PREDICTORS OF APPROPRIATE MANAGEMENT AMONG PATIENTS WITH TRAUMATIC HEAD INJURY SEEN IN REGIONAL AND DISTRICT HOSPITALS IN TANZANIA

DR. RAYNALD HARRISON, (MD)

MMED Emergency Medicine

Muhimbili University of Health and Allied Sciences

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Department of Emergency Medicine

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By

RAYNALD HARRISON

A dissertation submitted in partial fulfillment of the requirement for the degree of Masters of Medicine – Emergency Medicine Muhimbili University of Health and Allied Sciences

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CERTIFICATION

I, the undersigned certifies that have read and recommends for acceptance by the senate a dissertation entitled**: "Predictors of appropriate management among patients with traumatic head injury seen in regional and district hospitals in Tanzania"** in partial fulfilment of the requirements for the degree of the Masters of Medicine – Emergency Medicine of Muhimbili University of Health and Allied Sciences

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Prof. Hendry R Sawe
Supervisor

_____

Date

_____

Dr. Said S Kilindimo
Co-Supervisor

_____

Date

DECLARATION AND COPYRIGHT

I, **Raynald Harrison**, declare that this dissertation is my original work and that it has not been presented and will not be presented to any other university for a similar or any other degree award.

Signature……. Date……..

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DEDICATION

To my Lovely wife Agnes, my Son Ryan and the Harrison's Family

LIST OF ABBREVIATION

aOR	Adjusted odds ratio
BMC	Bugando Medical Centre
BP	Blood pressure
C.R.A.S.H	Corticosteroid Randomization After Significant Head injury
CCP	Cerebral Perfusion Pressure
CCU	Critical Care Unit
CDC	Centre for Disease Prevention and Control
C-Spine	Cervical spine
CT	Computed Tomography
DDH	Designated District Hospital
ED	Emergency Department
EDHD	Emergency Department visits, Hospitalizations, and Deaths
EMD	Emergency Medicine Department
FOUR	Full Outline of Unresponsiveness
GCS	Glasgow Coma Scale
GMH	Grady Memorial Hospital
HIC	High Income Countries
ICP	Intra-Cranial Cranial Pressure
ICU	Intensive Care Unit
IRB	Institutional Review Board
LMIC	Low-Middle Income Countries
MNH	Muhimbili National Hospital
MOI	Muhimbili Orthopedic Institute
MUHAS	Muhimbili University of Health and Allied Sciences
MD	Doctor of Medicine
RCT	Randomized Control Trials
REDcap	Research Electronic Data capture
RTA	Road Traffic Accidents
RTI	Road Traffic Injuries
RTC	Road Traffic Crush
TARN	Trauma Audit Research Network

TECCS	Tanzania Emergency Care Capacity Survey Study
TBI	Traumatic Brain Injury
THI	Traumatic Head Injury
UK	United Kingdom
USA	United States of America
UTHK	University Teaching Hospital of Kigali
WHO	World Health Organization

ABSTRACT

Background: Traumatic head injury (THI) is one of the leading causes of death and disability. In Developed countries, the designation of clear pathways and trauma centres has improved care and outcomes of THI patients unlike in developed countries the burden is still high and little is known about how well patients are managed.

Aim of the study: To determine factors that are associated with appropriate management among patients with THI seen in regional and district hospitals in Tanzania.

Materials and methods: This was a prospective cohort study of THI patients seen in regional and district hospitals of Tanzania from October to November 2020 and included 162 hospitals. Patients were enrolled consecutively for over a 24hour period at each site. A structured case report form (CRF) incorporated into online data capture software was used to document patients' demographics, clinical presentation, management, disposition and 24 hours' outcome. Appropriateness of management was assessed using the WHO essential trauma care guidelines. Resource availability was determined using the WHO emergency unit assessment tool. Data was analyzed using SPSS and summarized into counts, proportions, medians and interquartile range (IQR), 95% confidence interval (CI) and P-value determined statistical significance. Logistic regression analysis was used to determine predictors of appropriate management in THI patients.

Results: A total of 1056 trauma patients were seen in 162 hospitals around Tanzania during the data collection periods. Of these, 218 (20.6%) patients with THI were enrolled in this study. The median age was 29 years [IQR 20-38 years] and 73.4% were males. Road Traffic Crash (RTC) was the most common mechanism of injury, 112(51.4%). Among all THI, 130 (59.6%) received appropriate management. Availability of equipment at the facilities -adjusted odds ratio-(aOR 4.74 (95% CI 1.04-21.52) was associated with appropriate management, with moderate (aOR 0.013 (95% CI 0.002-0.11) or severe head injury (aOR 0.017 (95% CI 0.002-0.17) were significantly less likely to receive appropriate management.

Conclusion: In this study, head injury severity and lack of equipment at the hospital were found to be independent predictors of appropriate management of traumatic head injury patients. There is an exigency to develop, implement and study systems that can sustenance the improvement of THI appropriate management and optimize outcomes of such patients.

DEFINITION OF KEY TERMS

Traumatic Head Injury: is defined as any blow to the head caused by direct or indirect force which may or may not result in disruption of brain physiological function, with or without distortion of anatomic pattern of brain and/or tissues of the skull, scalp and face.(1)

Traumatic Brain Injury: Is brain functional impairment that results from external force.(2)

Mild TBI (Concussion): Is impairment in brain function without overt hemorrhage or gross lesion, is caused by an external force and results in GCS score of 14 or 15.(2)

Intubation: Is the insertion of breathing tube into the trachea for mechanical ventilation.

Mechanical Ventilation: is a form of artificial ventilation where mechanical means are used to either assist or replace spontaneous ventilation (as defined in this study)

Craniectomy: In this study will be defined as the removal of part of skull in order to relieve pressure when the brain swells.

Sedation: In this study it will be defined as the action of giving a sedative drug to a patient in order to attain a state of sleepiness or calmness.

Hypothermia: Is a medical emergency that occurs when the loses heat is faster than it can produce heat, causing dangerously low body temperature. In TBI the therapeutic temperature control is between 36^0C to 38.3^0C, hypothermia is temperature $<36^0$C.(2)

Major trauma: Major trauma is defined as Injury Severity Score (ISS) of ≥16.(3)

Acute intake area: Is defined in this study acute intake area are areas in a health facility receiving and stabilizing critically ill patients, both medical and surgical.

Appropriate management: Is defined as compliance by the acute intake area with WHO guidelines for initial stabilization (appropriate managing) for head trauma.

Predictors of appropriate management: As defined in this study these are factors which are associated with more compliance with WHO guidelines such as availability of resources, presence of personnel, appropriate knowledge for the severity or type of injury.

CHAPTER ONE

1. INTRODUCTION

1.1 Background

Traumatic Head Injury (THI) is a blow to the head caused by direct or indirect force which may or may not result in disruption of brain physiological function, and may or may not be accompanied by distortion of anatomic pattern of brain and/or tissues of the skull, scalp and face. The main concern about traumatic head injury is that it may result in traumatic brain injury (TBI). Traumatic brain injury is a functional impairment of the brain that results from external force (2,4). The World Health Organization (WHO) criteria defines TBI as an acute injury to the brain which is caused by a mechanical energy to the head from any external forces (physical). being it open/penetrating or blunt injury (5). The clinical manifestation of THI may range from scalp injury, confusion to coma, severe disability and/or death. Traumatic brain injury is a worldwide public health problem (silent epidemic) (6), that can result in long lasting disability, even in patients with mild THI (7,8). Traumatic brain injuries are a significant cause of death and disability around the world, in both developed and developing worlds, and is irrespective of age groups (9).

Traumatic brain injury can be categorized into mild, moderate and severe. Worldwide, mild THI accounts for about 81%, moderate THI accounts for about 11% and severe THI accounts 8% of all reported THI (7). According to the US Centers for Disease Control and Prevention (CDC), there were approximately 2.8 million THI-related emergency department visits, hospitalizations, and deaths in the United States in 2013 (10)

As seen in the US, traumatic head injury is mostly attributed to falls and RTCs (11). THI-EDHD (Emergency Department visits, Hospitalizations, and Deaths) has a trimodal pattern with the highest rate seen in those with age between 0-4 years, 14-24 years and >75 years (10). In the developed world, the elderly sustain more THI with the most common mechanism of injury being falls. THI is more common in males than female in

both the developed and developing world, but RTC is the most common mechanism of injury in the developing world (12)

As THI is heterogenous disease, there are different ways to categorize patients and this can be based on clinical severity, mechanism of injury and pathophysiology, each of which in one way or another has direct impact on treatment and prognosis of patients (13) The most commonly used clinical classifications of THI is the Glasgow Coma Score (GCS). Based on GCS, THI is classified into mild (GCS 14-15), moderate (9-13) and severe (≤8).

Health care settings in LMIC encounter three times more cases of THI's compared to HIC's and the data from these LMIC's are of low quality, which raises the need for robust and accurate injury reporting. LMIC's have a high incidence of THI's with low resources while the HIC's have low disease burden and higher resources, these disparities deserve attention and action (7). Many studies that have been done show that the timely and appropriate management of patients with traumatic head injury will lower the mortality and morbidity from traumatic brain injury. Patients with moderate and severe brain injury are more likely to die or have profound post brain injury sequalae if not attended in a timely fashion and with appropriate care. HIC's have well delineated guidelines and protocols in managing patients with traumatic head injury and this is proven by the low mortality seen mostly in developed countries. (14)

In Tanzania, there is no proper clinical pathway to clearly manage patients with traumatic head injury. Also, there is no pre-hospital care of patients with THI. Most patients will be brought to the nearest hospital in different areas of Tanzania by either good Samaritans or policemen or alone. They often go to hospitals that are ill equipped in terms of human resources, specialists, equipment and even knowledge. Patients seen at these centers may experience delays before being transferred to better equipped centers. Inadequate means of transfer to higher center is also a problem in LIC's; patients are usually transferred in ambulances which are not equipped for resuscitating a patient who may have a brain injury to prevent further insult, and these patients are usually accompanied by personnel with inadequate knowledge on how to handle patients with traumatic head injury.

The regional referral and the district hospitals are reported in most studies to be underequipped to care for traumatic head injury in-terms of human resources, equipment and drugs needed (15). While certain procedures such as craniotomy, craniectomy, cricothyroidotomy are usually performed/available in tertiary hospitals, there are many critical actions that can stabilize the patient and prolong the life and prevent disability in these patients prior to arrival at tertiary hospitals such as airway and breathing management skills like intubations, stabilizing the cervical spine, provision of appropriate medications in patients who require them. It is not clear if the skills to manage patients with head injuries are present in these peripheral regional referral and district hospitals or if there is availability of drugs, equipment for securing airway, or stabilizing the neck of these patients.

The main aim of good trauma care - and what we need to practice-- is to get the right patient, to the right hospital and at the right time. Most patients will have delays reaching the right hospital due to lack of a designated prehospital care system and designated trauma centers, lack of recognition at the receiving facility, poor road infrastructure and traffic, and lack of available transportation. Thus, appropriate initial care, at the first hospital encountered, is essential.

The main objective of this study is to determine the appropriateness of care of patients with traumatic head injury who present to regional and district hospitals and assess whether these facilities have adequate resources, personnel and also to look into their 24 hours outcome. Data from these studies will help to know where there are gaps in caring for these patients and what should be done to improve the clinical course of patients who sustained head injuries, and in particular, brain injury, so that mortality and morbidity can be improved.

1.2 PROBLEM STATEMENT

Head injury is recognized as a major public health problem worldwide. Traumatic head injury often is associated with traumatic brain injury (TBI), which confers high levels of long-term morbidity (16,17) The WHO estimates that THI will be among the top causes of death and disability by the end of 2020. It is a rising public health problem and has been termed as a "SILENT EPIDEMIC" (7). In developing countries such as Tanzania, the incidence of head injuries are on the rise due to urbanization, motor vehicle use and acts of violence(18). The morbidity and mortality from THI are substantial in LMICs because these injuries mostly affect the working age group which is involved in production of goods and services, and who provide for others in the home.

To minimize the potential impact of a head injury, it is critical that head injury victims receive appropriate and evidence-based care. It is not known however, how well these patients are treated at lower level hospitals, and if optimal care is provided before referred to a higher-level health facility. Few studies have looked at the appropriateness of initial management of trauma patients in general (15), and matching of resource availability but no study was found that looked into predictors of appropriate management of THI patients

1.3 CONCEPTUAL FRAMEWORK

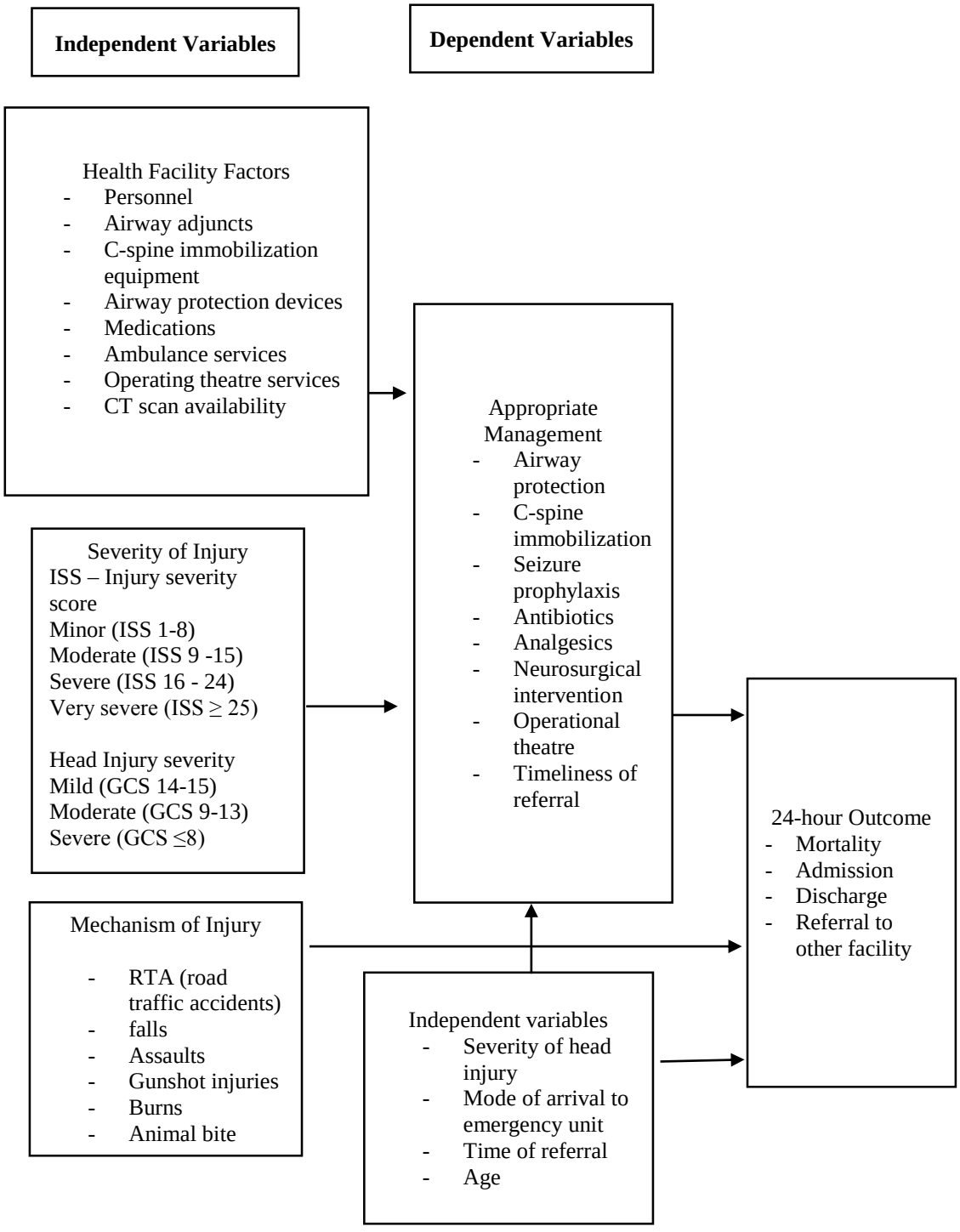

Figure 1: Conceptual framework of Traumatic Head injury study.

Source: Raynald Harrison.2020

Patients with head injury may require airway adjuncts, C-Spine collars, airway protection and analgesics; some require additional medications and some will need surgery; CT-scan is also a necessary resource. When head injury is accompanied by THI there is a need to prevent complications with urgent intervention, like airway protection, antiseizure prophylaxis, and neurosurgical intervention.

Appropriate care for traumatic head injury can be affected by a number of factors. The mechanism of injury, and its severity, can challenge non-specialists who lack knowledge about appropriate treatment or there may be lack of clear evidence of what is the best method of management of certain injuries. The facility may not have the resources to apply the appropriate interventions, or may not have the personnel with sufficient expertise to intervene appropriately. A facility may also not recognize the need for referral to a higher facility. Even the time of arrival can affect whether appropriate management is performed; departments may have less staff at night or on weekends, or difficulty obtaining expertise in night-time hours. Stock of equipment used earlier in the day may not get replenished until the morning.

1.4 RATIONALE

This study will aim primarily to look at proportion of traumatic head injury who receive adequate management and secondarily to determine the predictors of appropriate management and if that management is associated with their capacity in terms of resources and expertise when it comes to these regional referral and district hospitals. and if no appropriate management, then begin to get an idea of where effort, resources in terms of equipment and personnel, together with development of policies should be directed to improve the management of traumatic head injury in these settings. And another secondary outcome is, 24-hour outcome will be looked at.

This study will help to understand the current burden of traumatic head injuries in hospitals in Tanzania. It will also be a stepping-stone for further studies to be conducted. This study will help determine if there are gaps in patient care at peripheral hospitals, and whether these gaps are due to resources, personnel or other issues such as the expertise of the individuals working there. This will allow us to determine where resources and education are needed to improve the outcome of patients with head injury in Tanzania. Few studies have been done showing predictors of appropriate management, these studies have been done in mostly in developed and few in developing countries.

1.5 RESEARCH QUESTION

What are the predictors of appropriate management and 24 hours outcome among patients with traumatic head injury seen in regional and district hospitals in Tanzania

1.6 OBJECTIVES

1.6.1 Broad objective

To determine predictors of appropriate management and 24 hours outcome among patients with traumatic head injury seen in regional and district hospitals in Tanzania.

1.6.2 Specific objectives

1. To determine the incidence of traumatic head injury among trauma patients presenting to the emergency units of regional and district hospitals from October to November 2020
2. To determine the proportion of patients with traumatic head injury at district and regional hospitals who receive appropriate management interventions from October to November 2020
3. To determine the availability appropriate resources used in management of traumatic head injury patients presenting to district and regional hospital from October to November 2020
4. To determine the predictors of appropriate management of traumatic head injury patients presenting to emergency units of regional and district hospitals from October to November 2020
5. To describe 24 hours' outcome of patients with traumatic head injury presenting to the emergency units of regional and district hospital from October to November 2020.

CHAPTER TWO

2 LITERATURE REVIEW

2.1 An overview of traumatic head injury

Traumatic head injury is among the leading causes of mortality and morbidity in all developing and developed countries; it is mostly seen in youth, and mostly the result of road traffic accidents (19). There are 27.08 new THI cases annually with an estimated incidence of 369 cases per 100 000 population (20). The incidence is higher in the LMIC, 439 per 100 000 population than in the HIC at 298 per 100 000 (20). Whereas the major causes of THI are RTC in LMIC in the younger age group, there are reported higher incidences among the elderly due to fall in the HIC (2,11). The primary concern regarding head injury is the risk of developing traumatic brain injury. which is dysfunction of the brain, with or without anatomical changes. TBI are by definition due to traumatic head injury but not all Traumatic head injury are TBI, as some of traumatic head injury can only mean laceration of the scalp only.

TBI and traumatic head injury are often used interchangeably in studies but they definitely do not mean the same thing. Literature regarding traumatic head injury and traumatic brain injury can be somewhat confusing since all head injury is not TBI patients, meaning some studies have spoken on traumatic head injury to mean TBI and the other way around (11). Traumatic head injury (THI) is a leading cause of disability in all regions of the globe. The global incidence of THI is estimated at 200 per 100 000 people per year; however, this rate is uncertain and a likely underestimate (21). Incidence of THI is rising globally and this is attributed mainly to injuries caused by the increasing use of motor vehicles, particularly in LMIC's (22)

In the US traumatic brain injury is the leading cause of death and disability among children and young adults. Each year an estimated 1.5 million Americans sustained THI. It is estimated that around 5.3 million Americans live with permanent disability that are cause by THI (23)

2.2 Incidence of traumatic head injury

The section reviews the incidences of THI and associated TBI, in high-income and low to middle income countries. In a systematic review on the proportion of RTCs resulting in THIs, it was estimated that yearly around 69 million people suffer from traumatic head injury. The study reported a higher incidence in America and Europe with value of 1299/100,000 and 1012/100,000, respectively, than in Africa (801/100 000). However, the incidence in Africa is underestimated due to unavailability of records, including the trauma registry. Although there are reports that shows Low-Middle-Income countries have three times, even higher cases of THI than high income countries (7,11).

However, some studies have shown lower incidences of THI than others, even in the high-income countries. A study done in Norway on the epidemiology of hospital referred head injury, 247 head injured patients were seen and included in the study, the annual incidence rate was found to be 229/100,000 population (24). Very low incidences have also been reported in Sweden. In a study by Emanuelson et al, patient data was obtained using medical chart upon discharge of the patients from several counties in Sweden, the mean incidence of THI was 12/100 000 (25), which is smaller than other European countries. An even smaller incidence has been reported in Norway's prospective population-based study by Andelic et al which was conducted over a period of 2 years identifying 359 patients, reporting a decline from 5.2/100 000 to 4.1/100 000 in 2009 and 2010, respectively (26)

Another study conducted in New Zealand, a retrospective-prospective surveillance system (WHO injury surveillance guideline) was used to ensure all THI patients were identified over one year period; the overall incidence from this study was 790/100000 per person years. Mild THI was 18 times more common than moderate and severe THI with greater incidence of mild THI in children (0-4 years) than in youth and elderly (27). Instances of small but increasing incidences, compared with other countries have been reported. An example, in a retrospective study on patients with THI done in New Caledonia, the annual incidence ranged from 10/100000 to 15/100000 in 2010 and 2011,

respectively and an average incidence of 12.2/100000 in the five year period that the study was conducted (28)

In Africa, however, most studies are conducted in tertiary hospitals due to a higher research capability. However, it is difficult to make a comparison of them with population-based or surveillance data. Besides, many patients with severe head injuries may die before reaching the health facilities, and the mild injuries may be unrecognized and not referred. (29). In study done in Nigeria on the epidemiology of hospital referred head injury, 3282 patients were attended during the study period among which 428 (13%) were diagnosed to have head injury (11).

Nonetheless, Africa has recorded different incidences of THI as well. In a prospective study done in Johannesburg, the overall incidence rate of THI was 316 per 100,000, with higher incidence than in high income countries (30), but also higher compared with a study done at Nigeria of involving 9444 patients who attended at the Accident and Emergency Department. During a one year study period, the incidence rate of THI was 2710 per 100 000 per year (31). In a retrospective chart review done in Uganda, 120 patients were identified during the study period and the cumulative incidence of admission of patient with traumatic brain injury was 89/100 000 (32).

2.3 Demographic characteristics of traumatic head injuries

Studies have reported an association between THI and gender and age. In developing world youth are most involved in road traffic accidents In a retrospective cross-sectional analysis study done in Nigeria, a total of 1034 patients with head injury were in registry, of these 833 were due to all terrain road accidents, among them, males predominate (75.8%) with mostly being unemployed, students and traders (33). This is similar to another retrospective study done in Ethiopia of 106 patients and out of these male gender was dominant (71.7%) and majority of these injuries were seen at the age 15-29 years (19).

A retrospective study done in new Caledonia on traumatic head injury patients, 154 patients were recruited, There was no differences in gender when it comes to causes of

traumatic head injury; however males were the majority who suffered severe THI from all mechanisms of injuries and the highest frequency of injuries were noted at age 15-49 (71%) (28). In other retrospective population based survey conducted in Iran, 204 patient's records were reviewed, male gender was dominant (71.6%), most patients were of young age and most came from city with a mean age of 22.6 (34). This is similar to another retrospective study done in Iran, 1000 patients were involved where 81.8% of the patients with THI were males and youth aged 21-40 were mostly involved (35)

In Tanzania, the incidence of THI was reported higher in male than female. In a retrospective cross-sectional study done at Bugando Medical Centre, involving 260 patients with brain injury, the males predominate by ratio of 1.5:1 (17), comparable to another prospective descriptive study conducted at the same hospital, involving 150 pediatric patients, which reported male dominating in all the age groups (36).
A retrospective chart review of 120 patients with THI done at Mulago national referral hospital in Uganda, 42.1% of these patients with THI were of male gender aged 15-29 years (32). This study also concurs with other studies that male gender have increased likelihood of being involved in road traffic accidents as compared to females, and youth are more likely to be the victims which is different patterns as comparing to changing pattern in the UK , were elderly are mostly affected with fall as the mechanism of injury(3)

RTC as mechanism of injury is seen in most of the developing world as compared to the developed world. A prospective registry of THI patients which was created using Research Electronic Data capture (REDCap) done at Mulago hospitals reveals that the most common mechanism of traumatic head injury is RTCs (62%); among 563 patients mostly who suffered traumatic head injury were pedestrians and motorcyclists (37). A retrospective study conducted in Ethiopia concurs with above prospective study finding that RTCs (44.1%) is the most common cause of traumatic head injury (19).

A prospective observational study done at EMD-Muhimbili National Hospital in Dar Es Salaam ranked RTCs as number one mechanism of injury and motorcycles were leading among all motor vehicles (15). Similar picture is seen in a subgroup analysis of a larger

prospective cross-sectional study done across district and region hospitals in Tanzania, where 5227 patients were recruited and Road traffic accidents ranked the fist as the main mechanism of injury (44.7%), THI was the third top diagnosis in this study by 9.6%.(12). Also a prospective descriptive study done at BMC, showed that among the 150 pediatric patients who sustained injuries, RTCs was the most common mechanism of injuries (39.3%) and as with above studies motorcycles (71.2%) was the responsible for most of the road traffic accidents (36)

In a retrospective study done at Muhimbili orthopedic institute, 627 patients were enrolled, RTC's was the leading cause of THI (59.3%) which shows similar picture with above prospective study (38). Another study done in Bugando Medical Centre also shows similar results with RTC's (49.2%) being the most common cause of traumatic head injury (17). Another retrospective chart review of patients with Traumatic head injury, Road traffic accidents(79%) is also seen as the leading cause of traumatic head injury where 34% were from motorcyclists (32).

Trauma has traditionally affected the younger population mainly and high mechanism of injury being the culprit mechanism, but in high income countries this pattern is seen to be changing. with the older people are more frequently involved. This is because the mechanism of injuries differs. A study was done using Trauma Audit Research Network (TARN) database in the United Kingdom (UK) showing the changing of trauma pattern to elderly with fall being the main mechanism of injury (3)

2.4 Management of THI in emergency departments

There is wide variation among the emergency department in the THI patient's management. However, both early recognition and intervention can reduce the extent of head injury and affect the patient's final outcome (2). In the pre-hospital setting, proper stabilization and transport of the patient to an appropriate facility will improve the chances of survival. In the ED, proper management includes a primary survey to rule out airway, breathing and circulation problems that must be immediately addressed, C-Spine stabilization and assessment of neurological status with the GCS.

Emergency medicine management of traumatic brain injury includes, airway control and ventilation, monitoring Blood pressure(BP), maintaining BP will help to maintain Cerebral Perfusion Pressures (CPP) by maintaining MAP (mean arterial pressure), fluid management, sedation and analgesia, osmotherapy by mannitol, anticonvulsant therapy, management of temperature, glycemic control, antibiotic therapy, burr hole and in theatre patient may need decompressive craniectomy(2,39–42). Intracranial pressure (ICP) monitoring and management and nutrition are important to not ED but in the ward for the management of THI.

In a prospective randomized controlled trial (RCT) done in America, 404 patients were included in study on seizure control using phenytoin. There were fewer seizure episodes (3.6%) among the patients who received phenytoin (43). Similar results was seen in a systematic review and meta-analysis, where use of anti-seizure medication (Phenytoin and Levetiracetam) in the different studies reviewed did show reduction of seizures in THI patients (44). A retrospective study done in Washington, 114 patients were included in the study, patients were administered vasopressors, all improved and maintain CPP and MAP (45). This shows that patient with THI and are hypotensive, vasopressors can be used and have shown benefit.

In a systematic review of 18 studies on therapeutic hypothermia in TBI patients, some from RCT and others from observational studies, therapeutic hypothermia (32-34 ^{0}C) was very effective in controlling intracranial pressure (ICP) (46). This is in contrast to a prospective RCT (47) where standard of care plus therapeutic hypothermia (32-35^{o}C) did not show better outcome compared to standard care alone in reduction of ICP and had unfavorable outcome and the study was stopped. This find is similar to the Polar RCT on prophylactic hypothermia (48) where prophylactic hypothermia is not recommended.

2.5 Quality of care in traumatic head injuries

A prospective study done at Mulago hospital in Uganda, 563 patients with THI were reviewed, most patients 251 (45%), were managed non operatively, and 102 received neurosurgical intervention after the CT scan results, some patient did not undergo surgery (5.1%) due to infrastructure limitations (37). In a review of prospectively collected data

done at Malawi, 280 patients were included in the study, 14.3% of the patients had neck collars placed in the hospital, 7.5% of patients under went surgical intervention and 8.9% were intubated and placed on a ventilator (49).

In a prospective cross sectional study done at the Accident and Emergency of Bugando Medical Centre, where at total of 260 THI patients where included, , most patients (75.8%) were treated conservatively (i.e. close observation, antibiotics, anti-edema measures and anti-epileptics) while 24.2% of THI patients required neurosurgical intervention.(17). This is similar to another descriptive prospective study done at Bugando Medical Centre, 49/150 (32.7%) of children had injuries to the head and most patients with THI were managed conservatively, only 2 patients underwent craniotomy (36)

A retrospective study done at Muhimbili Orthopedic Institute (MOI), 627 patients with traumatic head injury were seen, and comparison of management at referral hospitals was compared with management at MOI, where in at peripheral hospitals most patients had no cervical neck stabilization done (94.6%), also most patients were kept on room air (93%) and most oxygen saturations was not monitored (89.8%). Nearly half of the patients were not assessed for their Glasgow Coma Scale (GCS) (48.9%). At MOI most patients received CT scan imaging (85.6%) and 90% of patients who had epidural/subdural hematoma underwent surgery, around 35% (Moderate and severe THI) received seizure prophylaxis and analgesics (38)

In a retrospective study done in Oslo university hospital, 1571 patients with THI were enrolled with 428 (27%) having severe head injury. Increasing age was associated with less intensity in management and it was irrespective of severity of head injury. Elderly patients with traumatic head injury received in appropriate management(50).

In a cross-sectional study (chart review) done at Aga khan university hospital, 146 patients with trauma were reviewed, 73(50%) each patients seen at day and night team, Time taken for these trauma patients to get appropriate care was longer in night time and this impaired management to these patients(51). Similar to another retrospective cohort study done in Japan, 805 trauma patients were seen with 426 (52.9%) of patients seen during off hours. Patient presented during off hours received management late especially

severely injured patients (THI in our context) as compared to those who came during business hours(52).

In another retrospective study done in Rwanda at rural district hospitals, availability of staffs and equipments was concluded to be predictors of care to trauma patients if these hospitals could reduce the need for referral and improve appropriate care of trauma patients in these districts hospitals.

2.6 Traumatic Head injury outcomes

Generally, outcomes in the LMICs are worse than in the HICs, attributed to better facilities of the later. In a prospective study done at in USA (United States of America), 1607 patients were included in the study, there was more patients admitted in ICU (65.6%) of the GMH (Grady Memorial Hospital), the mortality ratio was 120 deaths/1000 (53), compared to 196/1000 death at a hospital among 381 patients with THI, in India (54). In a retrospective review of prospectively collected data, 280 patients were included in the study, the overall mortality was 30.9%, 34/82 (41.5%) died while being managed at casualty area (49). Most patients were 67.6% were admitted in general ward while 2.3% were admitted in ICU.

In the East Africa sub-region, a prospective observational study done at University Teaching Hospital of Kigali (UTHK), 670 patients were included in the study, the mortality rate was 56.1% of the THI patients seen at UTHK (55) and associated factors were GCS <13, bradycardia or tachycardia, hypoxia and age >50 were associated factors. In Tanzania, a retrospective observation study done at MOI 627 patients were included in the study, the mortality rate of all severe THI patients was 78.2% which is similar to other LIC seen in the CRASH trial (56). But low mortality (33%) rate is seen in countries with improved in-hospital and out of hospital care (57). In retrospective review of prospectively study done in Malawi, 280 patients were included in the study, 27.6% of patients were intubated while tracheostomies were placed in 10.3% of THI patients. Also, a large number, 52.3% of the patients the CT Scan was done, 8.9% mechanically ventilated and 14.3% had neck collars to stabilize the c-spine.

CHAPTER THREE

3 METHODOLOGY

3.1 Study Design

This was a prospective cohort study of all traumatic head injury patients seen in regional, district and Designated District hospitals seen during a 24-hour period. The study spanned from October to November 2020. This study was part of the Tanzania Emergency Care Capacity Survey (TECCS), which was a large assessment of the general emergency care capacity of all district and regional hospitals in Tanzania. The larger study aimed at assessing the general emergency care capacity, disaster preparedness and burden of acute illness presenting to district, regional and zonal hospitals in mainland Tanzania. This part of the study focused on describing the clinical presentation, the incidence, appropriate management, and disposition of patients seen with traumatic head injury at Emergency Units of district and Regional hospitals in Tanzania where enrollment within the hospitals occurred in a 24 hours' duration.

3.2 Study setting

This study was conducted in all the emergency units in regional and district hospitals in Tanzania. Tanzania is located on the eastern coast of Africa and has Indian ocean coastline extending approximately 1424km long and also in cooperates several offshore islands including Unguja, Pemba and Mafia. The estimated population of Tanzania as per 2019 is 59.9 million men, women and children (58).

Tanzania is divided into seven different zones (Eastern, Central, Northern, Lake, Southern Highland, Southern and western zones) and each zone has regions which have both regional referral hospitals, designated district hospitals and district hospitals to attend patients in those areas. Table (see attached appendix) shows the zones and distribution of regional and district hospitals, in total Tanzania has 162 Hospitals(district and regional)(59). See attached appendix II, III and IV for all the regional referral and district hospitals distributed all around Tanzania.

Regional hospitals are the last referral point at the regional level, each comprises of beds capacity ranging from 176 to 450 with 9 or more wards. i.e. Surgical (male and female) Medical (male and female), Pediatric, Labor, Post-Natal, Ante-Natal, Obstetrics & Gynecology and I.C.U. Also have other departments like Radiology, Main pharmacy, Physiotherapy, Laboratory, Kitchen, Laundry, Mortuary, Stores, Operating Theatre, Administration, Outpatient and emergency department.

District hospitals are the last referral point at district level and each comprises beds capacity ranging from 100 – 175. They consist of Outpatient patient and Emergency department with 7 wards i.e. Medical ward (female and male) Surgical ward (female and male) obstetrics and gynecology ward, labor ward and pediatric ward.

Emergency departments of regional and district hospitals have treatment and casualty rooms for cold cases and acute medical care respectively, also have other services like Dispensing units, Counselling and social welfare activities, Medical Records, Injection rooms, Dressing and minor operation. ED Staff are Medical officers, Assistant Medical Officers, Assistant Nurse Officers, Nurse anesthetist and Medical attendants. Specialist Surgeon or Physician and Nurse Officer are also available at ED of regional hospitals.

Health care system in Tanzania follows a hierarchical system where at the very bottom are dispensaries at the village level while the health centers are at ward level. Next in the pyramid are the district hospitals which are at the district level followed with regional referral hospitals which are at the region level. When someone gets sick, or has a traumatic injury in the context of this study, they will be brought to a nearby hospital (which can range from a dispensary to a consultant level hospital) for care. Most of the time these hospitals are not sufficiently equipped to care for very sick patients. When the lower levels in the pyramid do not have the expertise to treat very sick patients, the patients will be transferred to the next higher-level hospital and finally the consultant.

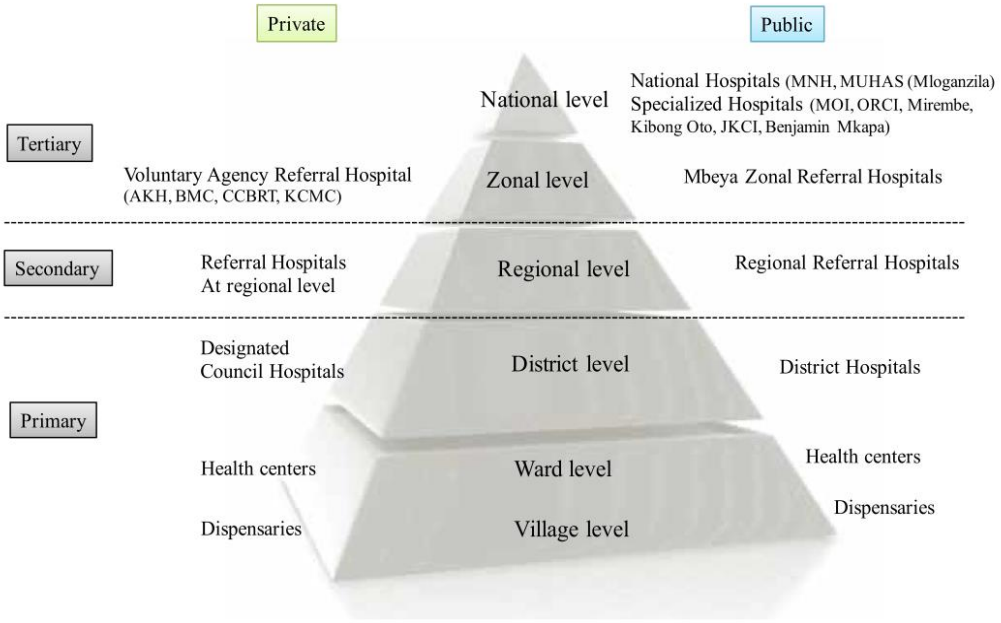

Figure 2: Illustration of the Pyramidal health system in Tanzania

3.3 Target population

All patients with trauma presenting in emergency units in Tanzania.

3.4 Accessible population

All patients with traumatic head injury presenting to emergency units in district/regional hospitals in Tanzania.

3.5 Study population

All patients with traumatic head injury attended at emergency unit in regional/district hospitals in Tanzania at the time the study was conducted.

3.6 Sampling design

Patients with traumatic head injury presenting to the emergency unit in the regional and district hospitals in Tanzania were consecutively enrolled in the study.

3.7 Subjects

3.7.1 Inclusion criteria

- All patients presenting with traumatic head injury in all emergency unit in regional referral, district and designated district hospitals

3.7.2 Exclusion criteria

- Revisits due to previous head injury (clinic visits).

3.8 Variables

We collected information on the following variables for this study

Predictor (independent) variables

1. Demographics e.g. age, gender, occupation
2. Mechanism of injury including RTC, fall from height, assault, hit by a falling object, animal bites, and gunshot
3. Severity of head injury (GCS)
   i. Mild Head injury defined as GCS of 14-15
   ii. Moderate head injury defined as GCS of 9-13
   iii. Severe Head injury defined as GCS ≤ 8
4. Method of arrival to acute ED/Casualty (brought in by police, self/family members or ambulance/paramedics)

Dependent variables

1. Management, appropriate or not, based on WHO trauma guidelines. The completeness and appropriateness of management strategies performed was evaluated based on the need for the intervention, assessed by using the WHO checklist of essential trauma care and defined as performed or not (60). Check list included C-spine immobilization, pain control, wound care, bleeding control, safe referral transport. For Each Element grading was as follows: 0 = not done, 1 = done.
2. 24-hours outcome; discharged, admitted, surgical intervention and referral to another facility. The primary outcome was the proportion of patients who received adequate management. Secondary outcomes were predictors of appropriate management of patients with traumatic head injury attending acute in-take areas/emergency unit.

3.9 Sample size

In a recent study done by Lucumay et al on quality of stabilization of patients referred to the MNH trauma center, there were 114 patients with traumatic head injury. Of these, 16 (14%) received management as recommended by WHO essential trauma guideline. The sample size of this study was estimated based on the proportion of patients who would have all actions done (14%) with a 95% confidence interval and margin of error of 5% using the formula below:

$N = 4Z\alpha^2P(1-P)/(W^2)$

Whereby:

N= Minimum required sample size

Zα= Standard normal deviation for α. A level of confidence of 95% will be chosen for this study.

P= Expected proportion with the characteristic of interest. A value of 14% is chosen basing on previous study by Lucumay et al

W= Total width of confidence interval. A width of 10% is chosen for this study.

N= 4*1.96*0.14(1-0.14)/0.01= 185

N=185

Hence the estimated sample size of patients with traumatic head injury needed for this study was 185. Following adjustment for 10% non-response rate a minimum sample size of 205 participants was needed for this study.

3.10 Patient recruitment and data collection

The study was conducted across all 26 Tanzania mainland regions covering all the districts and regional hospitals (162 hospitals), originally the number of hospitals were 150 but when research assistants went to collect data 12 more hospitals were included as some hospitals were upgraded to district hospitals and were not updated in the ministry of health data base. A team of twenty (20) trained research assistants were divided and occupy seven different geopolitical zones in Tanzania (Northern zone, Southern Highland zone, Southern zone, Lake zone, Eastern zone, Western zone and Central zone).

Each research assistant collected data for 24hours at a single hospital, over a period of six weeks (42 days). In that period each research assistant was estimated to cover between 7

to 8 regional, district and/or designated hospitals in total depending on the number of health facilities available in the allocated zone. To facilitate easy movement from one hospital to another within a designated region/zone assigned to a research assistant, all hospitals where data collection is to be done was allocated on google map and estimated distance from one hospital to another was calculated via use of google map application by Google Inc. Thereafter the research assistant chose the starting point (hospital) to start collection of data from list of assigned hospitals in his/her region or zone and he/she moved on to the next nearest hospital on the map up until all assigned hospitals in the specific region/zone were visited and data collection done.

Data collection was conducted in an emergency unit for continuous 24 hrs. after arrived to the specified health facility; the research assistant collected data in a specific hospital for only 24 hrs. Time of data collection was from 0800hrs in the morning on the day of data collection up to 0800hrs of the next day. All patients who met the inclusion criteria in the 24hrs period of data collection were recruited and data collected. Patient's/relatives were called (using mobile number taken during data collection) after 24 hours to ascertain the 24hours outcome of the patient

Thereafter the research assistant rested for 1-2 days before moving on to the next nearest hospital depending on the availability of public transport and repeated the same study procedures until all allocated hospitals in the specific region or zone were visited and data collection done. Since it took about 4-5 days for one cycle of arriving to a specific health facility, data collection, resting and travelling to next health facility each research assistant was able to complete all the allocated hospitals within specified time of six weeks (42 days) and some even less depending on the number of hospitals available in those zones.

A consecutive sampling of patients presenting during a consecutive period of 24 hours' in the emergency units were included in the study. Patients of all ages seen in these hospitals who presented with acute head injury were included in the study. We screened all patients who arrived at the emergency/casualty area, after vitals of the patient taken, those patients who have sustained head injury and met inclusion criteria were enrolled in the study.

Data was collected prospectively during the time patient's visit using a structured checklist. The research assistants interviewed either the patient, if the patient was not able to answer, relative(s) who were available in the intake area. A waiver of consent from the main study provided by the Muhimbili University of Health and Allied Sciences Institutional Review Board was used in this study as this is a sub-analysis from the main study.

For all patients that met the criteria, a structured case report form (CRF) incorporated into online data capture software was used to document patients' demographics, clinical presentation (details of the mechanism of injury and vital signs), method of arriving in the emergency unit, length of stay in the emergency unit, specific steps in management of patient, disposition and 24 hours outcome. The research assistant was available for a period of 24hrs so as to see all the traumatic head injury patients that were treated at the casualty area.

The main investigator of the larger study was the overall overseer of the data and ensured the correctness of the work and later analyzing the data collected. In the larger study (TECCS) I was one of the co-investigators and we had research assistants (20 research assistants), who assisted in collecting data at the regional and district hospitals of all the patients were attended in the emergency unit (traumatic and non-traumatic). The research assistants were trained properly on the use of the data collection checklists, and the relevant information collected on traumatic head injury patients that were included in the study.

3.11 Standardized data collection tool

A standardized data collection checklist (extracted from WHO) was used to collect data from all eligible patients (60)

Validity and reliability of tool

Data collection was conducted using a purposefully designed CRF. Validity refers to the accuracy of the data collected by the research instrument. To ascertain this, the CRF was pretested prior to initiation of the study to check for consistency in responses.

3.12 Data analysis

Research Electronic Data Capture (Redcap) was used, where the data we obtained from the study was given codes (was coded) and then the coded data was fed/imported into the REDcap. The data that was imported in the REDcap was analyzed using the statistical package for social science (SPSS) and analysis of the data was done. Using all the variables in the study, important frequencies and tables were generated. We calculated the Means/proportions and medians/interquartile ranges for all the appropriate variables. We also calculated the incidence of traumatic head injury in regional or district hospital. Categorical variables are presented as frequencies and percentages and continuous variables using measures of central tendency based on distribution of population. Details of analysis plan for the specific objectives is presented below:

Objective I: To determine the incidence of Traumatic head injury patients among trauma patients. The incidence of traumatic head injury patients in patients with trauma is analyzed with frequency distribution tables.

Objective II: To Determine the proportion of patients with traumatic head injury in referral and district hospitals who receive appropriate management interventions. The proportion of THI patients who receive appropriate management among patients with traumatic head injury is analyzed with frequency and proportion; using a Yes and No. Because of the possibility that some hospitals would not have any patients meeting inclusion criteria, it was determined that the unit of analysis would be the patient. Thus, the proportion of those with adequate management would be those with adequate management divided by the number of patients with head injury included in the study.

Management strategies performed was evaluated based on the need for the intervention, assessed by trained research assistants using the WHO checklist of essential trauma care and defined as performed or not if required)

a. The completeness and appropriateness of management strategies performed was evaluated based on the need for the intervention, assessed by using the WHO checklist of essential trauma which includes; C-spine immobilization, pain control, wound care, bleeding control and appropriate mode of transportation to the health facility. This checklist was applied by the research assistants and overseen by the primary investigators.
b. Each of the 5 components (C-spine immobilization, pain control, wound care, bleeding control and appropriate mode of transportation to the health facility) was assessed for each patient.
c. C-spine immobilization requirement was assessed using severity of head injury and any patients who presented with GCS ≤13 needed C-Spine protection. Patient complains like wounds/abrasions, bleeding and pain were used to assess the need for wound care, bleeding control and pain control respectively. Patient mode of arrival (either using ambulance or other modes of transportation) was assessed to evaluate appropriate mode of transportation to a referral health facility. If what the patient needed did not match what the patient was provided then the management was deemed inappropriate and if matched then management was deemed appropriate.
d. What the patient needed and what was actually provided to the patient was assessed and documented and final comment was made whether the management was appropriate (if what the patient needed matched what was actually provided) or not-appropriate (if what the patient needed did not match what was actually provided)
e. Each of the five variables were coded as follows, one (1) was given if the component was done and/or provided to the specific patient and score of zero (0) if the specific component was not done or provided to the specific patient.

The above items were scored individually, and there was no cut off number as we only look at whether the patient need the intervention or not and whether it was done or not. And if it was done then it was deemed appropriate and vice-versa.

Objective III: To determine availability of resources used in management and association with management of traumatic head injury. The availability of resources used

in management of traumatic head injury among patients with trauma is analyzed with frequency and proportion. Health related factors/resources list that are needed for the management of traumatic head injury are:

(a) Personnel neurosurgeon/surgeon
(b) Functional CT-Scan.
(c) C-spine immobilization equipment (Bedsheets, rigid/soft neck colar-availability of either one is adequate)
(d) Availability of Antiseizures (Phenytoin, benzodiazepines)
(e) Availability of working Ambulance
(f) Operating theater (capable of performing bar hole, craniectomy etc)
(g) Antibiotics availability (Available antibiotics at time of data collection)
(h) Analgesics availability (Paracetamol, Diclofenac, Ketamine, tramadol)
(i) Vital signs measurement equipment (BP machine, SPO2 Machine, RBG Machine-if one is not available then its inadequate)
(j) Initial wound care (hemorrhagic control-compression dressing, suturing)

All above mentioned resources were rated using the 3-tier rating

Availability of resources was assessed by interviewing the management and inspection (done by the research assistants) at the respective hospitals. The WHO emergency unit assessment tool was utilized to assess for adequacy looking into availability of resuscitative equipment, diagnostics, medications and surgical services. A 3-tier rating will be utilized to evaluate availability: 1-generally unavailable, 2- some availability and 3 – adequate. For all scores below 3, barriers to availability were identified.(61). The three-tier rating is explained as:

1-rated as Generally Unavailable: This means that the resources mentioned above were generally not available in the hospital.

2-Rated as Some availability: This was assessed as the resource is available but not all the time, for example the hospital might have a neurosurgeon who is a visiting doctor so at times will not be available. If the equipment needed is supposed to be there but during data collection maybe the reagents were out of stock or the equipment is broken down or is opened during certain hours of the day.

3-Rated as Adequate: this was assessed when all the required resources to manage the patient with traumatic head injury were always available.

This rating was entered in SPSS and data was analyzed where proportion of hospitals which met the availability of all the above resources together with facility that met some of the above available resources was calculated, I also calculated the proportion of the hospitals that did not have all of the above-mentioned resources needed for management of traumatic head injury. All hospitals, whether or not they had patients meeting the inclusion criteria during the data collection period, were included in this analysis.

Objective IV: To determine predictors of appropriate management instituted to patients with traumatic head injury in regional and district hospitals. The independent variable is socio demographic (age, sex, level of education, mechanism of injury, injury setting, mode of arrival, estimated time from injury, time of injury and prehospital care), mechanisms of injury (RTC, assault, fall from height, hit by falling object, animal bite and burn), resource availability and injury severity score.

Objective V: 24-hour outcomes of patients with traumatic head injury

These were reported using descriptive statistics of frequency and proportion looking into admission, discharge, referral to another facility and mortality.

3.13 Ethical considerations

Ethical clearance to conduct the study was requested from appropriate and relevant research review board at MUHAS. The ethical clearance of the larger study called TECCS was sought from IRB and the study was given ethical clearance that dates from 11th May 2020 to 10th May, 2021. Approval to conduct the study in the regional or district hospitals was sought from the appropriate authority in those regional and district hospitals after presenting to them the bigger study IRB approval, ministry of health and Ministry of education letters for allowing us to conduct study in the hospitals stated (see Appendix III)

Data was entered to REDcap and only the researcher and assistant were the only ones with access to the data.

There was no direct benefit to the participants from the study; nonetheless information gained in this study will allow identification of determinants of appropriate stabilization of THI patients which may help future trauma patients. There was no identifiable risk to the participants from this study. All the data collected was kept for the research purpose only. And all the equipment used to collect data from the patients were kept safe by the investigator/researcher and the assistants so as to maintain patient information confidential.

No harm came to those patients participated in the study as all the patient received all the care as per protocol of the hospitals that the study will be conducted.

CHAPTER FOUR

4 RESULTS

4.1 Study participants from screening to outcomes

During the study period all 162 regional and referral hospitals were visited and a total of 1056 patients with trauma attended during the study period. Of these, 218 (20.7%) patients with traumatic head injury (THI) were enrolled and followed up over a period of 24 hours. Among the patients with THI, 130 [59.6% (95% CI 53%-66%)] of patients were appropriately managed with 129 (99.2%) still alive after 24 hours.

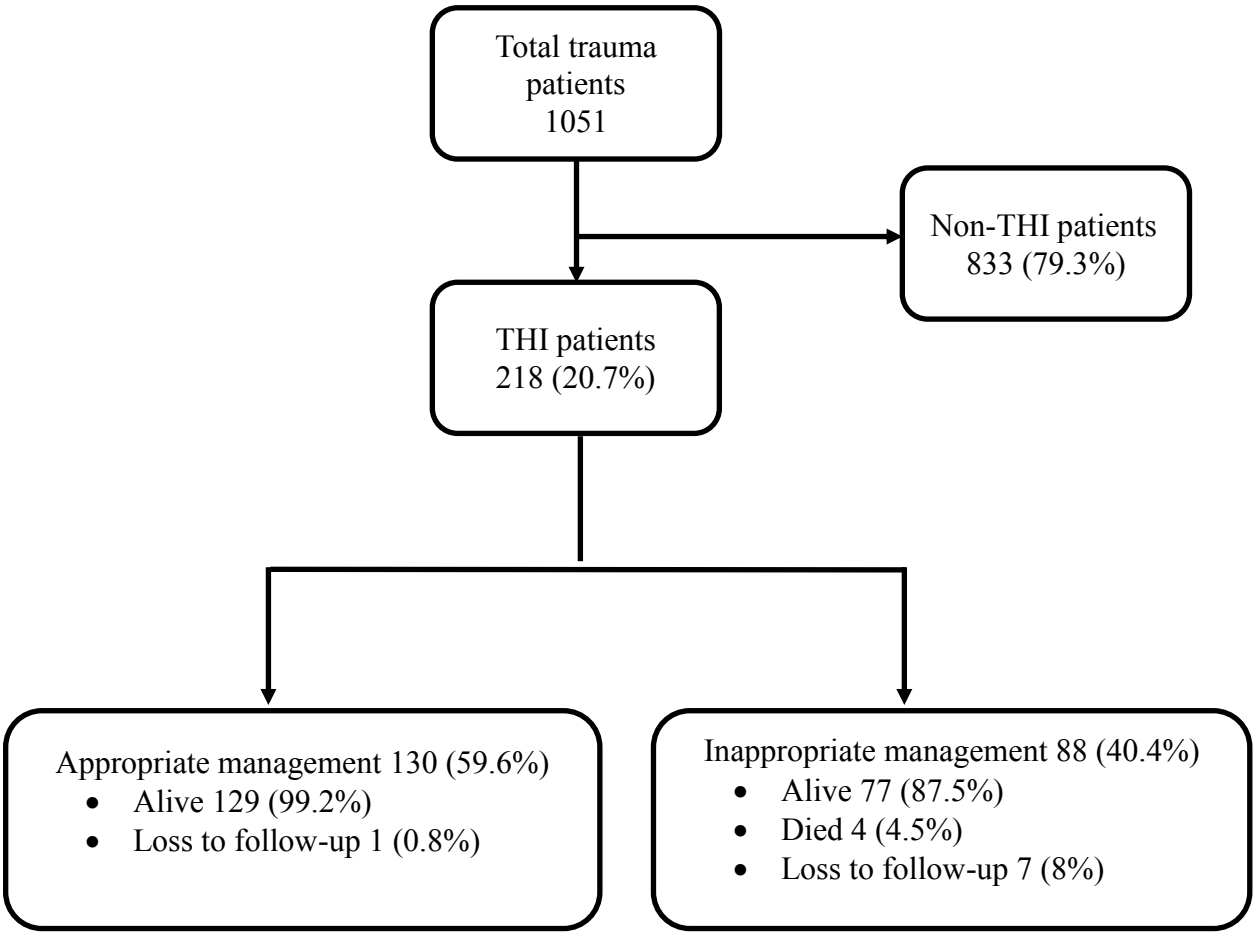

Figure 3: Study participants from screening to outcomes

4.2 Demographic characteristics of study population.

In total, the trauma patients were 1056 see at the district and regional hospitals, of these there were 218 (20.6%) (95% CI 18.2-23.2%) patients with traumatic head injury and 112 (79.3%) (95% CI 76.8-81.8%) non-THI patients. Among the 218 patients with THI, 160 (73.4%) were males, with a median age of 29 years (Interquartile range of 20-38 years), of which 119 (54.8%) had primary education. (Table 1)

Table 1: Demographics characteristics of traumatic head injury patients

Variable	Category	Frequency N=218	Percent (%)
Age group (years)	< 18	44	20.2
	18 - 35	105	48.2
	36 - 45	42	19.3
	46 - 60	21	9.6
	>60	6	2.8
Median age [IQR] in years		29 [20, 38]	
Sex	Male	160	73.4
	Female	58	26.6
Level of education	University level	10	4.6
	Secondary School	34	15.7
	Primary education	119	54.8
	No formal education	33	15.2
	Unknown	21	9.7

Among the 218 THI patients, 194 (89%) did not receive any form of pre-hospital care. RTC was the commonest mechanism of injury in 112 (51.4%) with animal bite being the list mechanism of injury in 2(0.9%). Of all THI patients,133 (61%) sustained injuries on the streets and 114 (52.3%) presented less than an hour from the time of injury with 92 (42.2%) having motorcycle as mode of arrival to the hospitals. Most 150 (68.8%) THI patients were seen during the day. (Table 2)

Table 2: Characteristics of traumatic head injury patients

Variable	Category	Frequency N=218	Percent (%)
Mechanism of injury	Road traffic crash	112	51.4
	Assault	65	29.8
	Fall from height	20	9.2
	Miscellaneous	10	4.6
	Burn	5	2.3
	Hit by falling object	5	2.3
	Animal bite	2	0.9
Injury setting	Street	133	61.0
	School	112	51.4
	Home	54	24.8
	In the office or place of work	14	6.4
	In farm	5	2.3
	Other	7	3.2
Mode of Arrival	Motorcycle	92	42.2
	Motor Vehicle	89	40.8
	Ambulance	26	11.9
	Police	10	4.6
	Bicycle	1	0.5
Estimated time from injury	< 1 hour	114	52.3
	1 – 2 hours	44	20.2
	2 – 3 hours	13	6.0
	3 – 4 hours	12	5.5
	5 and above hours	35	16.1
Time of injury	Day	150	68.8
	Night**	68	31.2
Pre-hospital Care	Yes	22	10.1
	No	194	89.9

******Night (2000Hours to 0800Hours)

4.3 Characteristics of patients with traumatic head injury

The predominant presenting complaints of patient with THI was scalp laceration 92 (42.2%). Most patients had an ISS <16, and GCS ≥ 14. Among patients with THI, an ISS Score of ≥16 was seen in 43 (19.7%) of patients and 20 (9.2%) presented with severe head injury defined as GCS ≤8. (Table 3)

Table 3: Clinical characteristic of patient with traumatic head injury

Variables		Frequency	Percent (%)
Presenting complaints	Scalp laceration	92	42.2
	Scalp hematoma	88	40.4
	Headache	76	34.9
	Loss of conscious	49	22.5
	Vomiting	8	3.7
	Open skull fracture	6	2.8
	Penetrating head injury	6	2.8
	Convulsion	5	2.3
	Depressed skull fracture	5	2.3
Head injury severity	Mild (GCS ≥14)	173	79.4
	Moderate (GCS 9-13)	25	11.5
	Severe (GCS ≤8)	20	9.2
Injury severity score	ISS score <16	175	80.3
	ISS score ≥16	43	19.7

4.4 Management received by traumatic head injury patients at emergency units

Among patients with THI, 176 (80.7%) received analgesics, 85 (39%) required suturing, and 75 (52.3%) required wound care (other than suturing). C-Spine immobilization was performed in 3 (1.4%) patients, endotracheal intubation was performed in 5 (2.3%) and CT scan of the head was done in 4 (1.8%).

Table 4: Management needed by and done to patients with THI in EU

		NEED	DONE	
Variables		**Frequency (n)**	**Frequency(n)**	**Percent (%)**
Management given	Analgesics	192	176	80.7
	Suturing	115	85	39.0
	Wound care	114	75	34.4
	Endotracheal intubation	45	5	2.3
	CT Scan of the brain	45	4	1.8
	C – spine immobilization	20	3	1.4

Out of 218 patients with traumatic head injury recruited in the study and 131 (59.6%) were managed appropriately in the regional and district hospitals (Figure 2).

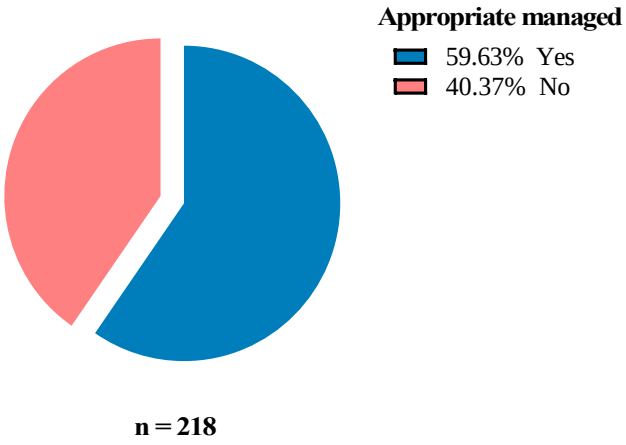

Figure 4: Proportion of patient with traumatic head injury who received appropriate management.

4.5 Determining resources used in management traumatic head injury

Availability of resources was assessed in all the hospitals visited. In more than 80% of the hospitals visited, operating theater, wound care equipment, antibiotics and antiseizure medications were available. Transport ambulances and analgesics were adequately available in approximately 50% of the hospitals visited. C-Spine immobilization equipment general surgical services was adequately available in approximately one-third of the hospitals and. CT-scan services generally unavailable at most hospitals.

Table 5: The resources available in management traumatic head injury.

Variables	Adequate n (%)	Some availability n (%)	Generally Unavailable n (%)
Transport Ambulance (for referring patients)	92 (57.5)	57 (35.6)	11 (6.9)
CT - Scan	6 (3.8)	0 (0)	154 (96.3)
General Surgery	61 (38.1)	23 (14.4)	76 (47.5)
Vital Signs measuring equipment	63 (39.4)	61 (38.1)	36 (22.5)
Antibiotics	126 (78.8)	30 (18.8)	4 (2.5)
C – Spine Immobilization equipment	54 (33.8)	57 (35.6)	49 (30.6)
Basic Wound Care equipment	149 (93.1)	10 (6.3)	1 (0.6)
Operating theatre	149 (93.1)	0 (0)	11 (6.9)
Analgesics	86 (53.8)	40 (25.0)	34 (21.3)
Antiseizure medication	128 (80.0)	23 (14.4)	9 (5.6)

4.6 Univariate and Multivariate analysis of factors associated with appropriate management among head injury patients.

Univariate analysis was done on several variables associated with appropriate management of head injury patients at emergency units. Availability of equipment at the facilities, injury severity score of 16 or more, moderate and severe head injury were found to be statistically significant on univariate analysis while availability of availability of equipment and severity of head injury were found to be statistically significant ($p<0.05$) at multivariate analysis (Table 6).

Table 6: Univariate and Multivariate analysis of factors associated with appropriate management among head injury patients.

Variable	Univariate analysis cOR	95% CI	P-value	Multivariate analysis aOR	95% CI	P– value
Availability of equipment						
Yes	3.57	1.20-10.67	**0.023**	4.74	1.04– 21.52	**0.044**
No	Ref					
Presence of human expertise						
Yes	2.72	0.77 – 9.59	0.119	0.14	0.014– 1.37	0.091
No	Ref					
Injury severity scores						
≥16	0.19	0.09 – 0.39	< **0.001**	0.52	0.19 – 1.4	0.194
<16	Ref					
Head injury Severity (GCS)						
Severe (3 – 8)	0.02	0.002-0.14	< **0.001**	0.017	0.002 – 0.17	< **0.001**
Moderate (9 – 13)	0.01	0.002-0.11	< **0.001**	0.013	0.002-0.11	< **0.001**
Mild (14– 15)	Ref					
Time of arrival						
Day	0.96	0.535– 1.72	0.893			
Night	Ref					
Age						
>60	1.38	0.229-8.38	0.723			
18 – 60	1.02	0.518-2.00	0.958			
<18	Ref					

4.7 Hours outcome of patient with traumatic head injury.

Among patients with THI, 45.6% of patient with traumatic head injury were alive and still in hospital, 41.9% were alive and discharged, 7.4% were transferred to another hospital, 5.1% of patients with THI died in the emergency unit.

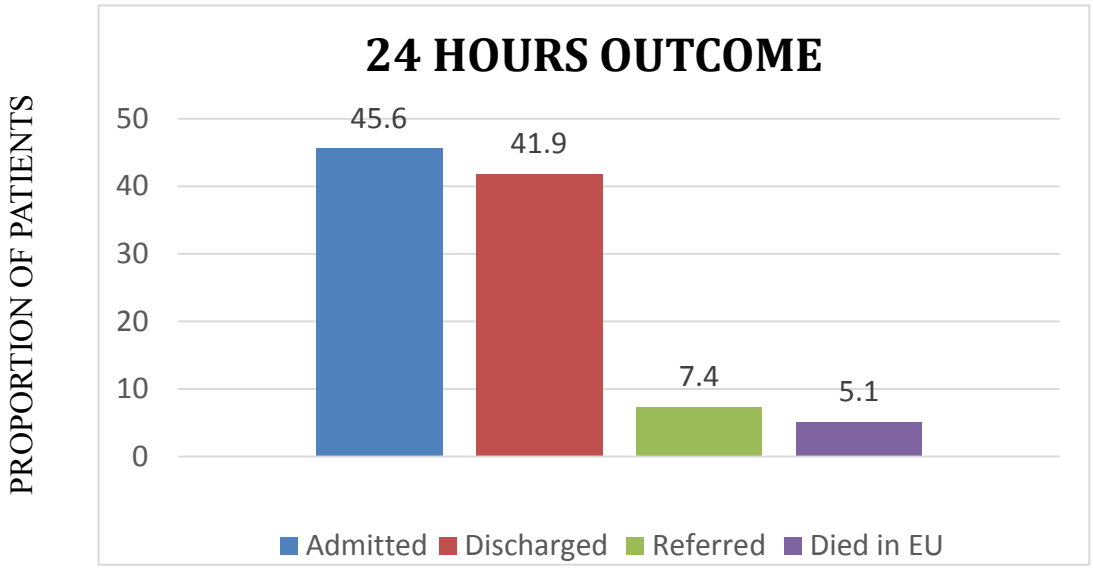

Figure 5: 24 Hours outcome of patient with traumatic head injury.

CHAPTER FIVE

5 DISCUSSION

This prospective cohort study aimed primarily to look at proportion of traumatic head injury who receive adequate management and secondarily to determine the predictors of appropriate management of THI patients seen in emergency unit throughout Tanzania and their 24hours outcome. In this study more than half of the patients received appropriate management and it was associated with adequate equipment at the hospital, while patients who were more severely injured or had worse head injury were less likely to obtain appropriate care, even when controlling for resource availability.

Despite the fact that many hospitals had adequate equipment for c-spine stabilization but very few patients who needed C-spine immobilization received one, a likely explanation could be the lack of knowledge and understanding the importance of C -Spine immobilization in THI patients. The findings in this study are similar to a study done to a tertiary trauma center in Tanzania (38) and in a study by Lucumay *et al*(15), where none of the head-injured patients transferred from regional and district hospitals arrived to the trauma center with C-spine immobilization. The percent of head injury patients who received C-Spine immobilization was only slightly higher (14.3%) in a study by Eaton et *al* done at Kamuzu Central Hospital, a tertiary care center in the capital of Malawi (49)

Similar to what has been observed in prior studies, we found that Computerized Tomography of the head was not done in most of the patients that required the imaging modality. This is not surprising given the fact that most of the hospitals visited had no CT scan in their facility. This is similar to a study done in Tanzania where 95% of patient did not have CT scan done. (62). In contrast to a study done in USA were CT scan was done in 44.3% of patient with isolated THI patients. (63).

Endotracheal intubation was not done in patients who presented with traumatic head injury and had all the indications of endotracheal intubation. Explanation to this is possible the lack of knowledge and skills that one should have regarding intubation and

availability of resources. Similar results were also observed in a study conducted in Tanzania by Lucumay et *al* where none of the patient who required endotracheal intubation received the intervention. (15)In another study, only 8.9% of the patient who required endotracheal intubation received the intervention. (53) In contrast over half of the patients in a study by Crandon at University Hospital of the West Indies were intubated. (64) Similar findings to another study done in USA were 42.7% and 47.7% of patients of traumatic head injury patients were intubated prehospital and ED respectively (65).

Analgesics was provided to most patients with THI after being assessed and found to be in pain. Explanation to this is that most health care providers are knowledge in pain assessment, the importance of alleviation pain and the easy availability of analgesics in the hospitals visited. This is similar in a study done in USA pain assessment was done in 43.8% of patients and of these, 45.5% received analgesics in ED. (63).

There was no prehospital care in around ninety percent of head-injured patients brought in to regional and referral. Most patients arrived to the hospitals without ambulances. Logical explanations to this are the lack emergency care services, poor to no paramedical services and fewer ambulances that a well-equipped to care for THI patients. In contrast to a study done in Finland where advance pre-hospital care is done and from this study THI patients were transported with Physician staffed EMS services the led to an outcome benefit. (66)

Availability of equipment/resources in health facility needed in treatment/management of traumatic head injury provides more efficient ways of managing patient with traumatic head injury and if heath workers have the required resources to manage patients with traumatic head injury this improves their eagerness to treat patients with THI. We found most of the most of the hospitals in district and regional level have the resources needed in management of traumatic head injury patients like operating theatre, initial wound care, analgesics, antiseizure but they lack mostly CT scan, C-spine immobilization equipment and neurosurgeons/surgeons that necessitate them to transfer the patient.

CT scan was generally unavailable in more than ninety-five percent of the hospitals visited. This is similar in a study done in Mexico where clinics and small hospitals had no CT scan and larger hospitals had CT scans but reported to be periodically break down and impair care of traumatic head injury patients. (67), this is contrast with a study done in Tanzania to a tertiary trauma care facility where 85.6% of patient with traumatic head injury had CT scan done. (38). CT-scan is the recommended imaging modality in patients with traumatic head injury (68,69)

Human resource needed to treat patient with traumatic head injury is low in regional and district regional referral hospitals in Tanzania, about a third of the hospitals had adequate general/neurosurgical services. Plausible explanation to this is that most neurosurgeon are concentrated in urban areas with possible friendly working environment. This is in contrast to a study done in Mexico where human resources to care for trauma patient was adequate especially in larger hospitals(67), but similar picture was seen in small hospitals and especially clinics in Mexico.

In this study we looked at several factors that can be used in predicting appropriate management such as injury severity score, lacking specific equipment, severity of head injury, safe referral, age, time of injury and lack of human expertise. Few studies have looked on how some of the above-mentioned factors predict appropriate management, most of studies have looked on predictors of outcome/disposition of patient with traumatic head injury.

In our study we found that availability of equipment in the regional and district hospitals increased the chances of receiving appropriate management and this was statistically significant. Similar findings are found in a study done at Rwanda, were equipping district hospitals with equipment increases the chance of patient with trauma to be appropriately managed(70). A plausible explanation for this is, trauma resuscitation equipment are crucial part of management of patients with trauma in our context THI.

We found that, GCS though not directly linked to whether the patient will be managed appropriately or not, but in our study, we found that having lower GCS increases the

likely hood of the patient to be treated inappropriately and this was statistically significant in both univariate and multivariate regression model. A plausible explanation to this is that there might be knowledge gap and lack of skills in caring patient with traumatic head injury and especially moderate and severe head injured patients.

In our study, age was assessed as being a predictor of appropriate management though it was found not to be statistically significant. This is in contrast with a study done at Oslo University Hospital were advanced age was seen as a predictor of being inappropriately managed as seen in this Oslo University hospital study treatment limiting decisions (TLDs) are more often made for older patients with TBI than for the young(50). The difference seen with the findings our study might be explained as the largest population that is sustained head injury are young, receiving appropriate management.

Time of arrival to the emergency department can affect the management of traumatic head injury patients, as most staffing and early investigations including CT scan and others are being done early during day time. This is line with a study done in Aga Khan University hospital in Karachi where most investigations to trauma patients including CT head for head injury patients are being done early in day time as compared to night time of arrival to EMD(51). Similar to another study done in Japan were off-hour arrival to emergency for trauma patients was associated with delayed in care.(52) This is in contrast to our study, time of arrival to emergency units was not statistically significant in predicting appropriate management.

Injury severity score has direct effect in appropriateness in management of THI patients. In our study as ISS increased the likely hood of being treated inappropriately rises though not statistically significant. In my study more than eighty-seven percent of patients who sustained head injury were still alive at twenty-four hours' follow-up. This large percentage of patient that are alive and either still admitted or discharge can be explained by the fact that most of the patients had mild traumatic head injury which is mostly managed conservatively. Around forty percent of patients in this study were discharged during 24hours follow up: this is similar to a study done in the USA where 38% of patient seen in ED were discharged. (63).

5.1 Strengths

1. This was a multi-center study involving the regional and district hospitals in Tanzania and data was collected on real time during on-site visits to each facility which we believe will allow generalizability.
2. A large number of variables were captured in this study which provides greater insight on predictors of appropriate management.
3. Patient were consecutively enrolled in a continuous manner for 24 hours and hence all patient who attended the hospital were seen (no missing of any potential participants).

5.2 Limitations

1. This was a one-day study that was collected on different days and by different health care professionals
2. Determination of what was needed by the patient was not done in real time during data collection this could results into underestimating or overestimating what was needed by the patient.
3. Analysis only involved the hospitals in which THI patients were seen, so the incidence of traumatic head injury might be higher than what is seen in this study if length of stay in one hospital is increased.
4. Long term outcomes of THI cannot be commented as this study only followed up these THI patients for only 24 hours.

CHAPTER SIX

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

Most patients were having mild traumatic head injury and about half of head injury patients were appropriately managed and were found alive after 24hours of follow up. Injury severity score, lack of equipment and GCS were found to be independent predictors of appropriate management of traumatic head injury patients.

6.2 RECOMMENDATION

1. Stocking these regional and district hospitals with proper resources (human and materials) needed in managing patient with traumatic head injury.
2. Provision of knowledge on severity of head injury and the skills on critical intervention to health care workers in regional and district hospitals needed in patient with traumatic to provide appropriate management as needed
3. Strengthening pre-hospital care so patients could be receiving appropriate management even from the place of injury.
4. Real time collection of data on what patients with THI needed could be done in order to eliminate a possible overestimating or underestimating what these patients need in regional and district hospitals in Tanzania as this was done with panel of specialists.
5. There is an exigency to develop, implement and study systems that can sustenance the improvement of THI appropriate management and optimize outcomes of such patients.

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APPENDICES

Appendix I: Case Report Form (CRF)

Inclusion criteria

- All patient presented with traumatic head injury in all emergency unit in regional referral and district and designated district hospitals

Exclusion criteria

- Revisits due to previous head injury (clinic visits)

TECCS2 - Patients details

Record ID

_____

Demographic Details

Referral

- ◯ Referred
- ◯ Self Referral
- ◯ Unknown

Reason for referral

_____

Mode of arrival

- ◯ Ambulance
- ◯ Bicycle
- ◯ Bus
- ◯ Car (Private or Taxi)
- ◯ Commercial vehicle
- ◯ Mini Bus
- ◯ Motorcycle
- ◯ Police
- ◯ Tricycle (Bajaj)
- ◯ Truck
- ◯ Unknown
- ◯ Walk in

Age

_____

Sex

- ◯ Male
- ◯ Female

Level of education

- ◯ University Level
- ◯ A'level Secondary Education
- ◯ O'level Secondary School
- ◯ Primary education
- ◯ None
- ◯ Unknown
- ◯ Other

Patient Address

_____

(Living place)

Patients / Relative Phone No

_____

Vital Signs	
SBP	_____
DBP	_____
Pulse	_____
RR	_____
SPO2	_____
Temp	_____
RBG	_____
AVPU	_____
Random Blood Glucose	_____
Triage done?	○ Yes ○ No
Who did the triage?	○ Enrolled Nurse ○ Registered Nurse ○ Health attendant ○ Clinical Officer ○ Assistant Medical Officer ○ Medical Doctor ○ Specialist Doctor ○ Medical student ○ Nurse student ○ Others
Triage level	○ Emergency ○ Priority ○ Queue

Presenting Complaint	
Time of presentation	_____
Medical or Trauma case	☐ Medical ☐ Trauma
Injury setting	○ School ○ Home ○ Street ○ In the office or place of work ○ In Farm ○ In the water bodies (lake etc) ○ Unknown ○ Others
Chief Complain	☐ Abrasion ☐ Acute loss of vision ☐ Altered mental status ☐ Bite ☐ Burn ☐ Chest pain ☐ Contusion (bruise) ☐ Crush Injury ☐ Difficult in breathing ☐ Dislocation ☐ Drowning ☐ Foreign Body ☐ Fracture ☐ Gun shot wound ☐ Head Injury ☐ Headache ☐ Injury to internal organ ☐ Laceration (Cut) ☐ Penetrating Wound/ Stab ☐ Reduced urine output ☐ Sided body weakness ☐ Soft Tissue Injury ☐ Spine Injury ☐ Traumatic Amputation ☐ Unknown ☐ Pain ☐ others
Other (describe)	_____
Substance Use	☐ Alcohol Consumption ☐ Cigarette Smocking ☐ None ☐ Other

_____

_____

Mechanism of Injury	☐ Road Traffic Crash ☐ Fall from height ☐ Burn ☐ Assault ☐ Stab ☐ Hit by falling object ☐ Poisoning ☐ Animal bite ☐ Hanging ☐ Drowning ☐ Gunshot ☐ Miscellaneous
Specify (motorcycle, pedestrian or car)	☐ Pedestrian ☐ Motorcyclist ☐ Passenger on motorcycle ☐ Tricyclist (Bajaj) ☐ Passenger on tricycle (Bajaj) ☐ Bicyclist ☐ Passenger on Bicycle ☐ Driver of a private car ☐ Driver of a commercial car (taxi etc) ☐ Passenger in a private car ☐ Passenger in a commercial car (taxi etc) ☐ Cart rider ☐ Others
Estimated time from injury to first health facility	_____
Care received at pre-hospital settings	_____
Head and neck worst injury?	○ No injury ○ Minor ○ Moderate ○ Serious ○ Severe ○ Critical ○ Unsurvivable
Face worst injury?	○ No injury ○ Minor ○ Moderate ○ Serious ○ Severe ○ Critical ○ Unsurvivable

Chest worst injury?	◯ No injury ◯ Minor ◯ Moderate ◯ Serious ◯ Severe ◯ Critical ◯ Unsurvivable
Abdomen worst injury?	◯ No injury ◯ Minor ◯ Moderate ◯ Serious ◯ Severe ◯ Critical ◯ Unsurvivable
Extremity (including pelvis) worst injury?	◯ No injury ◯ Minor ◯ Moderate ◯ Serious ◯ Severe ◯ Critical ◯ Unsurvivable
External worst injury?	◯ No injury ◯ Minor ◯ Moderate ◯ Serious ◯ Severe ◯ Critical ◯ Unsurvivable
Does the Patients have any of the following?	☐ Scalp Hematoma ☐ Scalp laceration ☐ Vomiting ☐ Headache ☐ Convulsion ☐ Loss of Conscious ☐ Open skull fracture ☐ Penetrating head injury ☐ Depressed skull fracture ☐ Other
GCS:_____/15	_____
Pupil Size	◯ Normal ◯ Unilateral Dilatation ◯ Bilateral Dilatation ◯ Bilateral Constricted
Name the extremities affected	_____

Investigations	
Laboratory Inveistigation	☐ BS/MRDT ☐ Urinalysis ☐ FBP ☐ Electrolytes ☐ Pregnancy ☐ CSF ☐ Culture ☐ ABG ☐ Sputam ☐ Random Blood Glucose ☐ Other
Write other laboratory investigation	_____
Imaging	☐ X-Ray of long bones ☐ X-Ray of Skull ☐ X-Ray of Pelvis ☐ X-Ray of Spine ☐ Ultrasound (FAST) ☐ Ultrasound (E-FAST) ☐ Ultrasound (Formal) ☐ CT-Scan of Brain ☐ CT-Scan of long bones ☐ CT-Scn of Spine ☐ MRI of Brain ☐ MRI of Spine ☐ MRI of Long bones ☐ Other ☐ None
Specify others	_____
Write other imaging investigation	_____

EU management	☐ IV Fluids ☐ Blood products ☐ Analgesics ☐ Tetanus toxoid ☐ IV Line placement ☐ Splinting ☐ Suturing ☐ Compression dressing ☐ Skeletal traction ☐ Close reduction ☐ Therapeutic Amputation ☐ External fixation ☐ C-Spine immobilisation ☐ Endotracheal intubation ☐ Chest tube placement ☐ splinting ☐ Mannitol ☐ Seizure prophylaxis ☐ Burr hole ☐ Surgical treatment of open depressed skull fracture ☐ Surgical treatment of closed depressed fracture ☐ Others
Others specify	_____
Procedures at EU	_____
Final EU Diagnosis-1	_____
Final EU Diagnosis-2	_____
Final EU Diagnosis-3	_____

Final EU Disposition	◯ Discharge ◯ Ward ◯ ICU ◯ Theatre ◯ Transfer to another facility ◯ Died in EU ◯ Absconded ◯ Other
Reason for transfer	☐ No Expertise / Skills ☐ Lack of medication ☐ Theatre not working ☐ Lack of ICU Care ☐ Patient / Relative request ☐ Severity of injury ☐ Other
24 hours follow up	◯ Alive and still in hospital ◯ Alive and referred to another hospital ◯ Alive and discharged ◯ Died at Emergency Unit ◯ Could not be traced

Appendix II: REGIONAL REFERRAL HOSPITALS

Facility Name	Common Name	Zone	Region	District
Amana	Amana	Eastern Zone	Dar es Salaam	Ilala
Bukoba	Kagera	Lake Zone	Kagera	Bukoba
Dodoma	General hospital	Central Zone	Dodoma	Dodoma
Geita	Geita	Lake Zone	Geita	Geita
Iringa	Government Hospital	Southern Highlands Zone	Iringa	Iringa
Katavi	Mpanda Municipal Hospital	Southern Highlands Zone	Katavi	Mpanda
Kitete	Tabora Regional	Western Zone	Tabora	Tabora
Ligula	Ligula Hospital	Southern Zone	Mtwara	Mtwara
Manyara	Manyara	Northern Zone	Manyara	Babati
Maweni	Maweni	Western Zone	Kigoma	Kigoma
Mawenzi		Northern Zone	Kilimanjaro	Moshi
Mbeya	Mbeya Regional Hospital	Southern Highlands Zone	Mbeya	Mbeya
Morogoro		Eastern Zone	Morogoro	Morogoro
Mt. Meru		Northern Zone	Arusha	Arusha
Musoma	Musoma Region Hospital	Lake Zone	Mara	Musoma
Mwananyamala	Mwananyamala	Eastern Zone	Dar es Salaam	Kinondoni
Njombe	Wikichi	Southern Highlands Zone	Njombe	Njombe
Ruvuma	HOMSO	Southern Zone	Ruvuma	Songea
Sekou-Toure	Sekou-toure	Lake Zone	Mwanza	Nyamagana
Shinyanga	Government Hospital	Western Zone	Shinyanga	Shinyanga
Simiyu		Western Zone	Simiyu	Bariadi
Singida	Singida Region Referral	Central Zone	Singida	Singida
Sokoine	Hospitali ya mkoa	Southern Zone	Lindi	Lindi
Sumbawanga	Sumbawanga Regional	Southern Highlands Zone	Rukwa	Sumbawanga
Tanga	Bombo Hospital	Northern Zone	Tanga	Tanga
Temeke		Eastern Zone	Dar es Salaam	Temeke
Tumbi		Eastern Zone	Pwani	

Appendix III: DISTRICT HOSPITALS

Facility Name	Common Name	Zone	Region	District
Arusha City Council	Arusha City Council Hospital	Northern Zone	Arusha	Arusha
Babati	Mrara	Northern Zone	Manyara	Babati
Bagamoyo	Bagamoyo Distr Hospital	Eastern Zone	Pwani	Bagamoyo
Bariadi Town Council	Somanda	Western Zone	Simiyu	Bariadi
Buchosa	Hospitali	Lake Zone	Mwanza	Sengerema
Bukombe	Wilayani	Lake Zone	Geita	Bukombe
Busega	Busega District Hospital	Western Zone	Simiyu	Busega
Butiama	Butiama	Lake Zone	Mara	Butiama
Care Plus Msasani		Eastern Zone	Dar es Salaam	Kinondoni
Chato	Chato	Lake Zone	Geita	Chato
Chunya	Chunya District Hospital	Southern Highlands Zone	Mbeya	Chunya
Dr. Jakaya Kikwete	Dr .Jakaya Kikwete	Western Zone	Shinyanga	Kishapu
Frelimo	Frelimo Hospital	Southern Highlands Zone	Iringa	Iringa
Hai	Wilayani	Northern Zone	Kilimanjaro	Hai
Handeni	Handeni District Hospital	Northern Zone	Tanga	Handeni
Igunga	Igunga	Western Zone	Tabora	Igunga
Itilima	Itilima	Western Zone	Simiyu	Itilima
Itumba	Itumba Hospital	Southern Highlands Zone	Songwe	Ileje
Kahama	Government	Western Zone	Shinyanga	Kahama
Kasulu	Hospitali ya Wilaya	Western Zone	Kigoma	Kasulu
Kasulu Tc	Milmani	Western Zone	Kigoma	Kasulu
Kibaya	Kiteto Hospital	Northern Zone	Manyara	Kiteto
Kibondo	Kibondo District Hospital	Western Zone	Kigoma	Kibondo
Kigamboni Council	GEZAJUU	Eastern Zone	Dar es Salaam	Kigamboni
Kilolo		Southern Highlands Zone	Iringa	Kilolo
Kilosa	Kilosa Hospital	Eastern Zone	Morogoro	Kilosa
Kinyonga	Kivinje	Southern Zone	Lindi	Kilwa

Kiomboi	Kiomboi	Central Zone	Singida	Iramba
Kisarawe		Eastern Zone	Pwani	Kisarawe
Kondoa		Central Zone	Dodoma	Kondoa
Kongwa	Kongwa	Central Zone	Dodoma	Kongwa
Korogwe	Magunga	Northern Zone	Tanga	Korogwe
Kyela	Hospitali ya Wilaya	Southern Highlands Zone	Mbeya	Kyela
Kyerwa DC	Hospital ya Wilaya	Lake Zone	Kagera	Kyerwa
Liwale	Liwale District Hospital	Southern Zone	Lindi	Liwale
Ludewa	Ludewa	Southern Highlands Zone	Njombe	Ludewa
Lushoto	Lushoto District Hospital	Northern Zone	Tanga	Lushoto
Mafia	Kilindoni	Eastern Zone	Pwani	Mafia
Mafinga	Mafinga Distric Hospital	Southern Highlands Zone	Iringa	Mafinga
Magu	Magu	Lake Zone	Mwanza	Magu
Mahenge	Mahenge Hospital	Eastern Zone	Morogoro	Ulanga
Makete	Makete	Southern Highlands Zone	Njombe	Makete
Mangaka	Mangaka Hospital	Southern Zone	Mtwara	Nanyumbu
Manyoni	Manyoni District Hosp	Central Zone	Singida	Manyoni
Maswa	MASWA	Western Zone	Simiyu	Maswa
Mbarali	Mbarali	Southern Highlands Zone	Mbeya	Mbarali
Mbinga	Mbuyula	Southern Zone	Ruvuma	Mbinga
Mbulu	Mbulu Town Hospital	Northern Zone	Manyara	Mbulu
Meatu		Western Zone	Simiyu	Meatu
Meru	Meru	Northern Zone	Arusha	Arumeru
Misungwi	Misungwi	Lake Zone	Mwanza	Misungwi
Mkomaindo	Mkomaindo	Southern Zone	Mtwara	Masasi
Mkuranga		Eastern Zone	Pwani	Mkuranga
Monduli	Monduli	Northern Zone	Arusha	Monduli
Mpwapwa	Benjamin William Mkapa	Central Zone	Dodoma	Mpwapwa
Mvomero	Council Hospital	Eastern Zone	Morogoro	Mvomero
Nachingwea	Nachingwea District Hospital	Southern Zone	Lindi	Nachingwea
Namtumbo	Namtumbo	Southern Zone	Ruvuma	Namtumbo
Nansio	Nansio	Lake Zone	Mwanza	Ukerewe

Newala		Southern Zone	Mtwara	Newala
Ngorongoro	Lopoluni	Northern Zone	Arusha	Ngorongoro
Ngudu	Ngudu	Lake Zone	Mwanza	Kwimba
Njombe Tc	Hospitali ya Mji Njombe	Southern Highlands Zone	Njombe	Njombe
Nyamagana	Nyamagana Hospital	Lake Zone	Mwanza	Nyamagana
Nyamwaga	NYAMWAGA	Lake Zone	Mara	Tarime
Nzega	Hospitali ya Wilaya	Western Zone	Tabora	Nzega
Nzera	Nzera	Lake Zone	Geita	Geita
Oltrument	Ekenywa Hospital	Northern Zone	Arusha	Arusha
Pangani		Northern Zone	Tanga	Pangani
Ruangwa	Ruangwwa	Southern Zone	Lindi	Ruangwa
Same	same district hospital.	Northern Zone	Kilimanjaro	Same
Tandahimba	TANDAHIMBA HOSP	Southern Zone	Mtwara	Tandahimba
Tanga City	HOSPITALI YA JIJI LA TANGA	Northern Zone	Tanga	Tanga
Tarime	Bomani	Lake Zone	Mara	Tarime
Tukuyu	Makandana	Southern Highlands Zone	Mbeya	Rungwe
Tumaini	Tumaini	Northern Zone	Manyara	Hanang
Tunduru	Tunduru District Hospital	Southern Zone	Ruvuma	Tunduru
Urambo	Urambo District Hospital	Western Zone	Tabora	Urambo
Usangi	Kilaweni	Northern Zone	Kilimanjaro	Mwanga
Ushetu	Ushetu	Western Zone	Shinyanga	Kahama
Utete	Utete	Eastern Zone	Pwani	Rufiji
Uvinza		Western Zone	Kigoma	Uvinza
Vwawa	Vwawa Hospital	Southern Highlands Zone	Songwe	Mbozi

Appendix IV: DESIGNATED DISTRICT HOSPITALS

Facility Name	Common Name	Zone	Region	District
Baptist	Baptist Hospital	Western Zone	Kigoma	Kigoma
Biharamulo		Lake Zone	Kagera	Biharamulo
Bumbuli Mission	Bumbuli	Northern Zone	Tanga	Lushoto
Bunda	Bunda DDH	Lake Zone	Mara	Bunda
Dareda	Dareda Mission	Northern Zone	Manyara	Babati
Dr. Atman	KRISTUMFALME	Southern Highlands Zone	Rukwa	Sumbawanga
Huruma	Huruma DDH	Northern Zone	Kilimanjaro	Rombo
Ilembula	Hospitali ya Ilembula	Southern Highlands Zone	Njombe	Wanging'ombe
Ilula	Ilula Mission/Ilula Itunda	Southern Highlands Zone	Iringa	Kilolo
Itete	Itete	Southern Highlands Zone	Mbeya	Rungwe
Izimbya	Katekaana	Lake Zone	Kagera	Bukoba
Karatu Lutheran	Karatu DDH	Northern Zone	Arusha	Karatu
Kibosho		Northern Zone	Kilimanjaro	Moshi
Kilema	Kilema CDH	Northern Zone	Kilimanjaro	Moshi
Kilindi	KKKT hospital	Northern Zone	Tanga	Kilindi
Kolandoto	kolandoto	Western Zone	Shinyanga	Shinyanga
Makiungu	Makiungu Maries Missionaries	Central Zone	Singida	Ikungi

Mbalizi	Ifisi Hospital	Southern Highlands Zone	Mbeya	Mbeya
Mugana	Mugana DDH	Lake Zone	Kagera	Missenyi
Muheza	Muheza DDH	Northern Zone	Tanga	Muheza
Murgwanza	Murgwanza DDH	Lake Zone	Kagera	Ngara
Mvumi Mission	Mvumi Mission	Central Zone	Dodoma	Chamwino
Mwambani	Mwambani	Southern Highlands Zone	Songwe	Songwe
Mzinga		Eastern Zone	Morogoro	Morogoro
Namanyere	Namanyere DDH	Southern Highlands Zone	Rukwa	Nkasi
Nyakahanga	Nyakahanga DDH	Lake Zone	Kagera	Karagwe
Nyangao	St. Walburg's DDH	Southern Zone	Lindi	Lindi
Nyerere	Mugumu DDH	Lake Zone	Mara	Serengeti
Orkesumet		Northern Zone	Manyara	Simanjiro
Rubya	Rubya DDH	Lake Zone	Kagera	Muleba
Sengerema	Mission	Lake Zone	Mwanza	Sengerema
Shirati KMT	Shirati	Lake Zone	Mara	Rorya
Sikonge	Sikonge DDH	Western Zone	Tabora	Sikonge
St Carolus	Mntinko Hospital	Central Zone	Singida	Singida
St. Elizabeth	st.Elizabeth	Northern Zone	Arusha	Arusha
St. Francis	St Francis DDH	Eastern Zone	Morogoro	Kilombero
St. Gemma	St.Gemma Hospital	Central Zone	Dodoma	Dodoma
St. Joseph	Kwa Ma-Sister	Northern Zone	Kilimanjaro	Moshi
Tosamaganga	Tosamaganga hospital	Southern Highlands Zone	Iringa	Iringa
Wasso	wasso	Northern Zone	Arusha	Ngorongoro

ZONES	OPERATING HOSPITALS IN TANZANIA MAINLANDS			
	Regional Referral Hospitals	District Hospitals	Designated District Hospitals	Total
Central zone	2	5	4	11
Eastern zone	5	10	2	17
Lake Zone	4	13	10	27
Northern zone	4	17	12	33
Southern Highlands zone	5	12	8	25
Southern zone	3	11	1	15
Western zone	4	15	3	22
Total	27	83	40	150

Appendix V: Approval for Ethical Clearance for study titled TECCS

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

OFFICE OF THE DIRECTOR OF RESEARCH AND PUBLICATIONS

P.O. Box 65001
DAR ES SALAAM
TANZANIA
Web: www.muhas.ac.tz

Tel G/Line: +255-22-2150302/6 Ext: 1016
Direct Line: +255-22-2152489
Telefax: +255-22-2152489
E-mail: drp@muhas.ac.tz

Ref. No.DA.282/298/01.C/ 15th May, 2020

MUHAS-REC-3-2020-207

Dr. Hendry R. Sawe,
Department of Emergency Medicine,
School of Medicine,
MUHAS.

RE: APPROVAL FOR ETHICAL CLEARANCE FOR A STUDY TITLED *"TANZANIA EMERGENCY CARE CAPACITY SURVEY STUDY (TECCS)"*

Reference is made to the above heading.

I am pleased to inform you that the Chairman has on behalf of the University Senate, approved ethical clearance of the above mentioned study, on recommendations of the Senate Research and Publications Committee Meeting.

The validity of this ethical clearance is one year effective from to **11th May, 2020 10th May, 2021.** You will therefore be required to apply for renewal of ethical clearance on a yearly basis if the study is not completed at the end of this clearance.

You will be expected to provide adverse events report where applicable, six monthly progress reports and a final project report upon completion of your study.

Dr. Bruno Sunguya
Ag. Chairperson, Senate Research and Publications Committee

Muhimbili University of Health and Allied Sciences
DIRECTOR
Research &
Box 65001

JAMHURI YA MUUNGANO WA TANZANIA
WIZARA YA AFYA, MAENDELEO YA JAMII, JINSIA, WAZEE NA WATOTO

Telegram "AFYA", DODOMA
Namba ya Simu +255 026 – 2322267
E-mail: PS@afya.go.tz

(Barua zote ziandikwe kwa
Katibu Mkuu)
Unapojibu tafadhali taja

Mji wa Serikali - Mtumba,
Barabara ya Afya,
S. L. P. 743,
40478 DODOMA

Kumb.Na.AB/209/04A/76 06 Oktoba, 2020

Waganga Wafawidhi wote,
Hospitali za Rufaa za Mikoa,
Tanzania Bara.

YAH: MAOMBI LA RUHUSA NA BARUA YA UTAMBULISHO KWENYE HOSPITALI ZA RUFAA ZA MIKOA TANZANIA BARA KWA AJILI YA KUFANYA UTAFITI.

Tafadhali rejea somo tajwa hapo juu.

Wizara ya Afya, Maendeleo ya Jamii, Jinsia, Wazee na Watoto imepokea barua kutoka Chuo Kikuu cha A fya na Sayansi Shirikishi Muhimbili (MUHAS) ya tarehe 15/09/2020 yenye Kumb. Na. MUHAS/EMD/HeD/2020/03 ikiomba ruhusa na Barua ya Utambulisho kama kichwa cha barua kinavyosomeka hapo juu.

Wizara inatambua umuhimu wa Tafiti katika Sekta ya Afya yenye kulenga kuboa ubunifu na maboresho ya namna ya utoaji huduma za Afya katika Vituo vya Kutolea Huduma ikiwa ni pamoja na Huduma kwa wanaohitaji huduma za charura.

Hivyo kwa barua hii Wizara inawatambulisha na kutoa ruhusa kwa Wataalamu MUHAS kufanya Utafiti kwenye Hospitali za Rufaa za Mkoa. Pia, Inawataka Waganga Wafawidhi wote wa Hospitali za Rufaa nchini kutoa ushirikiano kwa Watafiti hawa kwa kipindi chote watakachokuwa katika maeneo yenu.

Nawashukuru kwa ushirikiano.

Edwani N. Muanga
KAIMU KATIBU MKUU (AFYA)

Nakala: Makamu Mkuu wa Chuo,
Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili (MUHAS),
S.L. P.65001,
DAR ES SALAAM.

JAMHURI YA MUUNGANO WA TANZANIA

OFISI YA RAIS

Anuani ya Simu "TAMISEMI"
DODOMA
Simu Na: +255 26 2321607
Nukushi:+255 26 2322116,
Barua pepe:ps@tamisemi.go.tz
Unapojibu tafadhali taja:-

Tawala za Mikoa
na Serikali za Mitaa,
Mtaa wa TAMISEMI,
Mji wa Serikali – Mtumba,
S.L.P. 1923,
41185 DODOMA.

Kumb. Na. AB. 81/228/01

13 Julai 2020

Makatibu Tawala wa Mikoa,

TANZANIA BARA

Yah: UTAFITI WA HALI YA MFUMO WA HUDUMA ZA DHARURA (EMERGENCY CARE SYSTEMS ASSESSMENT) KATIKA HOSPITALI ZA HALMASHAURI YA WILAYA

Tafadhali husika na somo tajwa hapo juu.

2. Ofisi ya Rais –TAMISEMI kwa kushirikiana na Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili, wamepanga kufanya utafiti kwenye eneo linalohusu huduma za dharura katika Hopsitali za Halmashauri ya Wilaya zote nchini.

3. Utafiti huu unalenga kujua hali halisi iliyopo katika mfumo wa huduma za dharura katika Hospitali za Wilaya ili kuwezesha kuwa na mipango inayoweza kusaidia huduma hizi na kuokoa maisha ya Watanzania pale wanapopata dharura za klafya. Utafiti huu unatarajiwa kuanza tarehe 13 Julai, 2020.

4. Kwa barua hii, naomba kuwajulisha kuhusu zoezi hili, pia mnaombwa kuwafahamisha Wakurugenzi wa Halmashauri juu ya utafiti huu ili waweze kutoa ushirikiano utakaohitajika na watafiti kutoka Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili.

5. Ninawashukuru kwa ushirikiano wenu.

Dkt. N. A. Kapologwe

Kny: KATIBU MKUU