3. To determine the mode of transport of patients with lower extremity fractures presenting at MTRH.
4. To determine the prehospital care interventions of patients with lower extremity fractures presenting at MTRH

CHAPTER TWO: LITERATURE REVIEW

2.1 Burden of Trauma

Trauma has become a rapidly expanding non-communicable epidemic (Gosselin et al., 2009). According to WHO (2008) global burden of disease, approximately 5.8 million people worldwide die from injuries every year. In 2002, road traffic-related injuries, self-inflicted injuries, interpersonal violence were among the 15 leading causes of death among people between 5 and 44 years (Peden et al., 2002). In addition to those who die each year, many more people are temporarily or permanently disabled. This toll is expected to increase in coming years (Gosselin et al., 2009; Nordberg, 2000*)*.

The WHO (2015) Global status report on road safety, reflecting information from 180 countries, indicates that worldwide the total number of road traffic deaths has plateaued at 1.25 million per year, with the highest road traffic fatality rates in low-income countries. Currently, many developed countries have aligned at least one of their laws with best practice on seat-belts, drunk–driving, speed, motorcycle helmets or child restraints (Adam et al., 2008; Barss et al., 2008). While there has been progress towards improving road safety legislation and in making vehicles safer, the report shows that the pace of change is too slow. Urgent action is needed to achieve the ambitious target for road safety reflected in the newly adopted 2030 Agenda for Sustainable Development: halving the global number of deaths and injuries from road traffic crashes by 2020.

2.2 Socio-Demographic characteristics and mechanism of injury of lower extremity fractures

Road traffic injuries, already a major cause of death and disability in developing countries, are forecasted to increase as these countries become increasingly motorized. Patients were predominantly male (76.1%) and young (mean age 28 years). According to the study by Botchey et al., (2017) in Nairobi Kenya, they found that the most common mechanisms of injury were road traffic injuries (36.8%), falls (26.4%), and being struck/hit by a person or object (20.1%).

Injuries, whether due to road traffic accidents, violence or other causes, affect not only the immediate victim, but also his or her family and members of the surrounding community. The economic burden of injury is great – both in terms of the direct costs of medical care and indirect costs of premature death and disability (Fazel et al., 2012). This burden is magnified when one or more family members are forced to leave work to care for a disabled family member or relative. Numerous factors contribute to the high rate of injury in developing countries. These include hazardous environments and workplaces, income and gender inequalities, poorly designed roads, inadequate enforcement of traffic regulations, poorly maintained motor vehicles, alcohol and drug abuse, and lack of efficient emergency medical response systems (Saidi & Mutiso, 2013)

Generally, the best way to reduce rates of death or disability from life-threatening injuries is to reduce such underlying factors. Therefore, rising awareness among policy makers of the burden of injury has led to an increased need for easily quantifiable metrics to improve the allocation of resources for the treatment and prevention of injuries (Adam et al., 2008).

2.3 The need for Prehospital Care

It is often possible to minimize the consequences of serious injury, including long-term morbidity or mortality, by promptly providing effective prehospital care. Generally, the prehospital trauma care process consists of six key steps: detection, reporting, response, on-scene care, treatment in transit and transfer to definitive care (Sinthavalai et al., 2009).

A large comparative trauma study found that 51% of all severely injured persons in a large city in Ghana died in the prehospital setting, in comparison with 21% in Seattle, USA (O"Neill & Mohan, 2002). This suggests that improvements in prehospital care in developing countries could potentially have an important impact on decreasing the mortality and morbidity (Alsharif, 2016; Chalya et al., 2012).

Most countries in the developing world, such as Kenya, do not have structured emergency medical services to render prehospital care to injured casualties. The absence of formal emergency medical service necessitates innovative and low cost solutions to be devised to meet the growing need for prehospital trauma care

The essential elements of a pre-hospital trauma care system include prompt communication and activation of the system, timely response of the system, correct assessment and efficient treatment, and prompt transport of injured people to a formal health-care facility when necessary (Bhatti et al., 2013; MacFarlene & Benn, 2003). Emergency medical service (EMS) is responsible for providing prehospital trauma care in many developed countries and can be described as the link between prehospital trauma care and care at the hospital. Many low and middle income countries like Kenya have insufficient prehospital trauma care (Hardcastle et al., 2013; Von Elm et al., 2009), few victims receive treatment at the crash scene and

even fewer receive safe transport to the hospital by an ambulance. According to a study conducted in Kampala, Uganda, injured people are usually cared for and transported to the hospital by relatives, untrained lay people or drivers of commercial vehicles (Kobusingye et al., 2002).

Henry and Reingold, (2012), conducted a systematic review and meta-analysis to assess the effectiveness of prehospital trauma systems in developing countries. Multiple database and bibliography searches were conducted to identify articles assessing the effectiveness of prehospital trauma systems in developing countries. The primary outcome was mortality. Secondary outcomes were: physiologic severity score, injury severity score and prehospital time, appropriate statistical analysis was done. Out of fourteen studies, eight representing seven countries (n = 5,607) were included in the meta-analysis. Their pooled estimated results showed a 25% decreased risk of dying from trauma in areas that have prehospital trauma systems. In-field response time was reduced in both rural and urban settings. Authors concluded that, prehospital trauma systems in developing countries, particularly middle-income countries, reduce mortality.

The reasons for the high burden of RTA related mortality and morbidity in Kenya has been discussed in many studies, but little research has been done to assess prehospital trauma care. There is no evidence to show that the current assessment of prehospital care in Kenya has been studied at all, therefore what happens between scene of injury and the hospital to patients with lower extremity fractures is neither known nor documented.

2.4 Trimodal Death Distribution in Trauma

First described in 1982, the trimodal distribution of deaths implies that death due to injury occurs in one of three periods, or peaks (Valdez et al., 2016). The first peak occurs within seconds to minutes of injury. During this early period, deaths generally result from apnea due to severe brain or high spinal cord injury or rupture of the heart, aorta, or other large blood vessels. Very few of these patients can be saved because of the severity of their injuries (Bardes et al., 2018). Only prevention of injury can significantly reduce this peak of trauma related deaths.

The second peak occurs within minutes to several hours following injury. Deaths that occur during this period are usually due to severe head injuries, severe thoracic trauma, severe abdominal injuries, pelvic fractures, and/or multiple extremity fractures with significant blood loss. The deaths and morbidity from this second phase can be reduced by appropriate prehospital trauma care. The “golden hour” of care after injury is characterized by the need for rapid assessment and resuscitation, which are the fundamental principles of Advanced Trauma Life Support (ATLS).

The third peak, which occurs several days to weeks after the initial injury, is most often due to sepsis and multiple organ system dysfunctions. Care provided during each of the preceding periods affects outcomes during this stage. The temporal distribution of deaths reflects local advances and capabilities of trauma systems. The development of standardized trauma training, better prehospital care, and trauma centers with dedicated trauma teams and established protocols to care for injured patients has been shown to improve the outcome (Gunst et al., 2010).

Many fatal injuries may be prevented or their severity reduced by adequate prehospital trauma care (Carney, 1999). The major benefits of prehospital care are

realized during the second phase of trauma, when the timely provision of care can limit or halt the cascade of events that otherwise leads to death or lifelong disability. Without prehospital care, many people who might otherwise survive their injuries may die at the scene or en route to the hospital. Most deaths in the first hours after injury are the result of airway compromise, respiratory failure or uncontrolled haemorrhage (Coats & Davies, 2002).

Measures that are useful for preventing deaths in this phase include proper wound care, adequate immobilization of fractures, support of oxygenation and intravenous fluids during the first hours.

Deaths or worsening of injuries occurring in the first, immediate phase of injury cannot be directly prevented by improving the quality of prehospital care. An organized system of care may support injury prevention efforts by systematically collecting data that are useful for implementing prevention programmes, such as identifying high risk settings, high-risk behaviours, high-risk products and high-risk individuals.

2.5 Standards of Prehospital Care of Patients with Lower Limb Fractures

2.5.1 Primary Survey

After safe extrication and scene safety, the assessment and management of patients in the prehospital set up should follow the ABCDE principles (Revell et al., 2002). All patients with significant lower limb fractures should receive high flow oxygen at 15 litres per minute via a non-rebreathing trauma mask with a reservoir bag.

The management of life threatening injuries that jeopardise airway and breathing should take priority over extremity fractures. The exception to this is exsanguinating

external haemorrhage where delays performing assessment of airway and breathing would put the patient at risk of death from blood loss. Recognition of non-immediately life threatening external haemorrhage and its control are important and are identified by assessing the circulation. Lesser bleeding will usually be recognised under the exposure component of the primary survey and minor wounds, often as part of the secondary survey (Makhni et al., 2017).

2.5.2 Secondary Survey and Assessment of Lower Extremity Fractures

A secondary survey should only be undertaken on completion of the primary survey. As the prehospital provider on scene, it is important to obtain the history of the circumstances surrounding the traumatic episode and to be able to predict the possible injuries (Brooks et al., 2004). If the patient is talking, a brief history needs to be obtained. The key areas in the history taking should include: allergies, medication, past medical history, last meal, clinical events about the accident and the patient's tetanus status. Should the patient deteriorate in transit this information may be vital. The time of injury should also be recorded.

Examination may be difficult if the patient is trapped, there is poor lighting, or there are difficult environmental conditions. Minimal exposure should occur while the patient is outdoors but a brief assessment for lower limb injury is necessary.

Examination for musculoskeletal injuries should follow the "look, feel, and move" principles of assessment. However, in the presence of obvious fractures it is unnecessary to perform a detailed examination which will produce further pain.

Any open fractures should be identified and an attempt made to remove gross contamination. Gross contamination should be washed or wiped away using saline or saline soak pads and the wound covered with a sterile dressing. Ideally this dressing

should not be removed until the patient is in the operating theatre (McCoy et al., 2013).

The clinical examination should identify deformity of the lower limb which may require manipulation to allow splinting and packaging. The neurovascular status must be assessed before and after patient handling including manipulation. The capillary refill time should be determined and compared to the uninjured limb. Neurovascular deficit mandates immediate realignment which should be undertaken after the provision of adequate analgesia. The limb can normally be realigned by continuous longitudinal traction and manual correction to a neutral position. Repeated neurovascular assessment after any manipulation of the limb should then take place. If there has been no improvement the patient should be transported urgently to hospital for definitive care. If attempted reduction has worsened the neurovascular status, the limb should be returned to the original position, splinted, and the patient transported to hospital urgently.

Similarly fracture dislocations should be restored to a normal (or near normal) position as soon as possible particularly if there is a neurovascular deficit or skin compromise. Fracture dislocation of the ankle is the most commonly affected joint. Reduction should only be undertaken if the rescuer has been adequately trained in this procedure. Alternatively the limb should be supported in a padded box splint or equivalent and transported urgently to hospital (Willett et al., 2010).

2.6 Assessment of lower limb fractures

Untreated fractures of the lower limbs can lead to significant blood loss, which may be external and obvious, or covert. The estimated blood loss for a closed fracture of the femur is 1,000–1,500 ml and for a closed fracture of the tibia is 500–1,000 ml. These figures can be doubled if the fracture is open. Fractures of the lower limb, particularly the femur, should be considered a potential cause of hypovolemic shock, especially an open fracture (Chesters et al., 2014).

Control of external haemorrhage should precede fluid resuscitation. Unless haemorrhage is catastrophic (in which case a tourniquet should be used), control of bleeding should follow a stepwise progression: direct pressure, elevation, wound packing, indirect pressure and use of tourniquet (Bulger et al., 2014).

If, despite direct pressure and elevation, blood soaks through the dressing it should be removed, the wound packed with another dressing, and secured in place as firmly as possible. If blood continues to soak through, a windlass technique can be used to secure haemostasis: a dressing is held in place by a broad bandage (or crepe bandage), another broad bandage is secured with the knot over the wound, and a pen or similar object is placed under the knot and rotated until tight and then secured in place. Although painful when tight it will normally arrest haemorrhage. The neurovascular status of the limb should be assessed following application. If re-bleeding occurs the dressing can be tightened again to control haemorrhage. The time of application should be noted and the patient transferred to hospital immediately, recognising the presence of a time critical injury. If this technique still proves to be ineffective in arresting haemorrhage a proximal tourniquet should be applied (Welling et al., 2006). A simple and important technique in reducing blood loss involves traction and the splinting of fractures. In the case of untreated femoral shaft fractures, bony overlap

and large open venous channels in muscle potentiate bleeding. The application of traction helps realign the limb and closes the venous channels; in effect it reduces the space for bleeding from a sphere (of greater volume) to that of a cylinder. In the case of femoral fractures this is best achieved following titrated opiate analgesia and the position maintained by the application of a traction splint.

The experienced practitioner will be aware that the trauma patient may not exhibit the classical textbook signs of tachycardia and hypotension in hypovolemic shock. The prehospital provider should be vigilant and prepared for the possibility of circulatory deterioration. The Faculty of prehospital trauma care consensus statement (Moss & Porter, 2013), recommends that attempts to establish intravenous line should not prolong on scene times and it may be more appropriate to gain intravenous access en route to hospital. The exceptions to this are when the patient is trapped or when vascular access is necessary to provide analgesia (Jayaraman et al., 2014).

In the presence of compressible controllable bleeding (most limb fractures) fluid resuscitation is designed to restore circulation and demonstrated by normal physiological parameters: pulse and blood pressure. However, in the presence of non-compressible and non-controllable bleeding (some limb fractures) or major bleeding elsewhere (pelvis, chest, abdomen, and retroperitoneal bleeding), the object of resuscitation should be to maintain essential organ perfusion with the principle of hypotensive resuscitation maintaining a blood pressure of 80 mmHg or to restore the radial pulse (Liberman & Roudsari, 2007).

Complications of lower extremity fractures

Crush injury

The degree of crush injury is related to the magnitude and duration of crush. Muscle damage leads to hyperkalaemia, rhabdomyolysis and myoglobinaemia, and hypovolaemia. In the presence of crush injury intravenous fluid replacement should be considered early (Gonzalez, 2005). In isolated crush injury to the limbs, a policy of hypotensive resuscitation should (in the absence of cardiovascular pathology) be replaced by copious crystalloid administration.

Compartment syndrome

This is commonly seen in significant closed fractures but can also be seen in open fractures (Melamed et al., 2007). It is related to bleeding or swelling within a close fascial space. The syndrome does takes several hours to develop but can be seen and diagnosed in the prehospital phase when there is delay to hospital because of entrapment or long time for transport (Ulmer, 2002).

The clinical features of compartment syndrome include pain (despite analgesia), extreme pain when moving the toes, and paraesthesia, with pallor and absent pulses as a late feature. Compartment syndrome is a time dependant, limb threatening emergency (Olson & Glasgow, 2005).

Fat embolism

The incidence of fat embolism syndrome can be reduced by prompt correction of hypoxia and hypovolaemia and also by effective early fracture immobilisation (Hughes, 2016).

2.5.3 Splinting of Lower Extremity Fractures

The application of a splint is an essential aspect of the management of lower limb fractures. It should be done in the prehospital setting if possible. The benefits of splinting include reducing pain, reducing blood loss, reducing pressure on skin, reducing pressure on adjacent neurovascular structures, reducing the risk of fat embolism, and reducing the risk of further damage (Wood et al., 2003).

The principles of immobilisation include: assessment and reassessment of the lower extremity neurovascular status before and after any manipulation or handling of the fracture and immobilisation of the joints above and below the fracture (Andrews et al., 1999).

Splints commonly used by the ambulance service include Box splints, Vacuum splints, and Traction splints like Thomas splint (Lee & Porter, 2005).

Before and after application the rescuer should check the distal neurovascular status of the limb. The techniques for application are similar and the rescuer should be familiar with the splint used by their local ambulance service including its application and removal. An exchange splint should be applied in the accident and emergency department (Abarbanell, 2001).

2.6 Mode of Transport of Patients with Lower Extremity Fractures

In most circumstances, a severely injured victim should be transported from the scene of injury to definitive care at a fixed facility, such as a county hospital, regional hospital or trauma unit, within the shortest time and as safely as possible. Transport using a ground or air ambulance that is appropriately designed, equipped and staffed is the standard of care (Mock et al., 2003). However, most of the world's population has no access to formal prehospital emergency care. Not only do they have little

likelihood of being transported by an ambulance, they are also unlikely to receive any type of treatment in the field. In poor resource settings, most injured patients gain access to formal medical care by travelling using informal transport, such as in a private or commercial vehicle or a cart (Moller et al., 2018).

In the developing world, a vast majority of traumatic casualties are transported to the hospital in public service vehicles and taxis (Saidi, 2003). There is no adequate ambulance service and if present, they are poorly equipped (Forjuoh et al., 1999). Despite increased awareness of the global impact of injury and existing system, it has been highlighted that the field of trauma care has not progressed well. Assessment of prehospital care is essential in order to guide future efforts to strengthen the overall systems.

Countries that have ambulance services often face significant challenges. Factors that compromise the provision of these services include the use of inadequate vehicles, poor interagency coordination (such as between fire services, police and the emergency medical service),excessive demand relative to supply, poor roads, severe traffic, inadequate law enforcement, lack of funding and limited communication throughout the system. Globally, very few people have access to medical transport by air or advanced prehospital trauma care (Nielsen et al., 2012).

A number of factors make transport in rural settings more challenging than in urban areas. These include the scarcity of vehicles, the poor quality or non-existence of roads, rugged terrain, prolonged response and transport times and a general lack of healthcare infrastructure (Jayaraman et al, 2009). In light of the long transport times associated with injuries in rural communities, if possible transport should not be initiated before a seriously injured patient is adequately stabilized (Otieno et al.,

2011). When striving to create a prehospital transport system where none exists system planners should consider every available resource and whether there are any alternatives (Forjuoh et al., 2009).

2.7 Prehospital Time and the concept of the "Golden hour"

One of the key principles in trauma patient management is that of the "golden hour" (Kotwal et al., 2016). This period is defined as the immediate time after injury when resuscitation and stabilization will be most beneficial to the patient (Newgard et al., 2015). As time passes by, following critical trauma, tissue hypoxia increases and chances of survival or chance of good post survival prognosis decreases (Cornwell et al., 2000; Kigera & Naddumba, 2011). In all trauma patients it is critical to balance the need for prehospital care with the need for prompt transport of patient to hospital for definitive care. A prehospital time period more than one hour has been associated with significant increase in death and complications for severely injured patients (Sampalis et al., 1993). The time interval between the occurrence of trauma and the receipt of definitive care in a trauma centre is considered to play an important role in survival.

Response time is defined as the time interval from the call received by dispatchers to the paramedics' arrival at the scene. Adequate training of dispatchers and paramedics and the quality of the communication system are key elements to reduce these response times. Scene time is the time interval from arrival of paramedics to the trauma scene to their departure for a receiving facility. The amount of "on scene time" is dependent on possible extrication time and the number of paramedics and trauma patients on the scene (Arreola-Risa et al., 2000). The number of stabilizing treatments attempted in the field will also increase the scene time. Transport time is the time

needed to transport the patient from the scene to an appropriate facility. The transport time is largely controlled by distance from the site to the medical facility, the speed of ambulances and road conditions. The sum of the above three times is the total prehospital time.

Báez et al., (2006) reported on prehospital times and outcome in a large database cohort of severely injured patients. They found that in patients with ISS over 13, longer prehospital time was associated with increased length of hospital stay and more complications.

2.8 Prehospital Analgesia for Trauma Patients

Historically speaking, prehospital use of analgesics in trauma patients has been restrictive due to the fear of side effects such as respiratory depression (Cohen et al., 2004). Apart from unnecessary patient suffering, less use of analgesics has been associated with unfavorable outcomes for trauma patients. It has been reported that inadequate patient analgesia might be correlated with, pulmonary complications, chronic pain, anxiety, increased thromboembolic events, prolonged hospital times and even mortality (Rogovik & Goldman, 2007; Malchow & Black, 2008).

There is lack of evidence for recommending one specific analgesic drug in the prehospital setting (Alonso-Serra & Wesley, 2003). The analgesics used in the hospital setting for trauma in Kenya are morphine, tramadol and non-steroidal anti-inflammatory drugs like paracetamol and diclofenac (Otieno, et al., 2004).

2.9 Injury Severity Score

The ISS is an anatomical sum score developed to assess the total severity of injury in the whole body (Palmer et al., 2016). It is based on the highest Abbreviated injury score (AIS) in each of the three most severely injured ISS body regions. The score is derived from the sum of the squares of the AIS scores (ISS = AIS2 + AIS2 + AIS2) and it ranges between 1 and 75. The body regions are: the head and neck, the face, the chest (including the thoracic spine), the abdomen (including the pelvic contents) and the lumbar spine, and the extremities (including the pelvic girdle and external (meaning any injuries to the skin or body surface (Gennarelli, 2008). The ISS score takes values from 0 to 75. If an injury is assigned an AIS of 6 (unsurvivable injury), the ISS score is automatically assigned to 75. The ISS score is virtually the only anatomical scoring system in use and correlates linearly with mortality, morbidity, hospital stay and other measures of severity.

Its weaknesses are that any error in AIS scoring increases the ISS error, many different injury patterns can yield the same ISS score and injuries to different body regions are not weighted (Scale, 2005). Also, as a full description of patient injuries is not known prior to full investigation and operation, the ISS (along with other anatomical scoring systems) has limitations as a triage tool (Fani- Salek et al., 1999).

2.10 Prehospital Trauma Care Systems and the current best practice

The development of trauma systems is a process that requires cooperation between several different services, facilities, and authorities (Joshipura et al., 2003). The most important subjects and items are prehospital and in-hospital providers, insurance systems, types of injuries, and demographics in the area (Hofman & Pape, 2014). This is why trauma care systems differ depending on their location in the world.

Generally speaking, the systems are more developed in the Western world and it includes; EMS systems, trauma organizations and systems for education, evaluation, and rehabilitation (Uranus & Lennquist., 2002). Over the years, many countries have developed increasingly complex and costly systems for providing emergency trauma care. Particularly in urban and suburban areas, prehospital care is provided by professional trained paramedics (Roudsari et al., 2007). In the developed countries, fire fighters or police officers are often the first officials to reach the scene; followed by an ambulance equipped to render advanced prehospital trauma care being staffed by a physician, nurse or paramedics (Leppaniemi, 2005; Oluwadiya et al., 2005).

In the study by Murad et al., (2012), evaluation of a prehospital trauma system model was done. It was set out to determine the extent to which a low-cost trauma system reduces trauma deaths where prehospital transit times are long and to identify specific life support interventions that contributed to survival. The study period was from 1997 to 2006 and included 2,788 patients injured by land mines, war, and traffic accidents. The patients were managed by a chain of survival prehospital trauma system where non-graduate paramedics were the key care providers. The results of study showed that, 37% of the study patients had serious injuries with Injury Severity Score ≥ 9. The mean prehospital transport time was 2.5 hours. Trauma mortality was reduced from 17% to 4%, survival especially improving in major trauma victims. In most patients with airway problems, chest injured, and external haemorrhage, simple life support measures were sufficient to improve physiological severity indicators. It was concluded that, in case of long prehospital transit times simple life support measures by paramedics and lay first responders reduced trauma mortality in major injuries. Assigning life-saving skills to paramedics and lay people was a key factor for efficient prehospital trauma systems in low resource communities.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Study Site

The study was conducted at MTRH, Eldoret. The hospital is located 310 Kilometers Northwest of Nairobi.

Eldoret, the headquarters of Uasin Gishu County is Kenya's fifth largest urban Centre

MTRH has a capacity of 1,000 beds being the second largest referral hospital in Kenya. It has a catchment area with population of about 24 million people covering the Rift Valley and Western part of Kenya (representing at least 22 counties), parts of Eastern Uganda and Southern Sudan.

According to central statistics of the hospital, MTRH has an average number of outpatients at 600 per day and over 210,000 per year.

The accident and emergency department receives 10,000 patients per year. The hospital has cumulative figure of 35,000 admitted patients per year. Two thousand six hundred and eighty patients with injuries are seen annually at Accident and Emergency department of MTRH (Kamuren, 2018). According to MTRH central statistics, Orthopedics wards admit average of 1,300 patients per year

3.2 Study Design

It was a cross-sectional descriptive study. Adult patients with fractures of the lower extremity, presenting at MTRH emergency department and met the inclusion criteria were systematically recruited into the study.

3.3 Study Population

The study population comprised of all adult patients presenting at MTRH with lower extremity fractures.

3.4 Eligibility Criteria

3.4.1 Inclusion Criteria

The study included all patients above 18 years with fractures of the lower extremity as a result of trauma.

Multiply injured patients with lower extremity injuries were included in the study.

3.4.2 Exclusion Criteria

The study excluded patients pronounced dead on arrival, those with pathological fractures and patients previously admitted at other hospitals before transfer to MTRH.

3.5 Sample Size and Sampling Techniques

The sample size was calculated using Fisher´s formula (Mugenda & Mugenda, 2003).

$$n = \frac{Z^2 pq}{d^2}$$

$n = \frac{(1.96)^2 0.5.0.5}{0.05^2} = 384$

Where

n=Desired sample size of population more than 10,000

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

p=Estimated proportion of patients with adequate prehospital care

Set at 0.5 (maximum variability) since the proportion is not known

q=1-p

d=Desired level of precision, minimum error 5%

Therefore,

$n=\frac{(1.96)^2 0.5.0.5}{0.05^2}=384$

Unpublished hospital records show that the average number of trauma patients seen in MTRH is 2680. Out of these; about 400 had lower extremity fractures. From previous studies (Aitken et al., 2012; Botchey et al., 2017; Court & Caesar, 2006; Singer et al., 1998), 15% of trauma patients have lower limb fractures.

An average of 399 patients with lower extremity fractures are seen annually at MTRH Emergency Department.

Since the population was less than 10, 000, finite population correction was done using the following formula

$$nf = \frac{n}{1+\frac{n}{N}}$$

*n*f- Desired sample size of population less than10,000 people

$nf=\frac{384}{1+\frac{384-1}{399}}$=196 adult patients with lower extremity fractures

Systematic sampling of 196 adults was done by picking every second patient who met the inclusion criteria. The first entered patient was picked by simple random sampling on the day of commencing the study (1st January 2017).

3.5 Data Collection, Instruments and Procedures

Following institutional approval, patients with lower limb fractures presenting at MTRH Accident and Emergency department at MTRH and met the inclusion criteria were identified and systematically recruited into the study after giving informed consent. Data was collected using a pre-coded interviewer administered questionnaire and examination findings documented in standard data collection sheets.

The following parameters were evaluated: socio-demographic characteristics, mechanism and site of injury, mode of transport from site of injury to hospital, prehospital time which in the study is defined as time from injury to arrival at Accident and Emergency department, general trauma life support measures performed, extremity care measures performed in the prehospital setting – wound care measures, hemorrhage control, fracture stabilization and splinting of fractured limbs. The Ontario Prehospital Advanced Life Support (OPALS) Trauma Study Scoring for prehospital lower extremity care was used and the trauma care interpreted as either adequate or inadequate (Steill et al., 1999).

Data was collected between 1st January 2017 and 31st December 2017.

3.6 Data Analysis

Data obtained was imported into STATA version 13 SE coded, cleaned and analysed. Categorical variables such as sex, occupation, cause of injury, and fracture type among others were summarized as frequencies and the corresponding percentages. Numerical variables such as age and prehospital time interval that violated the Gaussian assumption were summarized as median and the corresponding interquartile range. Prehospital score was grouped into two binary categories; adequate and inadequate. Association between categorical variables was assessed using Pearson's Chi Square/Fisher's exact test. Mann Whitney U test was used to compare median prehospital time between binary categorical variables such as fracture type, cause of injury, age, ISS, sex and fracture type. Variables that were found to be significantly associated with outcome at bivariate level were fitted in multiple binary logistic regression analysis. All statistical tests were performed at 95% Confidence Interval. The findings were presented in prose form, tables and graphs.

3.7 Quality Control

Review of data after collection to check for missing data and unclear parts, cleaning of data and counterchecking was done.

3.8 Ethical Considerations

The study was approved by IREC before its commencement and the IREC approval reference number was FAN/2016/123. Subsequently, permission to conduct the study was granted by MTRH administration. Informed consent was obtained from patients. It was voluntary participation and freedom to withdraw at any stage was granted as per Helsinki declaration (World Medical Association, 2001).

Patients were informed appropriately on the study to be conducted in a language adequately understood, there was also written information.

Confidentiality of data was maintained during and after research.

There was a plan to disseminate the findings through oral defense of the thesis, sharing of the research findings with the Department of Orthopaedics of MTRH and the intent to prepare manuscripts for publication in peer reviewed journals.

3.9 Study Limitation

Limitations in this study included its inability to sometime differentiate between patients who were referred from other hospitals from those presenting to the Accident and Emergency Department for the first time. This was mitigated by the researcher thoroughly scrutinizing all ambulance logs and referral notes.

This was a hospital based study therefore the nature of the study automatically excluded out of hospital deaths where prehospital time intervals and prehospital interventions might have played a role. Also being a hospital based study, it was prone to recall bias; this was mitigated by verifying given information with a reliable third party, ambulance logs and examination of injuries.

CHAPTER FOUR: FINDINGS

4.0 Introduction

The findings are based on 196 adult (≥18 years) patients with lower extremity fractures.

4.1 Socio-Demographics

The age of the patients ranged from 19 to 89 years with a median of 35.5 (IQR27, 49.5) years. The ratio of male to female was 4.8:1 (male: 82.6%, female: 17.4%). Age above 83 years was considered outlier, and five patients were in this category.

Table 1: Socio-demographic characteristics

Variable (n=196)	Categories	Median (IQR) or n (%)
Age (years)	Median (IQR)	35.5 (27, 49.5)
Sex	Male	162 (82.6%)
	Female	34 (17.4%)
Occupation	Formal	58 (29.6%)
	Informal	90 (46%)
	Dependents	48 (24.5%)

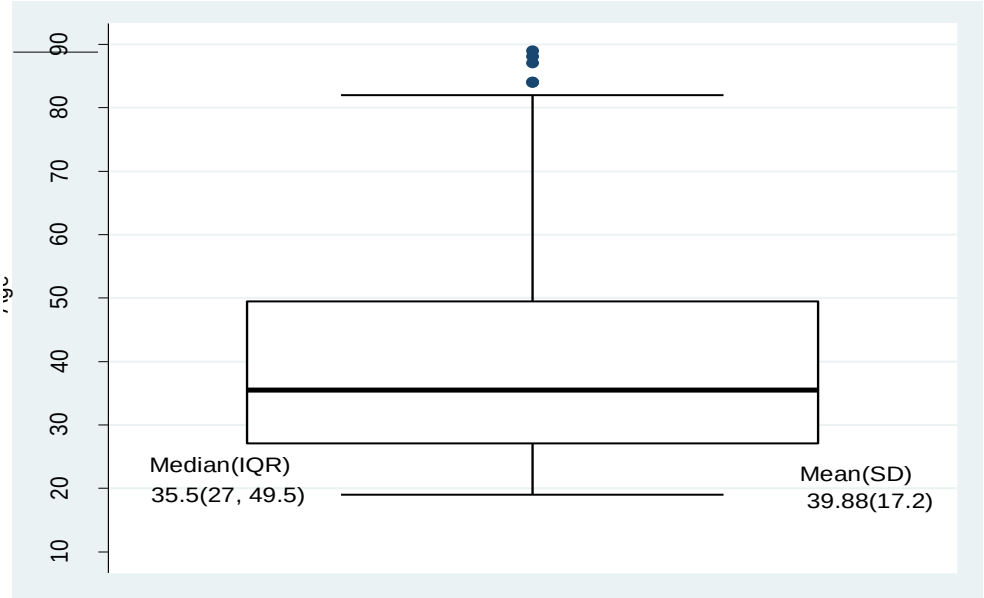


Figure 1: Age Distribution

The distribution age was slightly skewed to the right.

4.2 Mechanism of Injuries

Table 2: Mechanism of Injury

Cause of injury	Frequency(n=196)	Percentage (%)
RTA	149	76.0
Fall	31	15.8
Assault	10	5.1
Farm related	4	2.0
Hit by falling objects	2	1
Total	196	100

The mechanism of injury for 149 (76.0%) patients was road traffic accidents (RTA), 31 (15.8%) by falls and 10 (5.1%) assaults.

4.2.1 Arrival Time

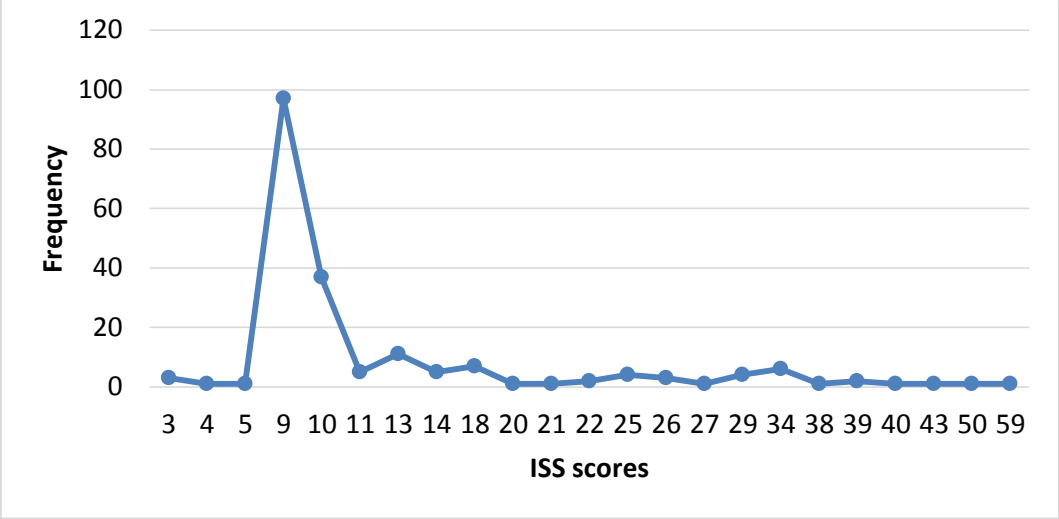
One hundred and twenty-four (63.3%) patients arrived in MTRH during the day (7am – 5pm) and 72 (36.7%) patients arrived at night (6pm to7 am).

4.3 Injury Type and Severity

Table 3: Injury Type and Severity

Variable	Category	Frequency(n=196)	Percentage (%)
Other associated Injuries	Upper extremities	58	29.6
	Head & neck	40	20.4
	Face	37	18.9
	Chest	12	6.1
	Abdomen	3	1.5
Fracture type	Closed	133	67.9
	Open	63	32.1
Fractured Bone	Femoral	85	43.4
	Tibia/fibular	57	29.1
	Ankle	40	20.4
	Foot	9	4.6
	Patella	5	2.5
Injury severity score (ISS)	Median(IQR), Min-Max	9 (9, 13)	3 – 59

Other associated injuries were on the upper limbs to 58 (29.6%) patients, head and neck to 40 (20.4%), face 37 (18.9%), chest injuries to 12 (6.1%) and abdomen to only3 (1.5%) patients. Closed fractures were more common 133(67.9%) compared to open fractures 63 (32.1%).



The ISS score ranged from 3 – 59 with a median of 9 (IQR 9, 13).

Figure 2: ISS Score Distribution

4.4 First Responder and Mode of Transport to MTRH

Table 3: First Responder and Mode of Transport to MTRH

Category	Category	Frequency (n=196)	Percentage (%)
First responder	Bystanders	135	68.0
	Ambulance staff	44	22.4
	Police	16	8.2
	Fire brigade	1	0.5
Medical assistance elsewhere before MTRH	Direct to MTRH	74	37.8
	Health Centre	49	25.0
	County hospital	35	17.9
	Private clinic	30	15.3
	Dispensary	8	4.1
Transport mode	Ambulance	96	49.0
	Public service vehicle	59	30.1
	Private vehicle	20	10.2
	Motorcycle	12	6.1
	Police vehicle	9	4.6
Prehospital Analgesic given	Yes	55	28.1
	No	141	71.9

The first responder at the scene of accident was a bystander for 135 (68.9%), ambulance staff for 44 (22.5%) and police for 16 (8.2%) patients.

Out of 196 patients, 122 (62.2%) passed by other healthcare facilities before they were brought to MTRH. These health facilities were health centers for 49 (25%) patients, 35(18%) patients for County hospitals and 30 (15%) patients for private clinics.

One hundred and forty-one (71.9%) patients did not receive any analgesic before they arrived at MTRH. Twenty-nine (14.6%) patients were given analgesics by the ambulance paramedics.

Out of the 122 patients who sought healthcare services elsewhere, 71(58.2%) were referred to MTRH using ambulance as a mode of transport.

4.5 Time from Injury to Arrival at MTRH

	Time	**Frequency(n=196)**	**Percentage (%)**
Prehospital time lapse	Up to 1 hour	67	34.2
	>1 to 6 hours	97	49.5
	>6 to 12 hours	18	9.2
	>12 to 48 hours	14	7.1
Totals		196	100

On average, it took patients 3.32 hours to arrive at the hospital. The longest time taken was 23 hours and shortest time being 10 minutes with median time of 1.5 IQR (0.83, 3.29).

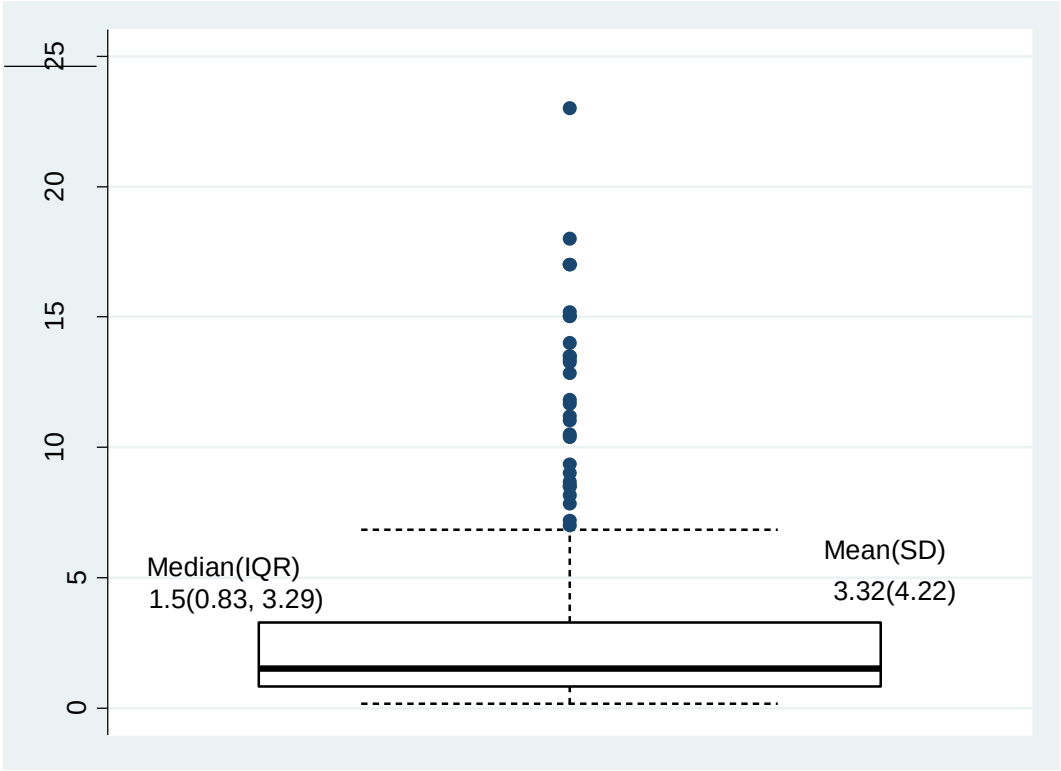


Figure 3: Prehospital Time Distribution

4.5 Prehospital Trauma Care Interventions

Table 4: Prehospital Interventions

Type	Category	Frequency	Percentage (%)
Prehospital assessment, Primary and secondary survey (n=196)	NO	112	57.1
	YES	84	42.9
Analgesics(n=196)	YES	55	28.0
	NO	141	71.9
IVF (n= 63)	YES	12	19.7
	NO	51	80.9
Splinting (n=196)	NO	135	68.9
	YES	61	31.1
Splinting type (n=61)	Thomas splint	33	54.1
	Improvised cartons/wood block	21	34.4
	POP/Back slab	7	11.5
Splinting adequacy (n=61)	No	17	27.9
	Yes	44	72.1
Wound care- Dressing and decontamination (n=63)	YES	28	44.4
	NO	35	55.6
External hemorrhage control (n=63)	Not done	44	69.8
	Pressure Dressing	19	30.2
Prehospital care (n=196)	Adequate	32	16.3
	Inadequate	164	83.7

There was documented prehospital assessment, primary and secondary survey in 84 patients (42.9%). Only 55(28.0%) patients had received analgesics before arrival at MTRH. Splinting was done for 61(31.1%) patients. Those who initially presented to other health facilities, (44.2%) were splinted while those who had not passed through

a health facility first (9.5%) were splinted by ambulance paramedics. Regarding the type of splint used, 33(54.1%) patients had Thomas splint in place on arrival, while 21(34.4%) patients used improvised cartons/wooden block. Those who used improvised carton/wooden block, 21 (75%) patients did not attain adequate splinting. For patients with open fractures (n=63), wound dressing had been done in 28 (44.4%) of patients. Pressure dressing with attempt to control hemorrhage had been done in 19 (30.2%) patients.

In general, most patients 164(83.9 %) had inadequate prehospital trauma care.

4.6 Association between Socio-demographic Characteristics and Prehospital care

Table 5: Association between Socio-demographic Characteristics and Prehospital care

Variable	Category	Prehospital care		*p*-value
		Inadequate (n=164)	Adequate (n=32)	
Age	Median(IQR)	37(27, 51.5)	30(25, 40)	0.039[m]
Sex	Female	30(88.2)	4(11.8)	0.429[c]
	Male	134(82.7)	28(17.3)	
Occupation	Formal	21(84.0)	4(16.0)	0.589[f]
	Informal	114(82.0)	25(18.0)	
	Unemployed	29(90.6)	3(9.4)	

[f]Fishers Exact test; [c]Chi Square; [m]Mann Whitney U test

Those who had adequate prehospital care were younger (30 years) on average compared to those who had inadequate prehospital care and this difference was statistically significant (p=0.039) About 12% of males had adequate prehospital care which was a lower proportion compared to females (17.3%) though the difference

was not statistically significant (p=0.429). In addition, there was no significant association between occupation and prehospital care (p=0.589).

4.7 Association between Prehospital Care and Injury Mechanism, Type and Severity

Table 6: Association between Prehospital Care and Injury Mechanism, Type and Severity

Variable	Category	Prehospital care		*p*-value
		Inadequate (n=164)	Adequate (n=32)	
Cause of injury	RTA	119(79.9)	30(20.1)	0.010[c]
	Others	45(95.7)	2(4.3)	
Other associated Injuries	Isolated fractures	70()	12(14.6)	0.587[c]
	Multiple injuries	94()	20(17.5)	
Fracture type	Closed	120(92.3)	10(7.7)	<0.001[c]
	Open	44(66.7)	22(33.3)	
Fracture Location	Single	107(82.2)	23(17.8)	0.468[c]
	Multiple	57(86.4)	9(13.6)	
Injury severity score	Median(IQR)	9(9, 11)	10(9, 19)	0.004[m]

[c]Chi Square; [m]Mann Whitney U test

There was a high proportion of those with appropriate prehospital care among RTA victims (20.1%) and this was statistically significant high (p=0.010) compared to other mechanisms of injury (4.3%). Likewise, those with open fractures had a higher proportion (33.3%) of patients who had adequate prehospital care compared to those who had closed fractures (7.7%). However there was no statistically significant association between prehospital care, location of fracture and the number of injuries

in multiply injured patient. On average those who were accorded adequate prehospital care had statistically significant higher ISS.

4.8 Association between Prehospital Care and First responder, Mode of transport to MTRH and Prehospital Time

Table 7: Association between Prehospital Care and First responder, Mode of transport to MTRH and Prehospital Time

Variable	Category	Prehospital care		*p*-value
		Inadequate (n=164)	Adequate (n=32)	
Pre-hospital time lapse	Median(IQR)	1.5(0.8, 3.5)	1.6(0.9, 3)	0.835[m]
First responder	Bystanders	125(92.6)	10(7.4)	<0.001[c]
	Professionals	39(63.9)	22(36.1)	
Medical assistance elsewhere before MTRH	Direct to MTRH	62(83.8)	12(16.2)	0.974[c]
	Elsewhere	102(83.7)	20(16.3)	
Transport mode	Ambulance	66(68.7)	30(31.3)	<0.001[c]
	Others	98(98)	2(2)	

[c]Chi Square; [m]Mann Whitney U test

A statistically significant (p<0.001) higher proportion (31.3%) of those who were transported by an ambulance had adequate prehospital care compared to those transported through other means.

Prehospital time and medical assistance elsewhere before MTRH were not statistically associated with quality of prehospital care received. However, initial helper(s) was statistically significantly (p<0.001) associated with quality of prehospital care where

those assisted by professionals (ambulance staff, police or fire brigade) were associated with adequate prehospital care.

4.9 Comparison between Prehospital Time and other factors

Table 8: Association between Prehospital Time and other variables

Variable	Category	Median (IQR)	Min - Max	*p*-value
Fracture type	Closed	1.33 (0.83, 3.17)	0.17 – 23	0.212
	Open	2 (1, 3.5)	0.33 – 18	
Cause of injury	Others	2.5 (1, 5.5)	0.5 – 23	0.030
	RTA	1.5 (0.83, 3)	0.17 – 18	
Multiple vs. isolated injury	Isolated fractures	1.9 (1, 5)	.33 – 18	0.120
	Multiply injured	1.5 (0.83, 3)	0.17 – 23	
Sex	Female	1.9 (1.17, 7)	0.33 – 17	0.160
	Male	1.5 (0.83, 3.17)	0.17 – 23	
Wilcoxon rank-sum				

The median prehospital time was lower for RTA (M=1.5 hours) compared to other mechanism of injuries (M=2.5 hours) and this difference was statistically significant (p=0.03).

4.9.2: Multivariate Analysis of Factors Associated with Prehospital Trauma Care

Table 9: Multivariate Analysis of Factors Associated with Prehospital Care

Variable	Category	AOR	95% CI	*p*-value
First responder	Bystanders	1		
	Professionals	2.64	0.99-6.99	0.051
ISS	Covariate	1.02	0.97-1.07	0.327
Fracture type	Closed	1		
	Open	3.91	1.55-9.81	0.004
Mechanism of injury	Others	1		
	RTA	1.51	0.27-8.33	0.635
Age	Covariate	0.97	0.93-1.00	0.124
Transport mode	Others	1		
	Ambulance	11.10	2.31-53.41	0.003

AOR – Adjusted Odds Ratio

In the multiple logistic regression, fracture type and transport mode were statistically significantly associated with adequate prehospital care. Those transported by ambulance had 11.1 increased odds of having received adequate prehospital care compared to those transported by other means. Similarly those with an open fracture had 3.9 higher chances of having received adequate prehospital care compared to the patients with closed fractures. Though not statistically significant, those who were attended to by professionals (ambulance staff, fire brigade and police) had 2.6 higher chance of getting adequate prehospital care compared to those who were attended to by bystander at the site of injury.

CHAPTER FIVE: DISCUSSION

5.1 Socio-Demographics

Injury prevention and control involves studying the patterns and causes of injuries and applying the findings to public policy with the goal of reducing the frequency and severity of injuries (Adam et al., 2008).

The results of this study highlight important demographic aspects of the problem of injury in Kenya. This study revealed that most patients with severe lower extremity fractures were in their most productive years with median age of 35.5(IQR27, 49.5).

Most of these injuries involved young men. The ratio of male to female was 5:1. This young male preponderance is a feature of a number of studies describing the injury situation in other regions of developing countries (Botchey et al., 2017; Kobusingye et al., 2002; Otieno et al., 2004). The potential for high Disability Adjusted Life Years (DALYs) losses suggested by injuries in this group clarifies the need for greater efforts to address injury prevention and if the injury has occurred, the need for reduction of morbidity and mortality, which prehospital trauma care aims to do.

The risk of injury is disproportionately borne by the under-privileged. Majority of the patients in this study worked in the informal sector. From the economic perspective, the importance of minimizing the long-term sequelae on these wage earners and breadwinners cannot be overstated. Further, the financial strain on the healthcare system is significant because this group of patients do not have medical insurance and neither do they have expendable income to be able to meet their treatment cost (Botchey et al., 2017).

5.2 Mechanism and Nature of Injury

Road Traffic Accidents were the most frequent cause (76%) of lower extremity fractures in this study, overwhelming all other causes. Falls were the second leading cause of injury in this study (15.9%). Similar trends have been found by other researchers. The three aetiologies (RTA, fall and assault) accounted for 96.9% of the injuries. The findings of this study were in agreement with those reported by Otieno, T et al., (2004) in a study conducted in Kijabe, Kenya, where the leading mechanism was RTA in 52% and falls at 22%. Chalya et al., (2012) in a study conducted at a tertiary hospital in Tanzania had 93% of injuries caused by RTA. The results are also in agreement with what Fazel et al., (2012) in a study done in Iran on demographic profile of the injured adults where 65% of injuries were caused by RTA.

The incidence of RTAs is predicted to rise as developing countries undergo rapid motorization, taking in to consideration the poor roads with cheap and readily available second hand vehicles that may not be roadworthy (Nordberg, 2000). The rise in the use of motorcycles in Kenya in the last 15 years has been associated with increased injury rates. According to the study by Saidi and Mutiso (2013) in Nairobi, Kenya, they found that between 2004 and 2010, motorcycle injuries increased at a rate of 29 % and, in some hospitals, motorcycle users were the predominant road user category among the injured. The injuries to the lower limbs and the head predominate in motorcycle trauma.

5.3 Severity of Injury

Analysis showed that on average those who were accorded adequate prehospital care had significantly higher ISS. There were no statistically significant differences in severity of trauma in either male or female. This is also in agreement with Saidi,

(2003) in a study done in Kenyatta National Hospital on initial care of road traffic accidents; it showed that ISS had an effect on the initial care received.

In trauma, mortality rates are highly related to the severity of injury experienced by individual patients. In this study 74% of patients had other associated injuries. Shock, a hypovolemic state, would considerably decrease the possibility of survival chances in trauma patients, if not treated in a timely fashion.

5.4 Mode of Transport

The mode of transport used affects the quality of prehospital intervention; time to hospital; and safety and comfort of patients while en-route. It is therefore a key factor in being able to provide early intervention and improve clinical outcomes.

A study in a tertiary hospital in Uganda by Otieno et al., (2011) found that only 15.5% of patients with musculoskeletal injuries were brought to a tertiary hospital by means of an ambulance. This contrasts the findings in the current study where 48% of patients were brought to MTRH by an ambulance, with the rest (including 71% of those who had passed through other facilities) arriving via other less desirable methods. This could be because the study included all musculoskeletal injuries, where some were considered minor and patients could not seek transport by ambulance. Exacerbation of fractures in patients forced to sit up right or slumped into the back of pickup trucks without rigid support may have occurred. The basics of prehospital trauma care, placement of peripheral lines for IVF resuscitation, and rigid back support could be provided in an ambulance and not possible in other modes of transport.

In both Seattle in United States of America and Monterrey in Mexico, 96% of the injured arrived at the hospital by ambulance (Arreola-Risa et al., 2000). This shows a

big disparity in the mode of transport between the developed and developing countries, which is a very crucial factor in management of patients with lower extremity fractures. If Kenya is to set up an EMS, priority areas will involve rapid prehospital ambulance service.

5.5 Prehospital Time

The ideal time to maximise outcome of trauma is when injury to definitive care happens within 60 minutes ”golden hour” of trauma (Kotwal et al., 2016). The time interval between the occurrence of trauma and the delivery of definitive care in a trauma centre is considered to play an important role in survival and limb outcome.

In this study, the prehospital time recorded was much longer than those in other studies in high and middle income countries. The injured, in the current study, arrived to hospital after an average time of three and half hours from injury. Only 34.2% of the injured arrived at MTRH in less than one hour. In the study by Arreola-Risa et al., (2000), the injury to hospital arrival times in Monterrey in Mexico was 73.0 ± 37.7 minutes. In Seattle, Washington, combined response, scene, transport time was 31.3 ± 9.8 minutes.

The results in the current study were also concurs with those from nearby Uganda where 46% of the injured reached Kampala hospitals within one hour (Mehmood et al., 2018). It was also in agreement with the study by Kigera and Naddumba (2011) in Uganda where the median delay in presentation to Mulago hospital was 3.5 hours. The long prehospital times in this study has profound implications for outcome and may have as its basis a lack of organized prehospital services in the region. Therefore, when injured, this group was at the mercy of bystanders and useful time was spent organising for transport to MTRH.

On analysis, average prehospital time was statistically significantly (p=0.030) lower (M=1.5 hours) among those whose cause of injury was RTA compared to other mechanisms of injury (M=2.5 hours). This could be explained by the fact that most RTAs occur on the highways and major roads where accessing the hospital might be easier compared to injuries occurring in the farm areas in rural communities.

5.6 Prehospital Trauma Interventions

Lower limb fractures are common injuries in prehospital care. Untreated fractures can lead to hypovolemic shock especially if open, and should be treated with effective haemorrhage control and splinting. A brief assessment for open fractures, deformity, and neurovascular compromise should be followed by effective analgesia, wound management, reduction (if needed), splinting, and packaging of the patient (Lee & Porter, 2005) Early adequate management reduces the morbidity and mortality of lower limb fractures.

Absence of a well-functioning and widely accessible prehospital trauma care system leaves unskilled and inadequately skilled caregivers to fill the gap. In this study, the first responder at the scene of accident was mostly by bystanders (69%). In the current study, though not statistically significant, those who were attended to by professionals (ambulance staff, fire brigade and police) had 2.6 times higher chance of receiving adequate prehospital care compared to those who were attended to by bystander at the site of injury.

This unique situation has been observed in other studies in sub-Saharan Africa (Andrews et al., 1999; Otieno et al., 2011), with prehospital care delivered by lay persons in 85% cases of injured patients arriving at a tertiary Kampala hospital. It is therefore not surprising that a small percentage of patients in this study received any

form of assessment, resuscitation, or adequate care in the prehospital period. Improved prehospital management may shorten hospital stays and reduce systemic costs.

Most patients did not receive the full complement of the basic interventions expected in the prehospital period, to include an assessment of respiratory status, airway protection, monitoring and assistance, bleeding control, intravenous access and wound care. Though with a median ISS of 9 (IQR 9, 13) and 32% of patients with open fractures, likely there were a significant number that may have benefited from early fluid resuscitation. This observation may be due to inadequate skills and material resources leading to failure in providing better care in a resource constrained setting.

5.7 Prehospital Care of the Fractured Extremity

In the current study, there was documentation of prehospital primary and secondary survey in 84 patients (42.8%). This finding is similar with the study by Otieno et al., (2011), where prehospital assessment and ATLS for patients with musculoskeletal injuries was only done for 18.4% of patients arriving at a tertiary hospital in Kampala, Uganda and in 29.2% there was an attempt to arrest active bleeding. Intravenous fluid infusion of 0.5-2 liters was administered to 11.4% patients who were deemed to require on arrival at the hospital. All were patients who had first presented to other lower level health facilities.

In this study, splinting was done for only for 31% of patients. Those who initially presented to other health facilities, only 44.2% were splinted while those who had not passed through a health facility first, only 9 % were splinted by ambulance paramedics. Regarding the type of splint used, 54 % of splinted patients had Thomas splint in place on arrival, 34% used improvised cartons/wooden block. This is in

agreement with a study done in Uganda by Otieno T et al., (2011), where only 24% of patients with fractures and splinting deemed necessary at the time of presentation at Mulago Hospital had been splinted. With various options available, even in a significantly resource constrained setting that a known fracture should not be splinted. Splinting provides a means to decrease pain, prevent potential neurovascular damage, and avoid further soft tissue damage.

Contrary to researcher's expectation, analgesic administration occurred in only 55 (28%) patients before arrival at MTRH. This is also the same pattern observed by Oluwadiya et al., (2005) in Nigeria, where prehospital analgesia was considered adequate in 15.1% of patients, inadequate in 5.6% and was not administered in 79.6%. Even though the current study did not establish the adequacy of the analgesia in those who received, it can be seen that the pattern is similar where most of the injured patients did not receive any form of analgesia. Severe trauma of extremities with fractures leads to extreme pain which can lead to significant emotional stress which eventually result in post-traumatic stress disorder in up to 40% of major trauma patients (Rogovik & Goldman, 2007).

Lastly, in the study by Oluwadiya et al., (2005), on prehospital care of the injured in South Western Nigeria, of those presenting to a national referral hospital with musculoskeletal injuries, wounds were not dressed, and no antibiotics administered in 40.6% and 68.1% of open fractures respectively. This was in agreement with the current study where those with open fractures, wound dressing was not done in 66% of patients. Pressure dressing with attempt to control hemorrhage had been done in 30.1% of patients. For trauma patients with open fractures, the first priority is haemorrhage control. Splinting, irrigation and wound care should be performed in the

prehospital setting and this has been shown to reduce complications like infections, fat embolism syndrome and compartment syndrome (Melamed et al., 2007).

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1: Conclusions

1. Road traffic accident was the major cause of lower extremity fractures and it affected mostly young men of productive age group.
2. Most patients with lower extremity fractures had other associated injuries.
3. Only One third of patients with lower extremity fractures presented within the "golden hour" of trauma.
4. Only 49% of the injured patients were transported to hospital by an Ambulance.
5. Adequate prehospital care was associated with professional first responder after injury and transport by an ambulance.
6. Overall, prehospital trauma care for patients with lower extremity fractures was found to be inadequate.

6.2: Recommendations

1. The national, county governments and non-state actors should establish a formal prehospital trauma protocol, guidelines and standards of service. This will ensure safe care and expeditious transport of the patient with lower extremity injuries.
2. Ambulance as a mode of transport for patients with lower extremity fractures to be provided.
3. There is need for establishment of emergency medical service, implementation of protocols for transport of trauma patients to the appropriate hospital and coordination of care.
4. There is need to make efforts towards prevention of RTAs because it is the major cause of lower extremity fractures. This can be done by implementing and observing WHO standard of road traffic safety.
5. . Further research is recommended on the effect of prehospital trauma care on the outcome of trauma patients in our setting.

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APPENDICES

Appendix 1: IREC Approvals

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471/2/3

MOI UNIVERSITY
SCHOOL OF MEDICINE
P.O. BOX 4606
ELDORET

Reference: IREC/2016/123

21st July, 2016

Dr. Korir Methuselah Tirop,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET-KENYA.

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
21 JUL 2016
APPROVED
P. O. Box 4606-30100 ELDORET

Dear Dr. Korir,

RE: PROVISIONAL APPROVAL

The Institutional Research and Ethics Committee has reviewed your research proposal titled:-

"Prehospital Care of Patients with Lower Extremity Fractures Presenting at Moi Teaching and Referral Hospital."

Your proposal has been granted ***one month provisional approval*** from 21st July, 2016 subject to ratification by IREC Full Board. Note that this is a preliminary approval and you are only allowed to set-up in readiness for the study but no recruitment should take place within this period until formal approval is granted.

Sincerely,

PROF. E. WERE
CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc CEO - MTRH Dean - SOP Dean - SOM
Principal - CHS Dean - SON Dean - SOD

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471/2/3

MOI UNIVERSITY
SCHOOL OF MEDICINE
P.O. BOX 4606
ELDORET
Tel: 33471/2/3

Reference: IREC/2016/123
Approval Number: 0001692

28th July, 2017

Dr. Korir Methuselah Tirop,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET-KENYA.

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
28 JUL 2017
APPROVED
P. O. Box 4606 - 30100 ELDORET

Dear Dr. Korir,

RE: CONTINUING APPROVAL

The Institutional Research and Ethics Committee has reviewed your request for continuing approval to your study titled:-

"Prehospital Care of Patients with Lower Extremity Fractures Presenting at Moi Teaching and Referral Hospital".

Your proposal has been granted a Continuing Approval with effect from 28th July, 2017. You are therefore permitted to continue with your study.

Note that this approval is for 1 year; it will thus expire on 27th July, 2018. If it is necessary to continue with this research beyond the expiry date, a request for continuation should be made in writing to IREC Secretariat two months prior to the expiry date.

You are required to submit progress report(s) regularly as dictated by your proposal. Furthermore, you must notify the Committee of any proposal change (s) or amendment (s), serious or unexpected outcomes related to the conduct of the study, or study termination for any reason. The Committee expects to receive a final report at the end of the study.

Sincerely,

DR. S. NYABERA
DEPUTY-CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc:	CEO	-	MTRH	Dean	-	SOD
	Principal	-	CHS	Dean	-	SPH
	Dean	-	SOM	Dean	-	SON

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471/2/3

MOI UNIVERSITY
SCHOOL OF MEDICINE
P.O. BOX 4606
ELDORET

Reference: IREC/2016/123
Approval Number: 0001692

28th July, 2016

Dr. Korir Methuselah Tirop,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET-KENYA.

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
28 JUN 2016
APPROVED
P.O. Box 4606-30100 ELDORET

Dear Dr. Korir,

RE: FORMAL APPROVAL

The Institutional Research and Ethics Committee has reviewed your research proposal titled:-

"Prehospital Care of Patients with Lower Extremity Fractures Presenting at Moi Teaching and Referral Hospital".

Your proposal has been granted a Formal Approval Number: ***FAN: IREC 1692*** on 28th July, 2016. You are therefore permitted to begin your investigations.

Note that this approval is for 1 year; it will thus expire on 27th July, 2017. If it is necessary to continue with this research beyond the expiry date, a request for continuation should be made in writing to IREC Secretariat two months prior to the expiry date.

You are required to submit progress report(s) regularly as dictated by your proposal. Furthermore, you must notify the Committee of any proposal change (s) or amendment (s), serious or unexpected outcomes related to the conduct of the study, or study termination for any reason. The Committee expects to receive a final report at the end of the study.

Sincerely,

PROF I.E. WERE
CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc CEO - MTRH Dean - SOP Dean - SOM
Principal - CHS Dean - SON Dean - SOD

Appendix 2: Introductory Letter

I am Dr. Methuselah Tirop Korir, a medical doctor currently pursuing Master of medicine degree in Orthopaedic surgery at Moi University, College of Health Science- Eldoret. I am conducting a study titled: **PREHOSPITAL CARE OF PATIENTS WITH LOWER EXTREMITY FRACTURES PRESENTING AT MTRH.**

You are being requested to take part in a research study. This information is provided to tell you about the study. Please read this form carefully. You will be given a chance to ask questions. If you decide to be in the study, you will be given a copy of this consent form for your records.

Taking part in this research study is voluntary. You may choose not to take part in the study. Saying no will not affect your rights to health care or services. You are also free to withdraw from this study at any time. If after data collection you choose to quit, you can request that the information provided by you be destroyed under supervision and thus not used in the research study. You will be notified if new information becomes available about the risks or benefits of this research. Then you can decide if you want to stay in the study

The purpose of the study is to evaluate the quality of prehospital trauma care of patients with lower extremity fractures. The process of your participation will involve examining your injuries, review of your investigations done (radiographs) and oral interviews. You have been chosen to participate in the study because you have lower extremity fracture as a result of trauma. Your participation in the study will not change the treatment you will be receiving at the hospital or neither will it prolong your hospital stay.

Information you will provide will be kept private and safe in a manner no one is able to trace it back to you.

For more information concerning your rights as a research subject: You may contact Institutional Review Ethics Committee (IREC) telephone number 053 33471 Ext.3008.

IREC is a group that reviews studies for safety and to protect the rights of study subjects.

Yours faithfully,

……..

Dr. Korir Methuselah

P.O Box 8924, Eldoret

Tel-0724420867

Barua Ya Utangulizi

Mimi ni Daktari Methuselah Tirop Korir. Nimehitimu kama daktari na nimesajiliwa na Bodi ya Madaktari ya Kenya. Kwa sasa, ninasomea shahada ya juu (masters) ya udaktari wa upasuaji wa magonjwa ya mifupa katika Chuo Kikuu cha Moi. Ninafanya utafiti kuhusu matibabu ya kwanza kabla ya hospitali kwa wagonjwa walio umia mguu.

Ninaomba ujiunge na utafiti huu. Maelezo yafuatayo yanahusu utafiti wangu. Ningependa usome na iwapo una maswali yoyote kwa sasa au baadae kuwa huru kuuliza.

Kujiunga kwako ni kwa hiari. Kutojiunga hakutaathiri matibabu yako ya baadae. Una huru wakujiondoa kutoka kwa utafiti huu wakati wowote. Iwapo kutatokea maelezo zaidi kuhusu utafiti huu tutakueleza na utapata fursa ya kuamua iwapo ungependa kuendelea na kujihusisha na utafiti huu.

Hakutakuwa na wakati wa kufuatiliwa kwa minajili ya utafiti kwani tutamaliza shughuli ya utafiti kwa siku moja.

Maelezo yote utakayotoa yatahifadhiwa vyema na kwa njia ya siri. Pia, hatutatumia maelezo yoyote ambayo yanawezesha kukufahamisha.

Iwapo utahitaji maelezo zaidi, waweza kuwasiliana na kikundi kinachoangazia utafiti na usawa wake wa IREC katika nambari ya rununu 053 – 33471 (ext 3008)

Mimi wako mwaminifu,

_____

Daktari Methuselah Tirop Korir

SLP 8924 Eldoret.

Nambari ya Rununu 0724420867

Appendix 3: Consent Form

CONSENT FORM FOR ADULT (ABOVE 18 YEARS)

I ……of……..phone number……..

Hereby voluntarily agree to participate in the study mentioned above regarding PREHOSPITAL CARE OF PATIENTS WITH LOWER EXTREMITY FRACTURES PRESENTING AT MTRH. The nature of the study has been clearly been explained to me by Dr.Korir Methuselah / his assistant in a language that I understand.

No force has been used or any form of special treatment promised to attract me to participate in the study however I may withdraw from it if I wish to and I shall not be treated differently or be mistreated.

No harm as a result of my participation in the study has been assured.

Name of participant……Signature…….Date……

Name of witness……Signature ……. Date……

Fomu ya Kibali
MADA YA UTAFITI: Prehospital Care of Patients with Lower Extremity Fractures Presenting at Moi Teaching and Referral Hospital, Eldoret, Kenya.

MTAFITI: Dr. Methuselah Tirop Korir

P.O Box 8924 Eldoret,

Simu ya Rununu: 0724420867

Mimi _____wa Sanduku la Posta _____, Nambari ya Simu_____najitolea kwa hiari yangu mwenyewe kutoa kibali cha kujihusisha katika utafiti uliotajwa hapo juu unaoendelezwa katika MTRH. Nimepokea maelezo ya tafsili kuhusu utafiti huu kutoka kwa Daktari Methuselah Korir (au Mtafiti msaidizi wake) katika lugha, kanuni na masharti ninayoelewa vyema. Mchakato wa ushiriki wako utahusisha kuchunguza majeraha yako, uhakiki wa uchunguzi wako kufanyika na mahojiano ya mdomo. Umechaguliwa kushiriki katika utafiti kwa sababu umejeruhiwa mguu. Nimehakikishiwa kuwa, sitadhurika kamwe kutokana na kujihusisha kwangu katika utafiti huu. Ilibainishwa kuwa kujihusisha katika utafiti huu ni kwa hiari na nina uhuru wa kujiondoa wakati wowote ule bila ya kuhujumiwa hasa kuhusu haki yangu ya kupokea matibabu katika MTRH. Zaidi ya hayo, nilihakikishiwa kuwa, kanuni zote za maadili ya utabibu, uhuru, haki, na manufaa zitazingatiwa katika utafiti huu.

Jina la Mhojiwa_____

Sahihi _____

Tarehe _____

Jina la shahidi _____

Sahihi _____

Tarehe_____

_

Appendix 4: Data Collection Tool

1. Socio Demographic characteristics

Subject Code _____

Patient Number _____

Age _____

Gender Male ☐ Female ☐

Occupation_____

Religion: _____

Level of education Post graduate: Graduate ☐ Secondary ☐ Primary ☐ None ☐

Time of arrival at hospital: _____

2. Injury circumstances

Time of injury: _____

Place of injury: _____

3. Cause of Injury

Road traffic accident ☐

Fall ☐

Assault ☐

Other (specify) _____

4. Who initially helped you at the scene of injury?

Ambulance staff ☐ Police ☐ Bystanders ☐ Fire brigade ☐

Teacher ☐

Other (Specify) _____

What kind of medical assistance did you receive?

_____

5. Did you seek medical assistance elsewhere before coming to MTRH?

Yes ☐ No ☐

If yes to (5) above, where?

Hospital ☐ Private Clinic ☐ Health Centre ☐ Dispensary ☐

Other (Specify) _____

What kind of medical assistance did you receive?

_____

6. What was the mode of transport to the hospital?

Ambulance ☐ Public service vehicle ☐ Police Vehicle ☐

Motorcycle ☐ Other (Specify) ----------

7. **Was analgesia provided?** Yes ☐ NO ☐

DATA COLLECTION SHEET

1. **Time of arrival at hospital**: _____
2. **Total prehospital time**: _____
3. **Limb affected**: Right ☐ Left ☐ Both ☐
4. **Other associated injuries**

Head and Neck ☐ Abdomen ☐

Extremities ☐ Chest ☐

Face ☐

5. Type of Lower limb Fracture

Open ☐ Closed ☐

6. Anatomical Location of the fracture(s)

Femoral ☐ Tibia ☐ Fibular ☐ Foot ☐

7. Injury severity score

AIS CODE	INJURY
1	
2	
3	
4	
5	
6	
ISS(AIS 1+AIS2+AIS3)Squared	

8. Prehospital general life support measures performed in the prehospital setting ☐

Airway management and cervical spine control

Breathing ☐

Circulation and hemorrhage control ☐

Disability and GCS score ☐

Exposure and environmental control

9. Lower extremity fracture care

Fracture splinting Yes ☐ No ☐

Type Of splint used

: _____

Is the splinting Adequate? Yes ☐ No ☐

10. For Open fractures

Wound care measures performed

Wounds cover ☐ Decontamination/irrigation ☐

Other: _____

11. External hemorrhage control

Not done ☐ Pressure pac ☐ Tourniquet ☐

Other (Specify): _____

12. Tetanus Toxoid administration: Yes No

Date of discharge: _____

Length of hospital stay (Days: _____

The Ontario Prehospital trauma Advanced Life Support (OPALS) Trauma Study Scoring for prehospital lower extremity care adequacy (Steil et al., 1999).

Quality indicator		**Score**	
Primary, secondary survey	Done Not done	10 0	
Analgesia administration	Yes No	10 0	
Adequate Splinting of fracture	Yes No	10 0	
Mode of transport	Ambulance Others	10 0	
Prehospital time	Less than 1 hr More than 1hour	10 0	
TOTAL SCORE		50	

Adequate prehospital trauma care is score above 40

Appendix 5: Work Plan

DATE	DURATION	ACTIVITY
Dec 2016 – Jan 2016	1 month	Topic selection
Jan 2016 – Feb 2016	1 month	Presentation of the concept paper to the department
March 2016 – May 2016	2 months	Proposal writing
May 2016 – September 2016	-	Submission to IREC
1st January 2017 – 31st December 2017	12months	Data collection
January 2018- May 2019	9 months	Writing and submission of thesis
2020	1 month	Oral defense

Plan of Dissemination

Proposal Writing	September 2016
Thesis Submission	April 2019
Oral defense	August 2020
Sharing the report with: MTRH, County government and Ministry of health	November 2020
Develop manuscripts for publication	November 2020

Appendix 6: Budget

ITEM	COST
Reams of printing papers @ 500	2000
Pens, pencils, rubber, Box file	2000
Flash disks (2)	4000
Research proposal printing	4000
IREC fee	2000
Research assistant 3,000p.m	36000
Data handling	10000
Printing and binding thesis	5000
Air time	5000
TOTAL	**70,000**