

**TREATMENT OUTCOMES OF  
MULTIPLE INJURY PATIENTS  
IN INTENSIVE CARE UNIT,  
KENYATTA NATIONAL  
HOSPITAL**

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# TREATMENT OUTCOMES OF MULTIPLE INJURY PATIENTS IN INTENSIVE CARE UNIT, KENYATTA NATIONAL HOSPITAL

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# DECLARATION

This research proposal is my own original work. All the statements and opinions herein are my own and not those of the hospital, the university or my supervisor.

Signature J. Andhoga Date 1/12/10

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## **DEDICATION**

This research is dedicated to my husband and extended family for encouragement and understanding. Your belief in my ability to excel in academics has greatly contributed in giving me the necessary drive that was needed to finish this work.

## **ACKNOWLEDGEMENTS**

I would like to thank the ethics and research committee, and indeed the management of Kenyatta National Hospital for allowing me to carry out this study. I am also very grateful to my colleagues and consultants whose criticisms were helpful in refining my research. They include Dr A Kibet, Dr. Misango and Dr.Kinyua among others. I also recognize the efforts and dedication of the doctors and nurses at the accident and emergency department and Intensive care unit for the well-being of the patients.

The guidance from my supervisor and teacher Dr. Olang cannot go unrecognized. I'm also greatly indebted to Dr. T. M. Chokwe for reviewing and refining this study.

## **ABSTRACT**

### **BACKGROUND;**

Trauma is a major cause of morbidity and is one of the leading causes of mortality in the world. At The Kenyatta National Hospital, traumatic injury accounts for 8.2% of admissions in the hospital with multiple injuries accounting for 4.7% of the patients. This is the first such study at The Kenyatta National Hospital.

### **OBJECTIVES;**

To document the clinical outcomes, patterns of injury and complications in patients admitted in Intensive care unit with multiple injuries.

### **RESEARCH METHODOLOGY**

A descriptive non-randomized cross - sectional study. Consecutive sampling was done and 52 patients with multiple injuries admitted into the intensive care unit of The Kenyatta national hospital were enrolled into the study and followed up for one month. Data was collected using a survey tool by the principal investigator and analyzed using SPSS version 17 and results presented in various formats. A pilot study was carried out before the actual implementation of the study.

### **RESULTS**

Out of the 52 patients recruited into the study 45(86.5%) were male while 7(13.5%) were female. Majority of the injuries were sustained following RTA 38(73. %) while 19.2% were due to falls. Electrolyte imbalance (32%) and acid base imbalances (26%) were the most commonly observed complications. At 1 month of follow up, 42 patients (80.6%) had died and only 2 (3.8 %) had good recovery while 7 (13.5%) recovered with disability and 1 (1.9%) was vegetative.

### **CONCLUSION**

There is a high mortality rate in patients admitted with multiple injuries in the ICU of Kenyatta National Hospital and much needs to be done to remedy this situation.

# LIST OF ABBREVIATIONS

<b>ARDS</b>	Acute respiratory distress syndrome
<b>GCS</b>	Glasgow coma scale.
<b>ICU</b>	Intensive care unit
<b>ISS</b>	Injury Severity Score
<b>KNH</b>	Kenyatta National Hospital
<b>MSOF</b>	Multiple system Organ Failure
<b>P<sub>s</sub></b>	probability of survival
<b>RTS</b>	Revised Trauma Score
<b>SIRS</b>	Systemic Inflammatory Response Syndrome
<b>SPSS</b>	Statistical Program for Social Scientists
<b>TBI</b>	Traumatic brain injury
<b>TRISS</b>	The Trauma Score–Injury Severity Score
<b>WHO</b>	World Health Organisation
<b>SBP</b>	Systolic Blood Pressure
<b>RR</b>	Respiratory Rate
<b>A&amp;E</b>	Accident and Emergency
<b>IV</b>	Intravenous
<b>CNS</b>	Central Nervous System



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# 1.0 INTRODUCTION AND LITERATURE REVIEW

Trauma is one of the leading causes of mortality in the world<sup>1</sup>. Traumatic injury occurs as a result of deformation of tissues beyond a threshold that results in structural damage.<sup>2</sup> In general injuries are categorized as either penetrating or non-penetrating (blunt trauma) with up to 94% of injuries due to Blunt trauma<sup>3</sup> mostly from road traffic accidents<sup>1, 4, 5</sup>. In 2004, 1.2 million people died in road crashes worldwide, 85% of these were from developing countries with grave economic, social and health consequences.<sup>6</sup> A review of records at the Kenyatta National Hospital showed that in 2008, traumatic injury accounted for 8.2% of admissions in the hospital with multiple injuries reported in 4.7% of the patients. Majority of the patients were male (81.8%). and mortality rate was higher in patients with multiple injuries, i.e. 11% versus 7.2% in the others. Mechanism of injury was reported as RTA (43%), falls (21.5%), assault (22.3%) and assault by firearms (13.9%). In Kenyatta National Hospital, Intensive care unit the mortality rate was 44% and traumatic injury accounted for 19.1% of cases.<sup>7</sup>

Multiple trauma is defined as severe accidental injuries involving more than one body organ system.<sup>8</sup> It may occur in more than 2 thirds of patients with traumatic injury<sup>5</sup> and results in a higher mortality than in patients with injuries at one site of the body only.<sup>9</sup> It has also been observed that patients with their two worst injuries in different body regions have higher mortality than those with their two worst injuries in the same region.<sup>10</sup>

The World Health Organization estimates that injury is the leading cause of death worldwide for both men and women from the ages of 15 to 44, and by 2020, injuries will be the third leading cause of death and disability in all age groups<sup>11</sup> hence.. There is need to improve quality of care of trauma patients to keep up with the rate of increase in traumatic injuries.

Trauma deaths occur at 3 traditionally recognized times after injury,<sup>2</sup> approximately half occur within seconds or minutes of injury; at the scene due to massive haemorrhage, crush injuries, massive CNS trauma or airway obstruction.<sup>2</sup> Second

mortality peak accounts for approximately 30% due to haemorrhage and CNS injuries. The third peak occurs from 1 day after trauma to weeks later and is usually attributed to infection and organ failure.<sup>2</sup> Many deaths may be preventable by prompt recognition of injuries and their physiological significance and definitive intervention. Recent studies have shown that on admission of multiple trauma patients to an intensive care unit, 39% of the deaths were within 24 hours of admission to the Intensive care unit, due to severe brain injury (95%) and from haemorrhagic shock (5%). A Further 60% of deaths occurred more than 24 h after the time of admission to Intensive care unit, mainly due to severe brain injury (75%)<sup>12</sup>. The quality and duration of the pre-hospital care are also factors that influence the length of Intensive care unit stay.<sup>13</sup>

## **Initial management of an acutely injured patient**

The initial evaluation of a critically injured patient is focused on the salvage from early trauma mortality, while critical care is designed to avert late trauma mortality. Advanced trauma life support (ATLS) approach by the American College of Surgeons is the globally accepted standard of care for trauma patients<sup>14</sup>. The initial evaluation follows a protocol of primary survey, resuscitation, secondary survey, and either definitive treatment or transfer to an appropriate health facility for definitive care.

### **Primary survey**

The steps of the primary survey are encapsulated by the mnemonic ABCDE (airway, breathing, circulation, disability, and exposure/environment).<sup>15</sup>

The airway is the first priority. The ability of air to pass unobstructed into the lungs is evaluated, and interventions undertaken, then an evaluation of breathing is done to determine patient ability to ventilate and oxygenate and a decision on the need for a chest tube and mechanical ventilation is made. Adequate circulation is established by treatment of hypovolemia with rapid fluid replacement, pericardiocentesis for cardiac tamponade, and Control of any external haemorrhage with direct pressure or surgery.

Once the cardiopulmonary system is sorted out, a Glasgow Coma Scale and motor examinations is done to rule out serious head or spinal cord injury that may lead to disability. Finally, control patient's exposure to immediate environment to prevent

hypothermia and completely remove patient's clothes for a thorough physical examination for other injuries. Simultaneously, several monitoring and diagnostic adjuncts are done in concert with the primary survey.

### **Resuscitation phase**

This ongoing effort involves monitoring patient's vital signs, protecting the airway with assisted ventilation and oxygenation as required and providing resuscitation with IV fluids and blood products. Radiographic imaging studies should be staged so that lifesaving interventions are not impeded. The most important laboratory test is the type and cross match, but a baseline haemoglobin or hematocrit is also useful on arrival

### **Secondary survey**

This begins after starting the resuscitation phase. A thorough head-to-toe examination is undertaken, a quick repeat of the primary survey to assess patient response to the resuscitation effort and to identify any deterioration and appropriate interventions undertaken. Then, the patient's history, from pre-hospital personnel and family members or other victims is taken.

### **Intensive care unit management**

Trauma is a systemic disease.<sup>16</sup> A patient whose mechanism of injury is of sufficient severity to warrant Intensive care unit care is quite likely to develop alterations in physiology of other organ systems not initially traumatized,<sup>2</sup> and adequate management can only be effectively provided in the environment of the Intensive care unit.

On arrival in Intensive care unit, a survey is made and requirement for continued resuscitation met such as resuscitation of injured brain and start mechanical ventilation if required. A thorough physical exam is done to identify other non life threatening injuries or missed injury, and appropriate radiological investigations are then undertaken.

## Critical care considerations

### Neurologic injury

Traumatic brain injury occurs commonly in the setting of major trauma and significantly contributes to poor outcomes.<sup>17</sup> When severe head injury accompanies multiple injury, it is likely to be the major determinant of late mortality. **Error! Bookmark not defined.** and this is dependent on the severity of the intracranial pathology<sup>18</sup>. The Glasgow Coma Scale (GCS) score quantifies the patient's neurologic status and enables the rapid and uniform communication of the initial assessment of the patient's possible neurologic injury.<sup>17</sup> It is derived from observation and responses to eye opening, best motor responses, and best verbal responses. Regardless of the quality of pre-hospital treatment of isolated head injury, a GCS score lower than 5 carries a very high mortality and for those with GCS scores between 5 and 8, survival depends on adequacy of treatment<sup>19</sup>

### Musculoskeletal injury

Traumatic injury results in tissue damage with loss of function, local haemorrhage, contamination and embolization of air, tissue or particulate matter at the time of injury, resulting in elevated compartment pressure, and persistent local tissue ischemia.<sup>2</sup> Open fractures with significant tissue loss are prone to local infection, necrosis and progressive tissue loss. Therefore, aggressive and frequent operative debridement, change of dressings and systemic antibiotics lead to better outcome.<sup>2</sup>

Orthopaedic injuries are seen in 53.2% of patients with multiple injuries and are generally not life-threatening unless they result in significant hemodynamic instability.<sup>1</sup>

The appropriate timing of fracture repair is controversial<sup>20</sup> Early fixation of long bone fractures is associated with much lower morbidity rates.<sup>2</sup> On the other hand, delayed internal fixation of femoral shaft fracture beyond twelve hours in patients with multi system trauma, allows time for appropriate resuscitation, and reduces mortality by approximately 50%<sup>20</sup>. A similar study showed that pulmonary complications were related to the severity of injury rather than to timing of fracture fixation<sup>21</sup>. Delayed fixation of long bone fractures may increase the incidence of acute respiratory distress

syndrome (ARDS). The mechanisms are uncertain but will probably include ongoing bleeding, increased pain, and physiological stress response and possible fat embolism.<sup>22</sup> Early patient mobilization after fixation of the fractures lessens the likelihood of pneumonia, venous thrombosis, and pressure sores and seems to allow for better tolerance of feeding, factors that undoubtedly allow for earlier discharge from the intensive care unit.

### **Pulmonary system**

Severely injured patients often present with hypoxemia, hypercarbia, and an unsupportable work of breathing, leading to urgent or emergent airway control, with both oxygenation and ventilation with a mechanical ventilator.<sup>17</sup> Rapidly changing physiologic trends is an indication for intubation and mechanical ventilation to augment work of breathing in increased ventilatory work load or decreased ventilation capacity to maintain arterial oxygen tension by increasing functional residual capacity or to induce hyperventilation for treatment of increased intracranial pressure. In trauma patients, lung abnormalities result in decreased compliance thus high airway pressures,<sup>2</sup> and the mechanical ventilator should be adjusted to address this as inappropriate ventilatory strategies can lead to lung injury.<sup>23</sup> Prolonged intubation and ventilation dramatically increase risk of mechanical complication and infection due to decreased cough, impaired mucociliary clearance, immunosuppression, and oropharyngeal/gastric bacterial colonization.<sup>2</sup> Pneumonia, atelectasis, pulmonary embolism, ARDS and empyema may occur in injuries to the chest.<sup>2</sup>

The established trauma patient may develop respiratory failure from pulmonary embolism or pulmonary sepsis.<sup>17</sup> The longer a patient is mechanically ventilated, the greater is the likelihood that the patient will develop ventilator associated pneumonia. <sup>17</sup>

### **Acute renal injury and acute renal failure and electrolyte imbalance**

Rhabdomyolysis is a dissolution of skeletal muscles that causes extravasation of intracellular contents such as myoglobin from the myocytes into the circulatory system and thus disturbances in electrolyte levels in serum and urine, metabolic acidosis, hypovolemia, myoglobinuric renal failure<sup>24</sup> Direct injury to the myocyte cell membrane occurs as a result of crushing, tearing, or the failure of sodium-potassium adenosine

triphosphatase pump in hypoxia due to shock, vascular occlusion, and tissue compression,<sup>24</sup> Injured myocytes also leak lactic acid and other organic acids, promoting metabolic acidosis and aciduria.

Myoglobinuric renal failure can be either oliguric or nonoliguric and occurs due to pigment-induced nephropathy with subsequent sloughing of the tubular epithelium that obstructs the renal tubules, causing an increase in intra-tubular pressure and the development of interstitial edema.<sup>24</sup> Renal failure may also occur due to renal hypoperfusion, direct renal injury, pharmacologic agents, or radiographic contrast.<sup>17</sup> Each of these pathophysiologic processes is aggravated by hypovolemia and subsequent renal vasoconstriction and pre-existing renal disease.<sup>24</sup>

## **Infections**

Infection is a major cause of post-trauma morbidity and with traumatic brain injury is a leading cause of death in patients surviving more than 3 days. Intra abdominal infection mostly occurs due to missed gastrointestinal injuries with gastrointestinal tract contamination and in open abdomen or abdominal compartment syndrome<sup>2</sup>. Catheter infection may be observed with Central Venous Catheter and urethral Catheter. Sinusitis occurs due to indwelling nasotracheal or nasogastric tube, and may be a reservoir for secondary pulmonary infection<sup>2</sup>. There is a higher risk of nosocomial pneumonia because of disruption of the barriers against infection by chest trauma, mechanical ventilation, and the use of steroids with colonization of the patient by hospital flora.<sup>25</sup>

## **Sepsis and organ dysfunction**

Sepsis results from failure of the immune system in the setting of the multiple infectious challenges. Trauma patients develop immunosuppression due to direct injury to tissues, release of multiple immunosuppressive mediators and immunosuppressive effects of the neuroendocrine response, to trauma.<sup>2</sup> Nutritional deficiency from poor caloric intake and increased metabolic requirements slows healing and further impairs the immune system<sup>11</sup>. This contributes to the early inflammatory response and subsequent late mortality from sepsis or organ failure.<sup>2</sup> Multiple organ dysfunction occurs secondary to Systemic Inflammatory Response Syndrome or sepsis and has a poor prognosis<sup>2</sup>.

## ASSESSMENT OF SEVERITY OF ILLNESS

Severity-of-illness scoring systems were developed in an effort to allow comparison of injuries and trauma patients among institutions.<sup>2</sup> It allows for evaluation of the delivery of care and prediction of outcome of groups of patients who are admitted to intensive care units though trauma scoring systems were developed using general trauma patient samples, not specifically critically ill trauma patients.<sup>2</sup>

The Injury Severity Score (ISS) is an anatomical scoring system that provides an overall score for patients with multiple injuries<sup>26</sup>. However, it does not account for the patient's age or related co-morbidity.<sup>2</sup> Injuries to different body regions are not weighted and multiple injuries within the same body region are only assigned a single score.<sup>26</sup>

The Revised Trauma Score (RTS) is a physiological scoring system that is heavily weighted towards the Glasgow Coma Scale to compensate for major head injury without multisystem injury or major physiological changes.<sup>27</sup> It also gives variables for probability of survival by regression analysis.<sup>28</sup>

The Trauma Score–Injury Severity Score (TRISS) combines the trauma score physiologic component (RTS) and anatomic component (ISS), and also patients age to yields a specific probability of survival (Ps)<sup>2</sup>. Adjustments are made for age and mechanism of injury sustained (blunt or penetrating) to calculate the probability of survival using a formula with coefficients derived from multiple regression analysis of the Major Trauma Outcome Study<sup>29</sup>. TRISS scores were shown to accurately predict group mortality in ICU trauma patients<sup>30</sup> and it is easy to use as the variables required can be obtained by physical examination of the patient.

Using the TRISS formula for calculation of probability of survival, it has been suggested to consider definitely preventable deaths as the deaths which occurred in patients with a probability of survival higher than 0.50 and possible preventable deaths as the deaths occurred with a probability of survival between 0.25 and 0.5. Deaths in patients with a calculated probability of survival less than 0.25 have to be considered non-preventable deaths<sup>31</sup>



## 2.0 STUDY JUSTIFICATION

Injuries are a major cause of morbidity in Kenya. In 2008 traumatic injury accounted for 8.2% of admissions in the Kenyatta National hospital. Multiple injuries were reported in 4.7% of the patients admitted in Kenyatta National hospital and 10% of patients admitted in intensive care unit. Many of the deaths occurring more than one day after the injury are preventable by recognition of injuries and their physiologic significance and then instituting the necessary supportive and definitive intervention that can be offered within the intensive care unit.

Enormous effort by the team working in the intensive care unit and resources are used in the management of these patients and yet no audit has been done to evaluate the Outcomes of multiple injury patients admitted and managed in the intensive care unit of The Kenyatta National Hospital. There is scarcity of literature and a need to know how these patients progress within the intensive care unit and after they leave the intensive care unit to continue management in other units.

This study will be undertaken to find out the complications and treatment outcomes of the patients with multiple injuries admitted in the intensive care unit, and how various factors may affect the outcome. These results will provide useful information that will allow us to judge practice performance and thus improve the performance of the entire Intensive care team. It will also provide a basis for future research on the subject.

## **3.0 OBJECTIVES**

### **Broad objectives**

To describe the clinical course and outcomes of multiple trauma patients requiring intensive care unit admission at Kenyatta National Hospital

### **Specific objectives**

1. To determine the patterns and mechanisms of injury of patients with multiple injury in intensive care unit.
2. To determine the complications observed in patients with multiple injuries in intensive care unit
3. To determine the clinical outcomes after 1 month of multiple injury patients admitted in intensive care unit.

## 4.0 METHODOLOGY

### 4.1 STUDY DESIGN

This was a hospital-based prospective, descriptive study.

### 4.2 Study Area

The study was undertaken at the Kenyatta National Hospital intensive care unit. The Kenyatta National Hospital is one of the teaching hospitals in Kenya and is the largest hospital in East Africa with 1800 beds and is situated in Nairobi, Kenya. The intensive care unit is the largest in the country with 21 beds. Patients were followed up in the wards and clinics after discharge from intensive care unit

### 4.3 Study Population

Patients with multiple injuries admitted to the intensive care unit

### 4.4 Selection Criteria

#### Inclusion Criteria

1. patients admitted to Kenyatta National Hospital within 24 hours of injury
2. referral to Kenyatta National Hospital within 48 hours of injury from other health care facilities
3. patients with multiple injury fitting the criteria
4. non gravid patients
5. patients/relatives who Consent to be in the study

#### Exclusion Criteria

1. Severe head injury with GCS less than 5
2. Gravid patients.
3. If consent is declined

### 4.5 Sample size estimation

52 patients were enrolled into the survey in order to describe the treatment outcomes of patients admitted to the intensive care unit with 95% confidence.

The sample size for this study was estimated using the prevalence study formula<sup>32</sup> as shown in equation (1) below;

$$n = \frac{Z_{\alpha}^2 \times P \times Q}{d^2} \quad (1)$$

Where;

$n$  is the sample size (if the target population is more than 10,000)

$Z_{\alpha}$  is the standard normal deviation at the 95% confidence level (1.96).

$P$  is the estimated proportion in the target population estimated to have characteristics being measured. Since the treatment outcome of patients admitted to ICU with multiple injuries is not known,  $p$  was estimated at 50% so as to yield a larger sample size.

$Q$  is  $1-0.5=0.5$

$d$  is the level of statistical significance set = 0.05.

Substituting in equation (1);

$$n = \frac{1.96^2 \times 0.5 \times 0.5}{(0.05)^2} = 384 \text{ patients} \quad (2)$$

From ICU records it is estimated that 60 patients are admitted into the ICU with multiple injuries over a period of 1 year. Since the sample size is over 5% of the study population ( $N$ ) the formula for finite population correction will be applied as shown below<sup>33</sup>;

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

(3)

Where

$n'$  = the desired sample size after the finite population correction.

$N$  = the estimate of the population size (number of patients who will be admitted in ICU with multiple injuries at KNH in a year i.e. 60)

Therefore,

$$\begin{aligned} n' &= \frac{60 \times (1.96)^2 \times 0.5 \times (1 - 0.5)}{(0.05)^2 \times (60 - 1) + (1.96)^2 \times 0.5 \times (1 - 0.5)} \\ &= \frac{57.6}{1.1075} = \underline{\underline{52 \text{ patients}}} \end{aligned}$$

Therefore the minimum sample size for this study is 52 patients.

## 4.6 Sampling Method

This study adopted consecutive sampling method. Patients admitted into the intensive care unit fulfilling the selection criteria during the period of the study were enrolled in the study. Follow up for 1 month was done in the wards and intensive care unit in order to ascertain the treatment outcomes of the patients.

Consent was obtained from either the relatives or the patient whenever possible.

## 4.7 Quality Control

1. Data collection and recording was done on a pre-tested data collection form by the principal investigator.
2. The data form was cross-checked to ensure completeness before the principal investigator left the study site.
3. The principle investigator stored them in hard and soft copies and analysis of results was done with the help of a statistician.
4. A pilot study was carried out before the actual data collection was done and the relevant changes incorporated before the main study was carried out.

## 4.8 OPERATIONAL DEFINITIONS

**Injury Severity Score** anatomical scoring system calculated based on the abbreviated injury scale. It is defined as the sum of squares of the highest abbreviated injury scale grade in the 3 most severely injured body regions. Six body regions are defined, as follows: the thorax, abdomen and visceral pelvis, head and neck, face, bony pelvis and extremities, and external structures

**Revised Trauma Score** a physiological scoring system, scored from the first set of data obtained on the patient, and consists of Glasgow Coma Scale, Systolic Blood Pressure and Respiratory Rate.

**Multiple injuries** -injury to more than one site of the body

**Systemic inflammatory response syndrome (SIRS)** is defined as the presence of the following criteria: body temperature  $>38^{\circ}\text{C}$ , heart rate greater than 90 beats per minute, respiratory rate greater than 20/min or  $\text{PaCO}_2 <32$  mm Hg, and neutrophil count greater than 12,000/mL or less than 4000/mL.

**Systolic blood pressure.**-This the peak arterial pressure reached during contraction phase of the cardiac cycle.

**Glasgow Coma Scale** is derived from observation and responses to eye opening, best motor responses, and best verbal responses

**Sepsis** is proven infection in the presence of SIRS

**Pulmonary complication**, - presence of pneumothorax, empyema, clinical pneumonia or pulmonary embolus

**Clinical Pneumonia**- presence of new pulmonary infiltrates and associated with elevated temperature, purulent sputum production, or leukocytosis

**Infection**, -presence of leucocytosis with positive microscopy or culture results

**Acute renal failure**- evidence of rising urea and creatinine levels

## **4.9 Data management:**

### **Data capture tool**

A written informed consent was obtained from the patient or the relatives who met the inclusion criteria. The principal investigator then filled in the data collection form for all study participants with Data collected from reviewing the patients' records and interview of health care providers and relatives. A physical examination was done to ascertain the injuries.

A tracking form was filled to be used for follow-up of patients after discharge from intensive care unit

### **Data Management and Analysis**

Data was collected during the period of 6 months from November 2009 to April 2010. Information was obtained using a data collection form.

Information collected on the data collection form by the principle investigator was entered into the computer and stored in both soft and hard copies. The statistical package for social scientists (SPSS) version 17 was used for both data management and analysis.

The results are presented in tables and figures where applicable.

### **Bias minimization**

#### **Sampling bias**

The study involved any patient who satisfied the inclusion criteria at intensive care unit of Kenyatta National Hospital, thus each patient admitted had an equal chance of being included into the study.

#### **Measurements and Information bias**

This was minimized by using a well coded standardized data collection form and well defined scoring systems and by adhering strictly to the operational definitions outlined. The data was collected by one principal investigator

## **4.10 Ethical considerations**

1. The study was non intrusive and largely based on routine Kenyatta National hospital protocol, therefore, no extra cost was incurred by the patient

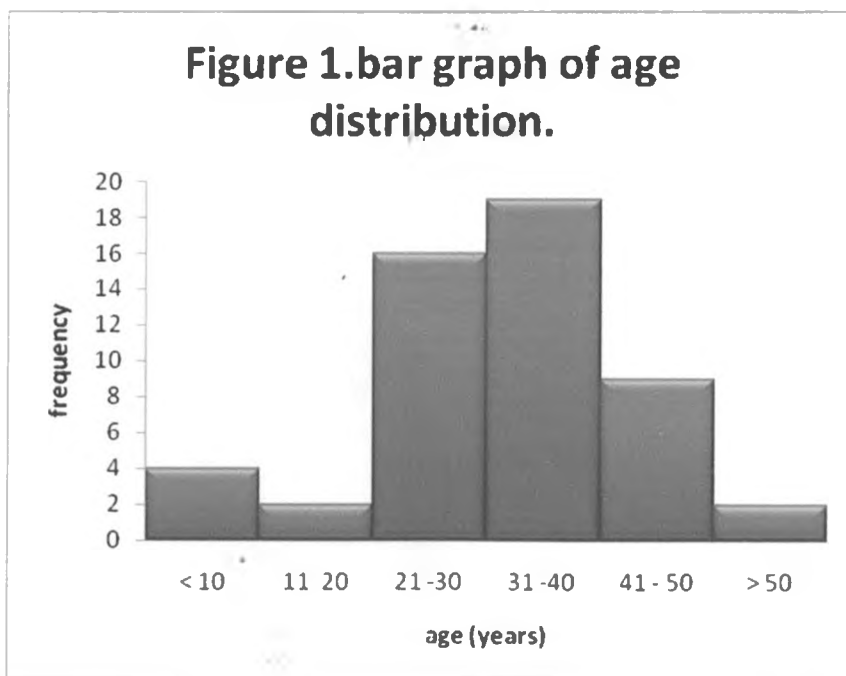
2. Written Informed consent from the patient or next of kin as applicable was sought. Failure to consent did not alter in any way the subject's quality of care.
3. Subjects were assured of confidentiality.
4. At any time during the course of the research, the respondent was free to withdraw consent.
5. The information required was obtained from of the routine patient care protocol and did not involve any extra expense or invasive procedure on the subjects recruited.
6. During the execution of the study, any findings that affected patient management and not known by the doctor on duty, was imparted immediately to ensure adequate management of the patient.
7. Permission was sought from Kenyatta National Hospital/University of Nairobi ethics and research committee before commencement of the study

## RESULTS

### 1. DEMOGRAPHY

Out of the 52 patients recruited into the study 45(86.5%) were male while 7(13.5%) were female.

Majority 35(67.3%) of the patients were 20-40 years old. The mean age was 33 years (range 2-56 year) but only 5 patients were below 13 years old (See figure 1).



## 2. INJURY CHARACTERISTICS

Majority of the injuries were sustained following RTA 38(73. %), falls accounted for 10(19.2%) only 2 (3.8%) of the patients sustained injuries due to assault and gunshot (See figure 2).

Of the injuries sustained, 44(84.6%) were blunt injuries while 8(15.4%) were penetrating injuries (See Figure 3).

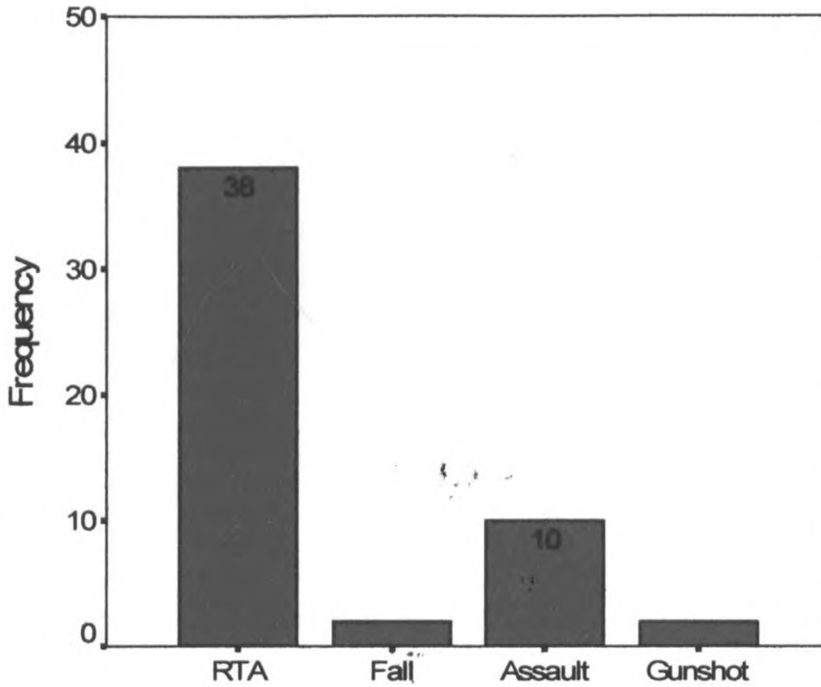


Figure 2. Bar graph showing mechanism of injury

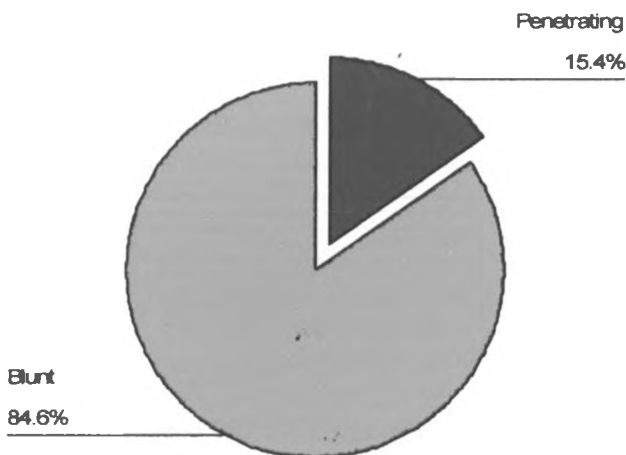


Figure 3. Pie chart showing class of injury



Injuries were observed in various sites of the body with most of the patients having head injuries 44 (84.6%) and external injuries 43(82.7%). The least injuries were observed on the neck and pelvis. 27(51.9%) had orthopedic injuries (See Figure 4)

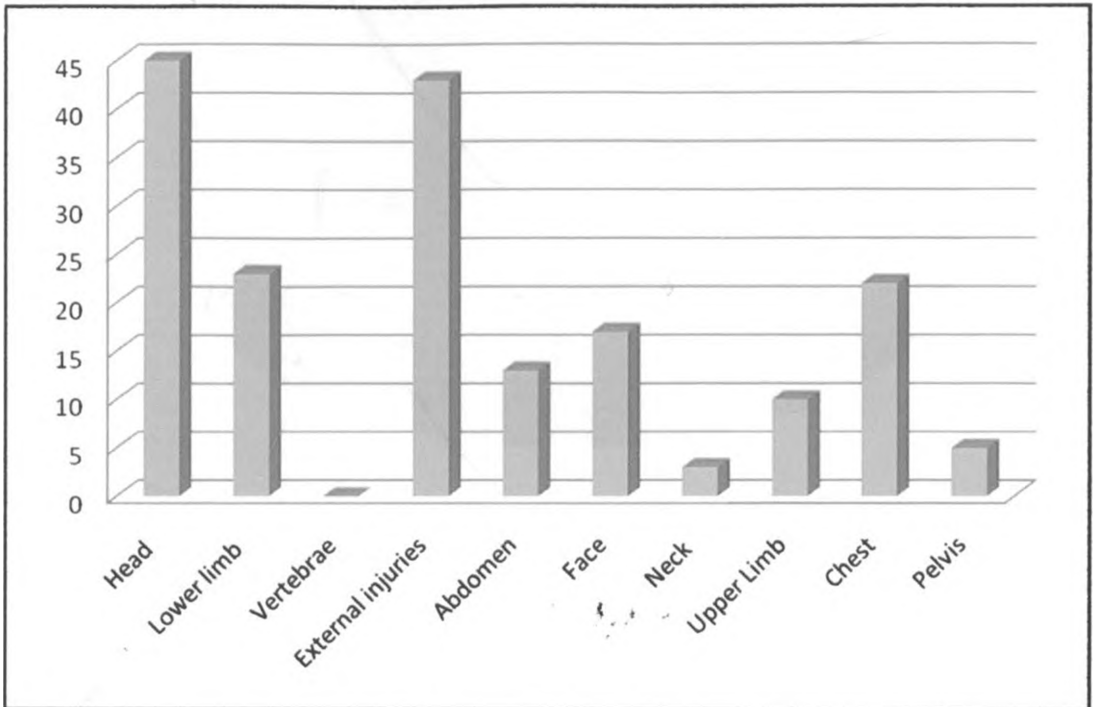


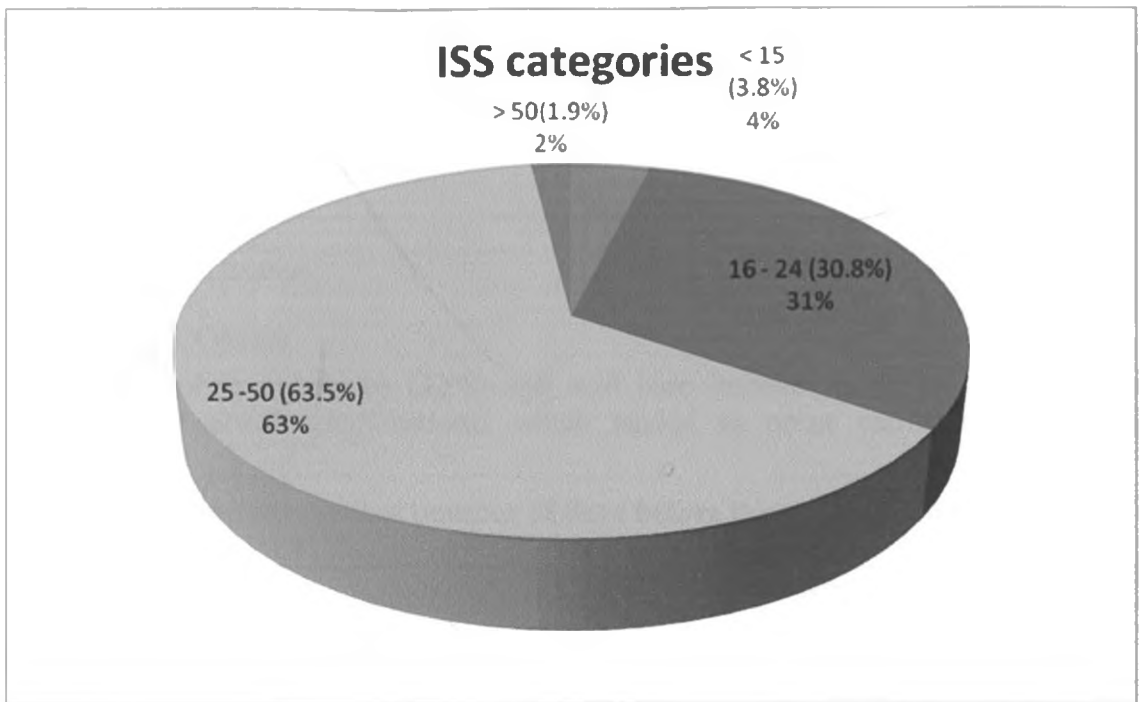
Figure4. A bar graph showing sites of injuries.

The number of injuries sustained by each patient ranged from 2 to 6 with a mode of 3.

Table 1. Distribution of number of injuries sustained by patients

Number of sites of injury	number of patients
2	4
3	26
4	17
5	4
6	1
total	52

33 patients (63.5%) had severe injuries (ISS 25-49), the median ISS was 29 (See Figure 5).



**Figure5\_Distribution of ISS categories.**

**Table 2.Disribution of GCS, SBP, RR, ISS, RTS, and TRISS (median and range)**

	RTS	GCS on Arrival	RR	SBP	ISS	TRISS
Median	5.33700	7.00	28.00	97.00	29.00	79.250
Minimum	2.542	5	6	48	13	36.6
Maximum	7.841	15	48	182	50	98.0

## 2 INTERVENTIONS IN ICU

During the study, 51(98.1%) patients were put on mechanical ventilation, 10 (19.6%) were weaned off the ventilator before death or discharge from ICU while 2 (3.9 %) were still on the ventilator by the end of the study period. The mean duration of mechanical ventilation was 11.7 days (range 1-30). 7 (70%) of the patients were on mechanical ventilation for less than 14 days.

11 patients underwent a total of 14 surgeries (excluding tracheostomies) during the study period. 1 patient had 2 surgeries while another had 3 surgeries during the study period-2 of his surgeries was done after discharge from ICU (See Table 3).

**Table 3.Frequencies of surgeries done**

surgery	Number done
Laparotomy	5
Surgical toilet/debridement	4
Internal fixation	2
Craniotomy	2
External fixation	1

### 3. OUTCOMES

Electrolyte imbalance (32%) and acid base imbalances (26%) were the most commonly observed complications, which tended to occur earlier than the other complications.

**Table 4. Showing the median number of days before the onset of complications.**

Complication	n (%)	Median (min-max)
Pulmonary complications	12(23.1)	8.5 (3 - 24)
Infections	11(18)	10 (3 -26)
Acid-base imbalance	19(26)	2 (same day-18)
Electrolyte imbalance	21(32)	2 (same day - 13)
Renal failure	3(5.8)	9 (3-21)
Sepsis	1(1.9)	5

Seven patients were discharged from ICU to the surgical wards, thereafter, one died in the ward.

By the end of the study, three patients were still admitted in the ward and 3 had been discharged home.

Of those patients surviving the duration of the study, Length of stay in ICU ranged from 3 to 30 days, median 19 days, mean 18.3 days while the Length of stay in the ward ranged from 4 to 27 days with a median of 15 days and, mean of 15 days.

#### **Glasgow outcome score (GOS) after 1 month follow up**

At 1 month of follow-up, 42 patients (80.6%) had died and only 2 (3.8 %) had good recovery while 7 (13.5%) recovered with disability and 1 (1.9%) was vegetative (See table 5).

**Table 5 showing Glasgow outcome score after 1 month follow up**

GOS	Frequency	Percent
1	42	80.8
2	1	1.9
3	4	7.7
4	3	5.8
5	2	3.8
Total	52	100.0

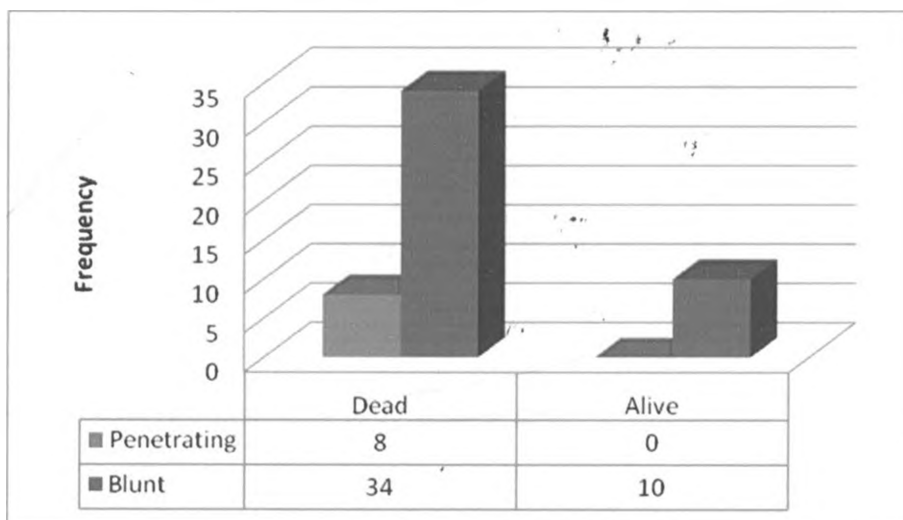
42 out of the 52 patients recruited died. Of those patients who died, 17 (38.1%) died on the same day (day 0) and an additional 23.8% died in the next 2 days. By the end of the first week, 80.9% of the deaths had occurred. (See table 6).

**Table 6** table showing the frequency and number of days before death

number of days before death	Frequency	Percent
Same day(day 0)	17	40.5
Day 1 to 2	10	23.8
Day 3 to 7	8	19.0
8 to 14 days	2	4.8
Over 14 days	5	11.9
Total	42	100.0

The treatment outcomes of the patients were grouped as those who died and those who stayed alive. This was cross tabulated with class of injury, and also correlated with; ISS, RTS, GCS, SBP, TS. (See figure 6 and table 7).

**Figure 6.** Outcome cross tabulated with class of injury.

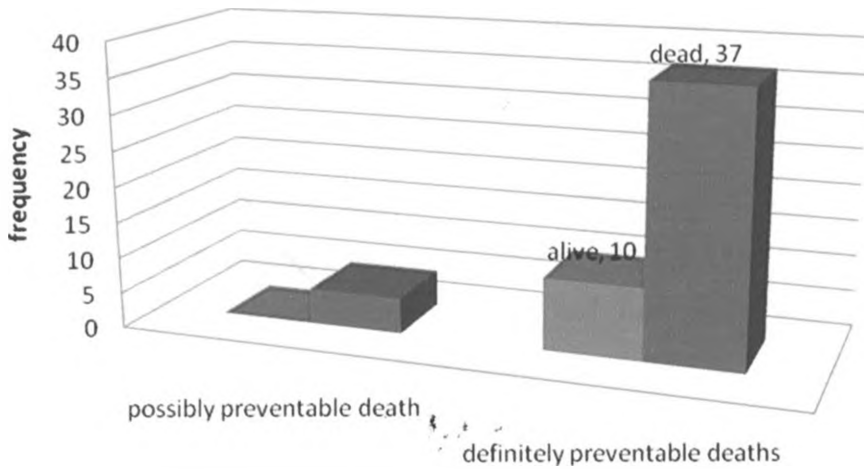


**Table 7.**Correlation of outcomes with; ISS, RTS, GCS, SBP, TRISS

	Dead n=42	alive n=10	p value
SBP	93(48-182)	111.50 (74-132)	0.025
ISS	29 (13-50)	25 (14-34)	0.055
RTS	5.19 (2.5-7.8)	6.0 (5.0 – 7.8)	0.034
TS	76.4 (36.6 – 95.7)	90.2(76.8 - 98)	0.004
GCS	7.0(5-15)	8 (5 - 15)	0.401

All the patients categorized by Probability of survival, in the “possibly preventable deaths” died while 37(78.7%) of patients categorized in the “definitely preventable death” died. (See figure 7).

**figure 7. Outcome of patients as classified by probability of survival**



The duration of stay at the A&E ICU ranged from 0 to 4. Only 21(40.3%) of the patients were transferred to the main ICU. 31(59.7%) patients died in the A&E ICU before transfer to the main ICU. The distribution of duration of stay in A&E is shown below. (See table 9).

**Table 9. duration of stay in ICU at A & E**

Duration of stay in days	Transferred to main ICU	Died in A&E ICU
0(same day)	9	17
1 day	6	7
2 day	3	2
3 day	1	3
4 day	2	2
total	21	31

## DISCUSSION

This study confirms that like in the other institutions, there was preponderance for young males among those who presented with multiple trauma. Most cases were due to RTA causing blunt injuries<sup>34, 35, 9</sup>. Majority of these patients were in their productive age<sup>36, 37</sup> and this is a blow to the economy of the country. The frequencies of other mechanisms of injuries vary in the various institutions. Assaults, falls and gunshot injuries accounted for less injuries and their frequencies varied between institutions.<sup>9, 38, 36</sup>

Head injury in this and other studies was the leading cause of severe morbidity in trauma patients and also a leading cause of admission into ICU due to need to protect airway and support patient's respiration. 51.9% had orthopedic injuries which is comparable to other studies on multiple injuries where 53.2% of the patients had orthopedic injuries.<sup>1</sup> Most patients had severe and moderate injuries as scored by injury severity score, this could be due to the fact the study was done in ICU and the patients had multiple injuries. Few patients had critical injuries as most patients with critical injuries may probably have died at the scene of the accident or during transportation to the hospital. There are no studies on multiple injury in ICU for comparison, though in major trauma studies a similar pattern of injury is noticed<sup>35</sup>.

The mean duration of mechanical ventilation was 11.7 days (range 1-30). The association between prolonged ventilation and a higher incidence of pulmonary complications was demonstrated as half of patients with a mean duration of ventilation of 5.8 days did not get pulmonary complications compared to 17.2 days among those who developed pulmonary complications. 2 patients (3.9%) were still on the ventilator by the end of the study period and were aged 56 and 3.5 years respectively. The latter was due to presence of high cervical spine injury.

1 patient with a probability of survival of 95.1% had 2 surgeries done at day 2 (internal fixation) and day 7 (laparotomy) after injury, while 1 patient with a probability

of survival of 76.8% had 3 surgeries during the study period-2 of the surgeries (insertion of external fixator and debridement) were done after discharge from ICU. Both patients survived to the end of the study period. The only other patient in this group surviving to the end of the study period had internal fixation done 23 days after injury.

“Damage control surgery” followed by delayed definitive surgery resulted in reduced morbidity and mortality, thus optimizing the patient’s condition before surgery proved to be also beneficial<sup>20, 21</sup>

Acid base and electrolyte imbalances, were the most frequent complications observed. This observation can be attributed to delays in coming to hospital after the accident and lack of or inadequate resuscitation in the pre-hospital period.

The incidence of sepsis and renal failure was considerably low and this may be so because 65.4% of the patients died within their 1<sup>st</sup> week in ICU. In a study by Goins et al Infectious complications were reported in 90% and organ dysfunction in 76% of multiple trauma patients<sup>39</sup> with prolonged stay in ICU.

Pulmonary complication occurred in 18%. Only 3 patients who survived to the end of the study did not have pulmonary complications and they were off the ventilator within 4 days of onset of ventilation.

This study had a greater length of stay in ICU in comparison to a similar study by Hall H. et al that had a median stay in ICU of 11 days, this may be attributed to the lack of HDU in the hospital and the patients had to stay in ICU until they were stable enough to be discharged to the wards.<sup>4</sup> The duration of stay in ICU is also noted to be longer than that of a study done by Mutie.<sup>40</sup>

In Mutie’s study done at KNH ICU on patients admitted into ICU<sup>40</sup> at 3 months of follow up, 71.3% patients were alive. In contrast to this, the outcome following multiple injuries in ICU at Kenyatta National Hospital is poor with 80.8% deaths after 30 days of follow up. In a similar study by Hall H et al with follow up of 6 months only 10% of the patients died during the study period.<sup>4</sup> A similarly high mortality rate (76.5%) was observed in patients with multiple traumas in Nigeria<sup>9</sup>

This study revealed a high mortality in the initial days following injury and this pattern is similar to other studies.<sup>38</sup> However in one study, 91.1% died within the first 6 hours, and the main failures of treatment were reported as lack of airway control or intravenous infusions in pre-hospital care and mismanagement with missed injuries in emergency department.<sup>41</sup> The same would apply to KNH where at this “golden hour”, a high quality of care is required.

Studies in Nigeria<sup>9</sup> and Uganda<sup>36</sup> which have similar socioeconomic climate as Kenya have shown a higher mortality rate in major trauma as compared to the major Trauma outcome study- norm of North America<sup>42</sup>. Majority of the deaths occur on the same day of admission and decline over subsequent days. This is also a trend that has been noticed in these developing countries and may be attributed to limited number of trained personnel on resuscitation working in A&E departments, lack of trauma response teams and poor rescue systems. Delayed radiological investigation to confirm injuries especially abdominal; and limited theatre space may also contribute to the high mortality rates. Kenyatta National Hospital is the national referral hospital and therefore most trauma victims are sent there for management.

All the patients classified by TRISS probability of survival as ‘possibly preventable deaths’ died while 37(78.7%) of patients categorized in the ‘definitely preventable death’ died. Though various studies support the use of TRISS as a method of determining outcomes of Trauma victims in an institution<sup>34, 3, 43, 44</sup> it has been found to have considerable disparity between the predicted and observed outcomes in developing countries<sup>35, 45, 36</sup>

In this study there was statistical significance between Probability of Survival and outcome of the patient (P value 0.007). Other factors that had a statistical significance to the outcome included systolic blood pressure (P value 0.025) and revised trauma score (P value 0.25). There were no statistically significant relationships with the injury severity score (p value = 0.83), or GCS (p value = 0.401) though in other studies it was observed that when severe head injury accompanies multiple trauma, it is likely to be the major determinant of late mortality.<sup>12</sup> Since patients with a GCS less than 5 were excluded



from the study, the outcome of the patients in the study might have depended on the adequacy of the treatment received<sup>19</sup>

Presence of abdominal injury was associated with poor outcome as 12 (99%) of the patients with abdominal injuries died, again this can be attributed to delayed investigations and interventions. Only 5(41.6%) of the patients with abdominal injuries were taken to theatre for laparotomy..

Since this study had a short follow up period, a longer period of follow up is required to fully appreciate the treatment outcomes of patients with multiple injuries. During the study period, the high mortality in the ICU at A & E was reported to the regulatory body.

In view of the above findings, the following recommendations were made:

1. All the staff in the A& E department should have some form of training in resuscitation such as Advanced Trauma and Life Support.
2. A major Trauma outcome study should be carried out to establish the major Trauma outcome norms against which to base evaluation of health institution that care for Trauma patients in this region.
3. A study on interventions on Trauma patients need to be done to evaluate the impact of our management on the outcomes.
4. There is need for a Trauma response team in the hospital.
5. There is need for a bigger intensive care unit within the hospital.

In conclusion there is a high mortality rate in patients admitted with multiple injuries in the ICU of Kenyatta National Hospital. This seems to compare well with observations made in other developing countries in the region. However, there is much that needs to be done to remedy this situation and achieve mortality levels similar to those seen in the resource-rich nations.

## 5.0 REFERENCES

1. Popović N, Blagojević Z, Nikolić V, et al. **Orthopedic injuries in polytrauma.** Acta Chir Iugosl.. 2006; 53(4):85-8.
2. Lazar J., Greenfield Mulholland M. W. et. al.. **Essentials Of Surgery - Scientific Principles And Practice.** 2nd Ed Lippincott William & Wilkins pub 1997;chap11
3. King PM, Tucker WS, Waddell JP, et al. **Correlation of trauma scoring and outcome in a Canadian trauma centre.** Can J Surg. 1994; 37(3):185-8.
4. Hall HC, Dobb G, Hall JL. **An evaluation of outcome after severe trauma.** J Qual Clin Pract. 2001; Sep;21(3):66-8.
5. Nardi G, Lattuada L, Scian F, et al. **Epidemiological study on high grade trauma. Friuli VG Major Trauma Study Group.** Minerva Anesthesiol. 1999; Jun; 65(6):348-52.
6. **World Report 2004 on Road Traffic Injuries.** World Health Organization/World Bank. Geneva. Available at: [www.who.int/violence\\_injury\\_prevention](http://www.who.int/violence_injury_prevention)
7. **Kenyatta National Hospital medical records department statistics.** 2008.
8. Arnstein Finset, Audny W. et al **Cognitive Performance in Multiple Trauma Patients 3 Years after Injury.** Psychosomatic Medicine. 1999; 61:576-583
9. Lateef O.A. Thanni, Adedayo O. Tade **Epidemfology of Severe Injury in a Nigerian Hospital** *Nigerian Journal of Orthopaedics and Trauma.* 2007; 6(2):67 - 69
10. Moore, Lynne ; Lavoie, André ; Le Sage, Natalie et al, **Two Worst Injuries in Different Body Regions Are Associated with Higher Mortality than Two Worst Injuries in the Same Body Region.** Journal of Trauma: Injury, Infection, and Critical Care. 2006; 60(4):802-805
- 11 Ronald D.M. (ed). Anesthesia for trauma. **Millers Anesthesia**, 6<sup>th</sup> Edition. Churchill Livingstone. 2005; 2451 – 2495.
12. Hadfield RJ, Parr MJ, Manara AR **Late deaths in multiple trauma patients receiving intensive care.** Resuscitation. 2001; 49(3):279-81.
13. Marx T, Wiedeck H, Hähnel J, et al. **Modification of ventilation and length of stay of traumatized intensive care patients by quality and duration of preclinical management.** Anesthesiol Intensivmed Notfallmed Schmerzther. 1994; 29(5):278-81.
14. American College of Surgeons. **Advanced Trauma Life Support Program for Physicians.** 7<sup>th</sup> ed. Chicago, IL; 2004.
15. David J Dries, **Initial Evaluation of the Trauma Patient** emedicine 2008: as accessed on march 30<sup>th</sup> 2009.
16. Khilnani P. **Management of a child with multiple trauma.** Indian J Crit Care Med 2004; 8:78-84
17. Lewis J Kaplan, Daniel M Roesler, **Critical Care Considerations in Trauma** eMedicine; 2008 as accessed on march 30<sup>th</sup> 2009.
18. Baltas I, Gerogiannis N, Sakellariou P, et al **Outcome in severely head injured patients with and without multiple trauma.** J Trauma. 2000 Apr; 48(4):613-21; discussion 621-3.

19. Schüttler J, Schmitz B, Bartsch AC, et al. **The efficiency of emergency therapy in patients with head-brain, multiple injury.** Quality assurance in emergency medicine] *Anaesthesist*. 1995 Dec; 44(12):850-8.
20. Morshed S, Miclau T , Bembom O, et al **Delayed internal fixation of femoral shaft fracture reduces mortality among patients with multisystem trauma.** *J Bone Joint Surg Am*. 2009 Jan; 91(1):3-13
21. Reynolds MA, Richardson JD, Spain DA, et al. **Is the timing of fracture fixation important for the patient with multiple trauma?** *Ann Surg*. 1995 Oct; 222(4):470-8.
22. Johnson KD, Cadambi A, Seibert GB. **Incidence of adult respiratory distress syndrome in patients with multiple musculoskeletal injuries: effect of early operative stabilization of fractures.** *J Trauma* 1985; 25; 375–84.
23. McCunn M: **Mechanical ventilation: Weapon of mass destruction or tool for liberation?** *Crit Care Med* 2003; 31:974-976,
24. Laura M. Criddle, **Rhabdomyolysis; Pathophysiology, Recognition, and Management.** *Critical Care Nurse*. 2003; 23: 14-30
25. Rodriguez JL, Gibbons KJ, Bitzer LG, et al: **Pneumonia: Incidence, risk factors and outcome in injured patients.** *J Trauma*. 1997; 31:907-912.
26. Baker SP et al, "**The Injury Severity Score: a method for describing patients with multiple injuries and evaluating emergency care**", *J Trauma* 1994; 14:187-196.
27. Champion HR et al, "**A Revision of the Trauma Score**", *J Trauma* 1989; 29:623-629.
28. Jesse B. Hall(ed), Gregory A. Schmidt(ed), Lawrence D.H. Wood(ed). **Principles Of Critical Care.** 3<sup>rd</sup> Edition McGraw-Hill2005;6:63-78
29. Boyd C. R. Tolson M. A. & Copes W. S. **Evaluating Trauma care: the TRISS method.** *The Journal of Trauma* 1987;27: 370-8.
30. Wong DT, Barrow PM, Gomez M, McGuire GP. **A comparison of the Acute Physiology and Chronic Health Evaluation (APACHE) II score and the Trauma-Injury Severity Score (TRISS) for outcome assessment in intensive care unit trauma patients.** *Crit Care Med*. 1996 Oct; 24 (10):1642-8.
- 31 Osvaldo Chiara, Stefania Cimbanassi, et al **Preventable trauma deaths: from panel review to population based-studies.** *World Journal of Emergency Surgery*. 2006
32. Fischer, Laing and Stoeckel (1983) in Mugenda O.M. and Mugenda A.G. **Research Methods: Quantitative and Qualitative Approaches;** Acts Press, Nairobi; 2003.
- 33 Daniel WW. **Biostatistics: A Foundation for Analysis in the Health Sciences.** 7th edition. New York: John Wiley & Sons 1999.
- 34 Koo M, Sabaté A, et al. **Mortality in patients with multiple injuries: analysis using the trauma and injury severity score in a referral hospital** *Rev Esp Anesthesiol Reanim*. 2009 Feb; 56(2):83-91.
- 35 Seetharaman Hariharan, Deryk Chen, Keith Parker, et al **Evaluation of Trauma Care Applying TRISS Methodology in a Caribbean Developing Country**
- 36 Kirya I F. M. Kijjambu S. Ezati I. **Outcome of major trauma at Mulago Hospital in Uganda. Assessment using the TRISS methodology.** *East and Central African Journal of Surgery* March / April 2008 Volume 13 Number 1

- 37 Murlidhar V, Roy N. **Measuring trauma outcomes in India: an analysis based on TRISS methodology in a Mumbai university hospital.** *Injury.* 2004 Apr;35(4):386-90.
- 38 C.K.van der Sluis, H.J. ten Duis, J.H.B. Geertzen **Multiple injuries: an overview of the outcome**, *Journal of Trauma: Injury, Infection, and Critical Care* 38:681, 1995
- 39 Goins WA, Reynolds HN, Nyanjom D, Dunham CM **Outcome following prolonged intensive care unit stay in multiple trauma patients.** *Crit Care Med.* 1991 Mar;19(3):339-45.
- 40 Mutie P. Ngumi Z. W. **assessment of patients' progress and clinical outcome three months postintensive care** 2008 university of Nairobi.
- 41 Osvaldo Chiaraa, Jane D Scottb, et al, **Trauma deaths in an Italian urban area: an audit of pre-hospital and in-hospital trauma care** Volume 33, Issue 7, Pages 553-562 (September 2002)
- 42 Champion HR, et al. **The Major Trauma Outcome Study: establishing national norms for trauma care.** *J Trauma.* 1990 Nov;30(11):1356-65.
- 43 Barbieri S, Michieletto E, Feltracco P, et al. **Prognostic systems in intensive care: TRISS, SAPS II, APACHE III** *Minerva Anestesiol.* 2001 Jul-Aug;67(7-8):519-38.
- 44 Chardoli, V. Rahimi-movaghar. **Analysis of trauma outcome at a university hospital in zaheden, Iran using the TRISS method.** *M East African medical journal* august 2006 vol 83no 8
- 45 Hill DA, Lennox AF, et al **Evaluation of TRISS as a means of selecting trauma deaths for clinical peer review..** *Aust N Z J Surg.* 1992 Mar;62 (3):204-8.

# **APPENDICES**

## **APPENDIX 1**

### **CONSENT EXPLANATION**

Dear participant,

I am Dr. Andhoga Jacqueline, a postgraduate student in Anaesthesia at the University of Nairobi. I am conducting a study on the treatment outcomes of multiple injury patients in intensive care unit, Kenyatta national hospital.

The findings of this study will be useful in the management of the severely injured patients in this hospital and the country as a whole. The study will be in the form of a data collection tool. Strict confidentiality will be maintained; the collected data will be used purely for research purposes.

Please, confirm that you have accepted to take part in this study by completing the consent form provided to you.

### **UFAFANUZI WA MAKUBALIANO**

Jina langu ni daktari Andhoga Jacqueline, mwanafunzi katika chuo kikuu cha Nairobi. Ninafanya utafiti kuhusu matokeo ya waliojuruhiwa katika ICU ya hospitali kuu ya Kenyatta.

Habari ambayo itatokana na utafiti huu itakuwa ni ya maana sana kwenye matibabu ya wa liojuruhiwa mahututi hapa hospitali ya Kenyatta na nchi kwa jumla. Utafiti wenyewe utakuwa kwa njia ya fomu ya kuandikia habari. Habari hii itakuwa ni siri na itatumika kwa utafiti pekee.

Tafadhali onyesha ya kuwa umekubali kuhusika kwenye utafiti huu kwa kujaza fomu ya makubaliano utakayopewa.

## APPENDIX 2

### INFORMED CONSENT FORM

I \_\_\_\_\_ [initials], hereby consent to be included/ for my patient to be included in the study on outcome of multiple injuries in ICU in Kenyatta National Hospital.

I confirm that I have been fully informed about the procedure, the confidentiality, and the voluntary nature of participation in the study. I fully understand the right of withdrawal from the study at anytime.

I hereby give my informed consent under no duress or coercion whatsoever.

Signature \_\_\_\_\_ Date \_\_\_\_\_

I, the researcher, have explained fully to the participant/participant's relative about the study, and have not withheld any information regarding the study. I have also assured the participant of his or her confidentiality during the study, and in case he or she withdraws from the study.

Researcher's signature \_\_\_\_\_ Date \_\_\_\_\_

### FOMU YA MAKUBALIANO YA KUJIUNGA NA UTAFITI

Mimi \_\_\_\_\_ [herufi za majina] nakubali/mgonjwa wangu kuhusishwa katika utafiti huu katika hospitali kuu ya Kenyatta.

Nadhibitisha ya kwamba nimeelezwa kuhusu utafiti huo na ninaelewa haki yangu ya kujiondoa wakati wowote kutoko kwa utafiti. Ninatia sahihi hii bila ya kusulutishwa.

Sahihi \_\_\_\_\_ Tarehe \_\_\_\_\_

Ameyashiriki / mwangalizi amefahamishwa kuhusu aina ya uchunguzi huu, na kuwa habari ambayo itatokana na utafiti huu itakuwa ni siri kati ya daktari, mshiriki na hospitali hata ikiwa mshiriki ataamua kujiondoa kwenye utafiti huu.

Sahihi ya mtafiti \_\_\_\_\_ Tarehe \_\_\_\_\_

### APPENDIX 3. QUESTIONNAIRE

Code number \_\_\_\_\_ Date of data collection \_\_\_\_\_ date of injury \_\_\_\_\_  
date of arrival to casualty \_\_\_\_\_ date of admission to ICU \_\_\_\_\_

In patient number \_\_\_\_\_ Referral from \_\_\_\_\_

Biodata: Age (in years) \_\_\_\_\_ Sex male/female

Pre injury Co-morbid condition(s) \_\_\_\_\_

Classification of injury penetrating blunt

#### Mechanism Of injury

RTA Y/N Assault Y/N Others \_\_\_\_\_  
Fall Y/N Gunshot Y/N

#### Sites of injuries and AIS

Site of injury	AIS	Site of injury	AIS	Site of injury	AIS
Head		Abdomen		Upper limbs	
Lower limbs		Face		Chest	
Vertebral		Neck		Pelvis	

Glasgow Coma Scale at arrival \_\_\_\_\_

Respiratory rate at arrival \_\_\_\_\_

Systolic blood pressure at arrival \_\_\_\_\_

#### Calculated scores:

Injury severity score: \_\_\_\_\_

Revised trauma score \_\_\_\_\_

Trauma Score - Injury Severity Score (Ps) \_\_\_\_\_

#### Interventions in intensive care unit

Mechanical ventilation; date started \_\_\_\_\_ Date stopped \_\_\_\_\_

Surgery, procedure \_\_\_\_\_ Date of surgery \_\_\_\_\_

#### List of complications and date of onset

Pulmonary complication, Y/N \_\_\_\_\_

Infection, sepsis Y/N \_\_\_\_\_

Acid-Base imbalance, Y/N \_\_\_\_\_

Electrolyte imbalance, Y/N \_\_\_\_\_

Acute renal failure Y/N \_\_\_\_\_

Sepsis Y/N \_\_\_\_\_

Glasgow outcome score At Month 1 of Follow-up \_\_\_\_\_

Date of death \_\_\_\_\_

## APPENDIX 4: INJURY SEVERITY SCORES

### ABBREVIATED INJURY SCALE

Injury	AIS Score
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Unsurvivable

The 3 most severely injured body regions have their Abbreviated Injury Scale score squared and added together to produce the Injury Severity Score.

### REVISED TRAUMA SCORE

Glasgow Scale(GCS)	Coma	Systolic Pressure(SBP)	Blood	Respiratory Rate(RR)	Coded Value
13-15		>89		10-29	4
9-12		76-89		>29	3
6-8		50-75		6-9	2
4-5		1-49		1-5	1
3		0		0	0

$$RTS = 0.9368 GCS + 0.7326 SBP + 0.2908 RR$$

### TRAUMA SCORE - INJURY SEVERITY SCORE: TRISS

Probability of survival ( $P_s$ ) =  $1 / (1 + e^{-b})$

$$b = b_0 + b_1(RTS) + b_2(ISS) + b_3(AGE INDEX).$$

	Blunt	Penetrating
<b>b0</b>	-0.4499	-2.5355
<b>b1</b>	0.8085	0.9934
<b>b2</b>	-0.0835	-0.0651
<b>b3</b>	-1.7430	-1.1360

Age Index is 0 if the patient is below 54 years of age or 1 if 55 years and over.

If the patient is less than 15 years, the blunt index for b3 (Age) is used regardless of mechanism.



## GLASGOW OUTCOME SCORE

Score	Rating	Definition
5	Good Recovery	Resumption of normal life despite minor deficits
4	Moderate Disability	Disabled but independent. Can work in sheltered setting
3	Severe Disability	Conscious but disabled. Dependent for daily support
2	Persistent vegetative	Minimal responsiveness
1	Death	Non survival

## GLASGOW COMA SCALE

The GCS is scored between 3 and 15, sum of the Best Eye Response, Best Verbal Response, and Best Motor Response, as given below:

### Best Eye Response. (4)

1. No eye opening.
2. Eye opening to pain.
3. Eye opening to verbal command.
4. Eyes open spontaneously.

### Best Verbal Response. (5)

1. No verbal response
2. Incomprehensible sounds.
3. Inappropriate words.
4. Confused
5. Orientated

### Best Motor Response. (6)

1. No motor response.
2. Extension to pain.
3. Flexion to pain.
4. Withdrawal from pain.
5. Localising pain.
6. Obeys Commands.

## APPENDIX 5 APPROVAL LETTER



**KENYATTA NATIONAL HOSPITAL**  
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P.O. Box 20723, Nairobi.  
Tel: 726300-9  
Fax: 725272  
Telegrams: MEDSUP", Nairobi.  
Email: [KNHplan@Ken.Healthnet.org](mailto:KNHplan@Ken.Healthnet.org)

Ref: KNH-ERC/ A/397

11<sup>th</sup> February 2010

Dr. Jacqueline Andhoga  
Dept. of Surgery/Anaesthesia  
School of Medicine  
University of Nairobi

Dear Dr. Andhoga

**RESEARCH PROPOSAL: "TREATMENT OUTCOMES OF MULTIPLE INJURY PATIENTS IN INTENSIVE CARE UNIT, KENYATTA N. HOSPITAL" (P345/12/2009)**

This is to inform you that the KNH/UON-Ethics & Research Committee has reviewed and **approved** your above cited research proposal for the period 11<sup>th</sup> February 2010 – 10<sup>th</sup> February 2011.

You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given. Clearance for export of biological specimens must also be obtained from KNH/UON-Ethics & Research Committee for each batch.

On behalf of the Committee, I wish you a fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of the data base that will be consulted in future when processing related research study so as to minimize chances of study duplication.

Yours sincerely

  
**DR. L. W. MUCHIRI**  
**AG. SECRETARY, KNH/UON-ERC**

**UNIVERSITY OF NAIROBI**  
**MEDICAL LIBRARY**

c.c. Prof. K. M. Bhatt, Chairperson, KNH/UON-ERC  
The Deputy Director CS, KNH  
The Dean, School of Medicine, UON  
The Chairman, Dept. of Surgery(Anaesthesia), UON  
The HOD, Records, KNH  
Supervisor: Dr. P. O. R. Olang', Dept. of Surgery(Anaesthesia) UON