

**GEOSPATIAL MAPPING AND CIRCUMSTANCES OF BURN
AMONG PATIENTS PRESENTING TO THE EMERGENCY
DEPARTMENT OF TERTIARY HOSPITAL DAR-ES SALAAM-
TANZANIA**

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**Mmed Emergency Medicine
Muhimbili University of health and allied sciences
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**Muhimbili University of Health and Allied Sciences
Department of Emergency Medicine**



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Dr. Emanuel Fares Kisanga, M.D

**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**

October, 2021

CERTIFICATION

We, the undersigned certifies that has read and recommends for acceptance by the senate a dissertation entitled, **“Geospatial mapping and circumstances of burn among patients presenting to the emergency department of tertiary hospital”** in partial fulfillment of the requirements for the degree of the Masters of Medicine – Emergency Medicine of Muhimbili University of Health and Allied Sciences

PROF. HENDRY SAWE

Date

Dr. SAID S. KILINDIMO

Date

DECLARATION AND COPYRIGHT

I, **Emanuel Faress Kisanga** 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.

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DEDICATION

To my lovely wife and children Ethan and Nevin.

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LIST OF ABBREVIATIONS

ARCGIS PRO	Architectural Geographical Information System Project.
DBP	Diastolic Blood Pressure
EMD	Emergency medicine department
ED	Emergency Department
RED	Cap-Research Electronic Data Capture.
GCS	Glasgow Coma Scale
HIC	Higher Income Countries
ICU	Intensive Care Unit
IRB	Institutional Review Board
LIC	Low Income Countries
LMIC	Low-and -Middle Income Countries
MDGS	Millennium Development Goals
MNH	Muhimbili National Hospital
MUHAS	Muhimbili University of Health and Allied Sciences
POC	Point of care test
SBP	Systolic Blood Pressure
SPSS	Statistical Package for Social Sciences
SSA	Sub-Saharan Africa
WHO	World Health Organization
MOI	Muhimbili Orthopedic Institute

ABSTRACT

Background: Burn injuries result in severe and often life-changing medical, social and psychological problems, along with a severe economic loss to individuals and their family. Ninety-percent of burns are preventable. However, even within one country, burn injuries' location and causative factors differ substantially between communities and regions. This prospective descriptive study describes the added benefit of using the geospatial techniques in mapping the burns prevalence in Dar es Salaam. The geospatial technique could be helpful in formulating the preventive measures in highly populated cities with similar context.

Study objective: To determine the geographical location of burn patients and circumstances of burn among patients with burn injuries presenting to Muhimbili National Hospital in Dar Es Salaam, Tanzania

Materials and methods: Patients presenting with burns were identified from patients at the emergency department and enrolled in the study after signing the informed consent. The patient's residency Geographical Information System (GIS) coordinates were mapped over a base map of Dar es Salaam provided by ArcGisPro and entered into a kernel density analysis to identify areas of high burn prevalence including a map on statistical spatial clustering. The study used a questionnaire to interview the patients with burns on the causes, circumstances of the burn. The analysis included the magnitude of burn, etiologies and the circumstances.

Results: Among 144 participants enrolled, (56.3% (81/144) were male. The median age was 3 years (interquartile range, 2 – 9 years). Using the coordinates, most burns came from the convergence of Ilala, Temeke and Kinondoni district in Dar es Salaam, with almost two-thirds of participants coming from Ilala District alone. The majority (84.7%) were referrals from other facilities. On arrival, the majority were stable. Most, 86.8%, had superficial partial burn (wet-pink), multiple (65.3%). Nearly half of the participants had a total burn surface area of 15% or more; involving mainly the upper limbs and anterior trunk. Regarding the causative agent, 86.1% were due to scald. Over 90% of burns happened at home and in the kitchen, 88.9%. Almost half of them received first aid at home, which included the application of honey/powder. Only 43% applied cold water. Following the management at the emergency department, 11.1% were discharged home and 84.7% were admitted to the burn ward.

Conclusion: Geospatial technique has enabled the researchers to establish not precisely where the burn took place in the city but also a clustering of burns in the city and using the coordinates, most burns came from the convergence of Ilala, Temeke and Kinondoni district in Dar es Salaam, with almost two-thirds of participants coming from Ilala District alone. The knowledge of initial burn management before the survivors are referred to the health facilities is poor. Strengthening burn management capabilities, both in knowledge, skills and equipment, of the regional hospitals, could decongest the national hospital.

DEFINITION OF KEY TERMS

- ArcGis Pro:** Is a new, integrated geographical information system application used for creating and using maps, compiling geographical data, analyzing mapped information, sharing and discovering geographical information, using geographical information in a range of applications and managing geographical information in a database(1–3)
- Circumstance:** Is a factor connection with or relevant to an event or action.
- Emergency care:** This means the provision of initial resuscitation, stabilization, and treatment to acutely ill and injured patients and delivers those patients to the best available definitive care, regardless of their ability to pay.
- Emergency department:** Is department in the hospital responsible for providing immediate care in patients with different medical o surgical or traumatic complaints with or without a referral from other facilities. Also known as emergency room, casualty center, accident and emergency or urgent care unit
- Emergency physician:** A specialist trained in emergency medicine and who works in emergency department or acute intake areas, attending undifferentiated patients with different complaints. In Tanzania, emergency medicine specialists are trained in a three-year Masters in emergency medicine program.
- Geospatial mapping** Is a type of spatial analysis technique that typically employs software capable of rendering maps processing that process spatial data and applying analytical methods to terrestrial or geographic datasets, including geographic information system (GIS).

CHAPTER ONE

1. INTRODUCTION

1.1 BACKGROUND

A burn is an injury to the skin or any other organic tissue primarily caused by heat or radiation, radioactivity, electricity, friction, or contact with chemicals. Thermal burn occurs when some or all of the cells in the skin tissues are destroyed by hot liquids (scalds), hot solids (contact burn) or flames (flame burn) (4).

Burns are a global public health problem, accounting for an estimated 180,000 deaths annually. Every day, over 30,000 people suffer new burns worldwide, severe enough to warrant medical attention, equating to an estimated 11 million new burns each year globally (4,5). The majority of burns occur in low and middle-income countries (LMIC) and almost two-thirds occur in the World Health Organization (WHO) African and South-East Asia region (4).

Over 95% of fire-related burns occur in LMIC(6). Death by burn injury in LMIC is estimated to be eleven times higher than in high-income countries and among the leading cause of disability and adjusted life years lost in LMIC(7). WHO estimates that 43,000 people die of burn in Africa every year with the rate of 6.1 per 100,000(6). This is in contrast to most other injuries, where rates of injury tend to be higher in males than in females. The higher risk for females is associated with open fire cooking or inherently unsafe cooking stoves, igniting loose clothing. Open flames used for heating and lighting also pose a risk, and self-inflicted or interpersonal violence are also factors (although understudied). Along with adult women, children are particularly vulnerable to burns. Burns are the fifth most common cause of non-fatal childhood injuries. While a major risk is improper adult supervision, a considerable number of burn injuries in children result from child maltreatment(4). Geospatial mapping could help the planners to identify areas prone to and circumstances of burns and design appropriate intervention.

Second and third-degree burns are the most common burn (6); 98% of burns occur unintentionally (7). While heat burns caused by flame, hot liquids and hot objects are the most common burns, chemical burns are the least common (8). The most common cause of burns in hospital and death-based studies was direct contact with flame (6). Burns caused by electric shock and chemical substances are more common among men in the workplace (9). Burns cause long-term discomfort, functional impairments and psychological problems. A severe burn injury can impact all aspects of a person's life, including their aesthetic appearance, financial situation, relationships with others, psychological, social (e.g. integration work/school) and physical functioning (10). Nearly 75 percent of all scalding burns in children are preventable(11). Age is an important and critical factor contributing to burn patients' clinical outcome (5). The very young and the elderly are more likely to succumb after a major burn than their adult counterparts (5). In Dodoma, Tanzania, from 1983 to 1991, of the 49 children who suffered amputations, 16% of their amputations was due to burns (8).

Burn injuries are a significant cause of prolonged hospital stays, disfigurement, disability, and death in the Africa Region (9). However, even within one country like Tanzania, the location and circumstances of burn injuries differ substantially between communities and regions, and no prior studies had looked at geospatial locations of burn injuries in Tanzania. The geospatial mapping technique used in this study will help to determine the geographical location of the burn injured patients and socio-demographic factors among patients with burns from different regions which present to a national referral hospital in Tanzania. The information from this study will aid in access to appropriate care, public awareness and implementing targeted prevention measures.

1.2 PROBLEM STATEMENT

Burns are the 4th leading traumatic event worldwide after traffic accidents, falls, and violence among individuals (6). They result in disability or death and a decrease in the quality of life (10). According to World Health Organization, every year, more than 300,000 people die from fire-related burn worldwide, with the highest number of deaths from burns occurring in south Asia and the middle east (4,11).

Burns are more frequent in LMIC, with over ninety-six percent of fatal fire-related burn injuries occurring in LMIC (4). High-income countries have made progress in lowering burn deaths through a combination of prevention and care strategies among these strategies include a national system of disease monitoring either through civil registration, vital statistics, household surveys, demographic surveillance systems or verbal autopsies, to capture mortality and morbidity such as musculoskeletal system impairment and burn wounds. Other strategies such as a uniform method for coding medical and surgical conditions across the countries and the common procedures are adopted and promoted, which enables comparison of burn related injuries and readiness to deliver the intervention (4).

However, many of these improvements have not been applied in LMIC. While we often know ages of burn victims and types of burns they receive, we haven't looked at whether there are geographic differences in burn frequencies, which could explain why burns are occurring and what interventions are needed. Comprehensive epidemiological studies of burn victims from different regions are needed to understand the geographical location and circumstances of burn in particular areas and implement targeted prevention measures.

1.3 CONCEPTUAL FRAMEWORK

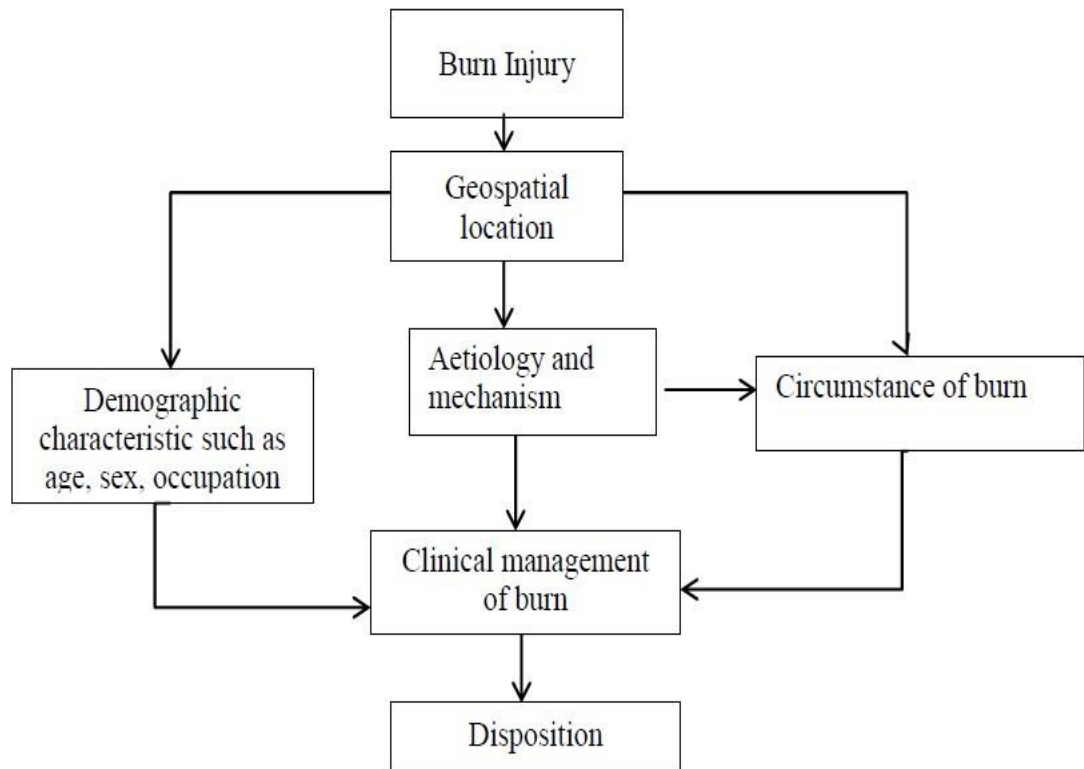


Figure 1: Study conceptual framework

Geospatial location and circumstances of burn are determined by several factors, including demographic characteristics like age and sex. Etiology as well can contribute more burn in given geographical location like occupation-related burns like electrical works and welding especially when safety equipment are not used. The management given at EMD for burn patients without involving counselling on ways of prevention or controlling the source and clinician to assess and be assured the safety of the victims home or area of residence before disposition, especially during discharge, could result in more frequency of burn in a given geographical location especially burn caused by domestic violence or child abuse.

1.4 RATIONALE

Prior studies that looked at burn injuries are largely retrospective and focused on incidence and outcome (12–16). Although there have been many studies on the incidence, etiology, and characteristics of burn patients (14, 15, 17–19), there has not been a study that had looked at the geographical location of burn injuries. Knowing where burns are most frequent and determining burns in an area is essential to target prevention efforts. Such studies need to be done prospectively to capture accurate information about the exact location and mechanism of the burn. This information can be used to target prevention efforts, such as improve awareness, developing and enforcing effective policy, providing burn prevention programs, strengthening burn care, strengthen capacities to carry out burn care in those areas.

1.5 RESEARCH QUESTIONS

What are the geographical location and circumstances of burn patients with burn injuries presenting to Muhimbili National Hospital in Dar es salaam, Tanzania?

1.6 OBJECTIVES

1.6.1 Broad objective.

To determine the geographical location and circumstances of burn among of patients with burn injuries presenting to Muhimbili National Hospital in Dar es Salaam, Tanzania

1.6.2 Specific Objectives

1. To determine the precise geographic location of the incident of burn among patients with burns injuries presenting to Muhimbili National Hospital in Dar es Salaam, Tanzania
2. To describe etiologies of burn among patients with burns injuries presenting to Muhimbili National Hospital in Dar es Salaam, Tanzania
3. To describe circumstances of burn among patients with burn injuries presenting to Muhimbili National Hospital in Dar es Salaam, Tanzania
4. To describe the management strategies of patients with burns injuries presenting to Muhimbili National Hospital in Dar es Salaam, Tanzania

CHAPTER TWO

2 LITERATURE REVIEW

2.1 Etiology and mechanism of burn injuries.

Thermal burns are caused by heat such as fire, hot objects and steam; the depth of the thermal injury is related to contact temperature, duration of contact of the external heat source, and the thickness of the skin (17). Electrical burns occur when electric energy is transformed to heat as the current passes through insufficient conducting body tissue, resulting in the injury of the cell membrane. This leads to disruption of membrane potential and function. Electrical burns may be caused by several sources of electricity, such as lightning, stun guns and contact with household current (18).

A chemical burn occurs when skin or eyes come into contact with an irritant, such as an acid or a base, which causes a reaction. Chemicals that are swallowed can cause burns to internal organs(19). Ionizing radiation can cause damage to skin and tissues. The most common type of radiation burn is sunburn. Radiation burns are most commonly seen today following therapeutic radiation therapy and are also seen in patients who receive excessive radiation from diagnostic procedures and in those individuals who work in the nuclear industry (20).

Flame injuries and scalds are the most common causes of burns in children and adults worldwide. Based on information collected from USA burn centers between 1995 and 2005, 46% of burns resulted from flame/fire and 32% from scalds from hot liquids (21). Burn from the fire are the most common cause of burns in adults. Flame/fire-related injuries overall are the most frequent reason for admissions to USA burn centers. Scald burns occur from hot tap water baths, hot foods and liquids, and heated cooking oils. Flames account for 35 to 42 percent of hospital admissions related to burns, while scalds account for 15 to 18 percent (21).

Worldwide, scalds account for 60 to 80 percent of burn injuries for young children. In the United States, the number of scalds far exceeds the number of flame burns in children age 0 to 4.9 years (21). In high-income countries, children under five years of

age are at the highest risk of hospital admission from burns, although 15–19-year-olds are also a group at high risk(22). Nearly 75% of burns in young children are from hot liquid, hot tap water or steam. In some low and middle-income countries such as China and Iran, flame burns and scalds occur at approximately the same frequency in children under 18 years (21). Three pediatric hospitals in Mexico found that most emergency department visits for burns in children under ten years of age were due to exposure to boiling liquids, most commonly overly hot bath water (21). Over 75 percent of children under 18 hospitalized for treatment of burns in Taiwan were injured by scalding liquids(23). A retrospective review of burns in 650 Ghanaian children age zero to five years found that the most common cause of burns was scald through spillage or immersion (45 percent), contact with a hot object (33 percent), or flame (19 percent). The most common cause of burn injuries in infants hospitalized for burn care in Eastern Saudi Arabia is scald burns (87 percent of all burns) (21).

2.2 Classification by depth, size and anatomical area

A combination of the burn mechanism, burn depth, extent, and anatomic location helps determine the overall severity of the burn injury (minor, moderate, severe), which provides general guidance for the preferred disposition and care of these patients(24). Cutaneous burns are first classified according to the depth of tissue injury. The depth of the burn largely determines the healing potential and the need for surgical grafting. Superficial or epidermal burns involve only the epidermal layer of skin, while partial-thickness burns involve the epidermis and portions of the dermis. On the other hand, full-thickness burns extend through and destroy all dermis layers, while deeper (fourth-degree) burns extend through the skin into underlying soft tissues such as fascia, muscle, and/or bone (24).

A thorough estimation of burn size is essential to guide therapy and the extent of the burn injury is expressed as a percentage of the patient's total body surface area (TBSA) (24). Superficial (first-degree) burns are not included in the percentage TBSA burn assessment. This estimation can be facilitated using a Lund-Browder chart, the Rule of Nines, or the palm method(25). The most accurate method of assessment of TBSA burn in children and adults is the Lund-Browder chart. The extent of extensive TBSA burns

is often underestimated, and factors such as gender, body shape, and obesity can affect the assessment(24).

2.3 Location and circumstances of burn injury

In a study done in urban Tanzania, 88% of burns occurred in the home(26). According to Mbembati, et al. more than 90% of children's burn injuries were related to cooking: 39% were related to hot water, 31% to hot food, and 14% due to open flame and 9% due to cooking oil (27). A child may fall into a fire, or more likely tip a pot of boiling liquid onto him or herself (27). Justin-Temu and colleagues also found that about 90% of children's burn injuries were related to cooking; the remaining injuries resulted from lighting candles and small lanterns (27). Work-related injuries account for 20 to 25 percent of all serious burns, with the most common being fire/flame and scald (28). Perhaps because of rapid economic growth, there has been an increase in occupational injuries in China including burns. Globally, the food service industries (for example, restaurants that use deep fryers) are responsible for 12 percent of work-related injuries (21).

2.4 Factors associated with burn injury.

Young girls, particularly in LMICs, are at risk of burns at home, particularly in the kitchen (29). The use of potentially unsafe kerosene cooking appliances and open fires at floor level and wearing traditionally loose clothing and wraps are seen as significant risk factors for flame related burns in younger women aged 16-35 years (30). Adult males are typically most at risk for burns in the workplace, second to exposure to flames, scalds and faulty electrical wiring (31). Children under the age of 15 are at increased risk of burns, with 84% of all pediatric burns occurring at home, particularly in the kitchen, where 80% of the child is unsupervised (30).

The unsupervised use of homemade fireworks by children during festivals also increases burns in LMIC (21,30). Babies and young infants one year or under are at most risk from burns from bed netting and sleepwear, second to faulty electrical wiring and simple devices such as mosquito coils. In addition, local traditional practices of hot water baths for mothers immediately after childbirth and treating convulsions in

children with fire are added reasons for burns, unique to some African countries (33). Unfortunately, burns from intentional exposure to chemicals, including chemical assaults, are also seen in LMICs, mostly inflicted upon males as violent crimes or as a crime of passion (19,34). Females also suffer intentional burns from flames in the 20-30 age groups due to suicide attempts or assaults by men (35).

2.5 Geospatial location

The field of medical, geographic information systems has become increasingly helpful to understand the broad picture of public health; the field holds a substantial capacity to understand differences and similarities in population health globally. The instruments supporting this field include geographic information systems, disease surveillance, big data, and analytical approaches like the Geographical Analysis Machine, Dynamic Continuous Area Space Time Analysis, cellular automata, agent-based modelling, spatial statistics and self-organising maps.

Disease mapping has made significant contributions toward improving health care worldwide (36). For example, a retrospective analytical study done by Ettinger et al. assessed the pattern of use of an Emergency Department at Dublin in people aged 65years or older(37). All Emergency Department presentations by individuals 65 years and older were extracted for analysis. This study found distinct clusters of addresses around the hospital site with a different pattern of use based on the age cohort. and the average distances travelled to the EMD were shorter for the population aged 65years and above compared to younger patients (38).

The spatial representation using GIS help identify high-risk areas for burn and specific conditions or events, allowing identifying factors unique to those high-risk areas in the given community. A study done by C.H.Laseck et al. used GIS to track 3,109 incidents of trauma in an international trauma registry from 2005-2015 to determine existing international trauma clusters. They found four major areas with significant clusters of incidents. The spatial distribution of intentional injuries was significantly correlated with socioeconomic features, including where social economic status such as

unemployment, single-parent households, and lack of high school degree diploma were identified as significant factors by spatial correlation(39).

Another study by Blake et al. published in 2014 used GIS to track 575 violent, traumatic incidents to find patterns in location, time, victim's age and injury type. They found a higher prevalence of violence in Vancouver's nightclub district on Friday and Saturday nights with higher rates in neighbourhoods with low social economic status and the strong pattern formed by victims sex, age and mechanism of injury (40).

The use of GIS in our study will show areas where burn are more prevalent in Dar es Salaam Region and the technique can be widely used in Tanzania. Besides, investigating the aetiologies and circumstances under which the burn occurred can improve the burns preventive measures .Furthermore, using GIS may assist hospitals and health planning at the regional level to understand the origin of age cohort burn patients attending the emergency department.

CHAPTER THREE

3 METHODOLOGY

3.1 Study design

The study design was cross-sectional descriptive study for all ages among patients presenting with a burn injury to the Emergency Department of Muhimbili National Hospital and Mloganzila hospital from November 2020 to March 2021.

3.2 Study area

The study covered the five districts of Dar es Salaam region of Tanzania, namely Ilala, Temeke, Ubungo, Kinondoni and Kigamboni from which according to the 2012 Republic of Tanzania census reported their population to be; 1.221 million, 1,368,881, 845,368 and 1,775,049 respectively; from which majority of these burn patients are referred and also some are self-referred to Muhimbili National Hospital (MNH) and Mloganzila Hospital (Figure 2). The study was conducted at the two hospital's Emergency Medicine Department (EMD). The MNH is a 1500-bed tertiary teaching hospital that serves as a national referral hospital.

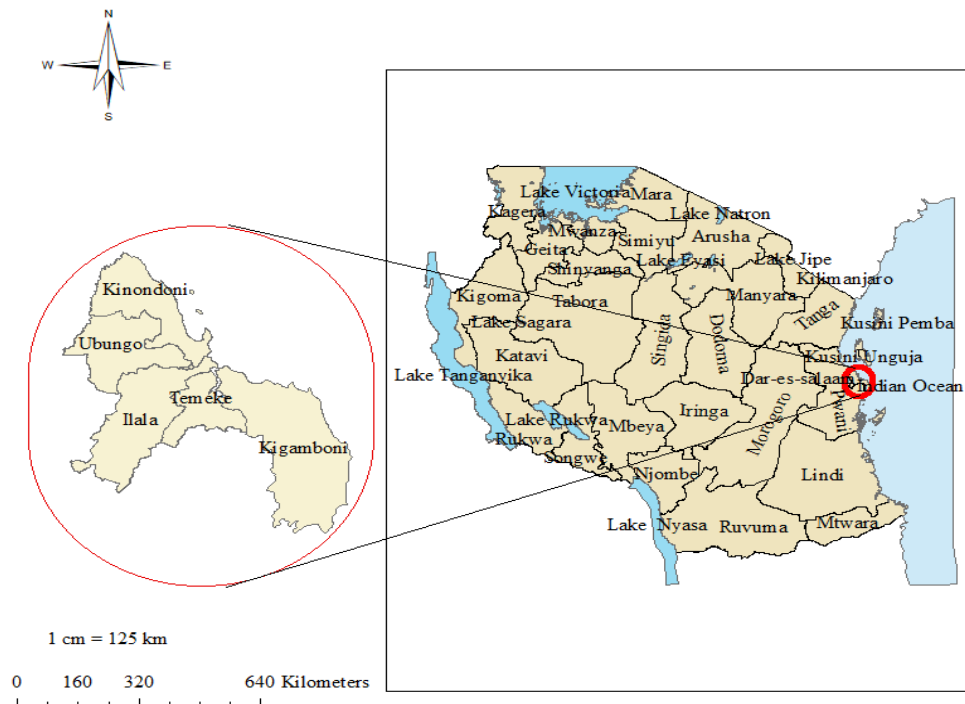


Figure 2: The map of Tanzania, showing also the five districts of Dar Es Salaam

The EMD is the receiving department for all emergency referrals and self-referral cases at MNH. The department was opened in January 2010. The EMD is the first and currently only full capacity EMD in Tanzania having emergency physicians available in the department for 24-hours, every day including weekends. The department treats critically ill patients, conducts research in emergency medicine, as well as trains emergency care providers for the country. The EMD in collaboration with other stakeholders serves as the commanding and tertiary receiving center for mass causality incidents around Dar es Salaam and Tanzania at large. The department attends 150–200 patients each day. The department has special rooms for adults and pediatric care and these rooms are under the supervision of emergency medicine specialists and master's trained nurses who oversee the care given by junior doctors and nurses. MNH-Mloganzila hospital is an academic tertiary referral facility, like MNH, It was opened in September 2017, receives referred and self-referred patients who have been seen in the district and regional hospitals as well as from home. The EMD is equipped with advanced life support machines and point-of-care investigations that help to provide specialized and quality emergency investigations that help to provide specialized and quality emergency intervention to all patients, adults and pediatric presenting to MNH-Mloganzila campus with undifferentiated medical, surgical and trauma illnesses at different levels of acute. The department also coordinates the ambulance unit, which is used to transfer patients between MNH main campus when such need arises, but also some dedicated services upon request of patients/relatives. The EMD in collaboration with other stakeholders serves as the commanding center for mass causality incidents around Dar-es salaam and Tanzania at large

3.3 Population

3.3.1 Target population:

All patients with burn related injuries presenting to the EMD of tertiary level hospital in low resource settings.

3.3.2 Accessible Population

All patients presenting with burn related injury to the EMD of MNH in Dar-es Salaam, Tanzania

3.4 Study population

All patients presenting with burn related injuries to the EMD of MNH in Dar-Es Salaam, Tanzania.

3.5 Sampling design

Consecutive sampling of all burn related injuries patients presenting to the Emergency Medicine Department of Muhimbili National and Mloganzila within the study period.

3.5.1 Inclusion criteria

Patients of any age with the complaint of a burn injury attending EMD (both resuscitation and treatment area)

3.5.2 Exclusion criteria

Patients too sick to participate, or do not speak English or Swahili were excluded .Also, patients with burns but coming from outside Dar Es Salaam region were excluded.

3.6 Variables of interest

3.6.1 Independent variables

1. Demographics (age, sex, marital status)
2. Aetiologies of burn to the victim.
5. Mechanism of burn to the victim
6. Management strategies of burn injury patients at EMD-MNH
7. Disposition of burn victim after management at EMD-MNH

3.6.2 Dependent variables

1. Clustering of location of the incident of burn.
2. Circumstances of burn injuries.

Confounding variables

Muhimbili hospital is located in Ilala District, this could be a reason why majority of referred patients from the spatial distribution were seen as compared to other districts.

Outcome variables

The primary outcome

A map showing spatial distribution of areas where burns are common among burn patients cared for, at EMD-MNH.

Secondary outcome

Common demographics and circumstances of burn injuries among burn patients cared for, at EMD-MNH.

3.7 Sample size estimation

The sample size of this study was calculated by counting total attendance for the past 12 months attending EMD at both MNH and Mloganzila Hospital; and determining the burn percentage. This enable the researchers to attain enough sample size to create geospatial map. For the last 12month period 70,944 patients attended MNH and Mloganzila hospital, amongst them 643 had burn injuries; hence the estimated burn prevalence of 0.9%. To calculate the sample size, the Confidence Interval (CI) of 95% was used, expected proportion of burn (P) 0.9% and total width of Confidence Interval (W) set to be 0.05 was entered into a formula and the sample size came to be 55.

Demonstration by using a formula of sample size for proportions

CI confidence level=95%

P-expected proportion=0.9% (0.009)

Normal approximation to the binomial calculation

$\alpha = (1-CL)/2 = 0.025$

Standard normal deviate for $\alpha = Z_{\alpha} 1.960$

Sample size (N) is calculated according to the formula:

$$N = \frac{4Z_{\alpha}^2 P (1-P)}{W^2}$$

Where: Z = 1.960 for a confidence level (α) of 95%, P = 0.009 for estimated proportion (expressed as decimals),

W = 0.05 width for confidence interval

$Z_{\alpha}=1.960$, $P=0.009$, $W=0.05$

$$N = \frac{4 \times (1.96)^2 \times 0.009 \times (1-0.009)}{(0.05)^2}$$

N= 55

Calculated sample size, $N=55$

The calculated sample during the proposal development was 55 participants or The other way used to estimate the sample size is based on wanting to achieve representative proportion of patients, and since there 643 in a year, and we enrolled patients for $\frac{1}{4}$ of a year, that would be 160 burn patients. However, the researcher obtained the ethical approval to re-estimate the sample size in order to increase the statistical power, as the number of burns increased during the study period. To end, 144 participants were enrolled.

3.8 Patient recruitment and data collection

Burn patients were identified by the research assistant by asking physicians in the department about their patients. After the patient had been triaged and placed in their treatment area, Every patient with a burn related injury patient (resuscitation and treatment area) was screened by the research assistant who explained the study and obtained written consent from the patient or relative.. The research assistant interviewed the patient or family member using a structured questionnaire regarding their history demographic information (age, gender and location of where they live), what the burn was due to, and how it occurred. Using Google maps on an I-pad, every study participant was asked to point to the exact location(s) where the burns occurred and the geographical coordinates were gathered. A point density analysis arcGispro and choropleth map arcGis was used to show the level of variability of geographical distribution of burn patients from five districts of Dar-es salaam region. The researcher created another map showing statistical spatial clustering. The researcher and research assistants used Lund-Browder charts, with drawn up parts of the body to estimate TBSA. The research assistant painted with a pencil/pen parts of the body affected with burn injury and this helped to calculate the percentage of TBSA, hence improved the accuracy of estimating.

3.9 Standardized data collection tool

A questionnaire used to collect the data was adapted from BASAT and Trauma registry, in English and translated in Swahili. The researcher and the research assistant collected the data among patients who brought in to the EMD of MNH for 90 days from February – April 2021. The researcher trained the research assistant about the questionnaire

completion before the study commenced. The training included: how to perform an interview and collect data, how to communicate with the patient, family or caregivers in situation where the patient cannot consent as well as how to select and point closest geographical location using a Google map locator mentioned by the participant.

3.10 Pre-testing of the data collection tool

The researcher trained two research assistants on using the Case Report Form and the iPad to collect the required information. The training took 3 days to be completed. After the training, the fourth day was used to pilot the tools and the iPad, and identify any gaps and shortcomings before the actual data collection.

3.11 Quality and accuracy of data

The data from the completed questionnaires were transferred from the handwritten standard data collection forms into Research Electronic Data Capture (RED Cap, Version 6.0.1, and Vanderbilt University Tennessee, USA), every day during collection. The principle investigator supervised data accuracy check and the data quality.

3.12 Data Analysis

Data entry was done using Red cap (Version 6.0.1, Vanderbilt University, Tennessee, USA and exported into the Excel file (Microsoft corporation, Redmond, WA, USA) and then the data exported to Statistical Package for Social Science (SPSS version 23.0, IBM, Ltd, North Carolina, USA) for analysis.

3.13 Ethical considerations

Ethical clearance was obtained from MUHAS Senate of Research and Publication Committee of MUHAS. Approval for data collection was sought from respective authorities at MNH. Acquired records were coded to hide patient's identity and stored on a computer with a password known by researchers only. The written forms were kept in a safe cabinet accessed by only researchers. All burn injured patients received a standard of care regardless of whether they participated in the study.

3.14 Study limitations and mitigation measures

This was a single centered study, this may reduce generalizability, however Muhimbili is a national Hospital hence may receive patients from different parts of Dar es Salaam region and all over the country.

CHAPTER FOUR

4 RESULTS

4.1 Patient screening and participant's enrollment

In total 21,409 patients were screened at the ED to identify the burn patients eligible to enroll in the study. Amongst them, 21,241 had other emergencies, and 168 had burns. Of those with burns, 24 were excluded from the study; 20 lived outside Dar es Salaam, 3 had missing information and one did not consent. Therefore, 144 participants were recruited (Figure 3).

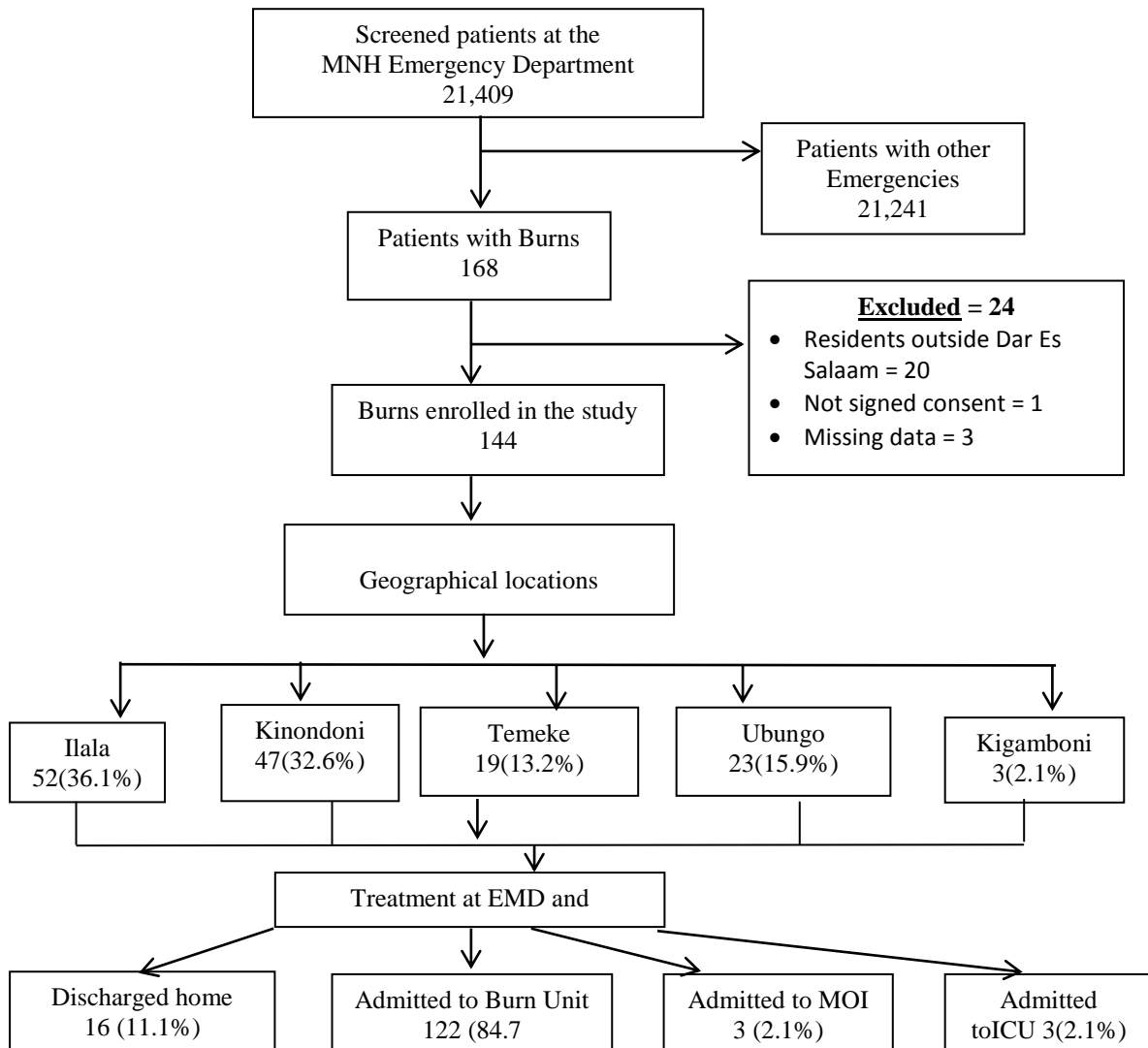


Figure 3: Study procedure and flow chart

4.2 Participant's Demographic characteristics

In total 144 participants presenting at the ED with burns were enrolled in the study; 56.3% (81/144) male and 43.8% (63/144) female. The < 1 year were 12.5%, 1 – 18 year were the majority, 69.4% (median age was 3 years (IQR 2 – 9 years)). Table 1 describes the social demographic characteristics of the participants. Almost 36.1% (52/144) were Ilala District residents, and 32.6% were residents of Kinondoni District (Table 1). Slightly over half 52.1% (75/144) of the patients with burns arrived at the department by ambulances, all of whom were referred from other hospitals.

Table 1: Socio demographic characteristics of the study participants

Variable	Category	Frequency (n)	Percent (%)
Age group (years)	Infant (<1year)	18	12.5
	Child (1 – 18years)	100	69.4
	Adult (≥ 18years)	26	18.1
Median age group (IQR) (years)		3 (2, 9)	
Sex	Male	81	56.3
	Female	63	43.8
District	Kinondoni	47	32.6
	Temeke	19	13.2
	Ilala	52	36.1
	Ubungo	23	16.0
	Kigamboni	3	2.1
	Occupation	Employed	8
	Self employed	6	4.2
	Unemployed	130	90.3
Marital status	Single	129	89.6
	Married	15	10.4
Education level	Primary	34	23.6
	Secondary	8	5.6
	College/University	2	1.4
	No formal education	100	69.4
Patients is accompanied by	Parents	122	84.7
	Caregiver /Relative	11	7.6
	Grand parents	1	0.7
	Friend	4	2.8
	Other	4	2.8
	Alone	2	1.4
Mode of arrival	Ambulance	75	52.1
	Bus/Min bus	27	18.8
	Car (Private or tax)	27	18.8
	Motorcycle	8	5.6
	Walk in	7	4.9

4.3 Assessment of patients with burns

In total, the majority of patients, 84.7% (122/144) were referred to the ED from primary facilities, whereas, 15.3% (22/144) self-referrals. On primary survey assessment, airway and breathing were found to be normal in most, 97.9% (141/144) and 97.2% (140/144) respectively. Other vital signs were normal in most of the patients (Table 2)

Table 2: Clinical characteristics of the patients

Variable	Category	Frequency (n)	Percent (%)
Referral	Yes	122	84.7
	No	22	15.3
Airway assessment	Abnormal	4	2.1
	Normal	140	97.9
Specific airway abnormality	Voice changes	1	25.0
	Oral / Airway burn	2	50.0
	Obstructed by foreign body	1	25.0
Cervical neck collar placement	Not needed	142	98.6
	Needed but not placed	2	1.4
Breathing assessment	Normal	140	97.2
	Abnormal	4	2.8
Specific breathing abnormality	Shallow chest rises	3	2.1
Spontaneous respiration	Yes	144	100
Median SBP in mmHg (IQR)		118 (106, 134)	
Median DBP in mmHg (IQR)		73 (66, 79)	
Median pulse rate (IQR)		123 (105, 144)	
Median respiratory rate (IQR)		23 (20, 30)	
Median SPO ₂ (IQR)		100 (99, 100)	
Median random blood glucose (IQR)		6.00 (5.00, 7.20)	
Used source of oxygen	Oxygen	3	2.1
	RA	141	97.9
Specific oxygen used	NC	1	33.3
	NRBM	1	33.3
	Invasive ventilation	1	33.3
Pain	Yes	118	81.9
	No	26	18.1
Median pain score (Range)		2 (0, 9)	

Regarding the burn assessment 86.8% of the patients had second degree burn, whereas, 65.3% of the patients presented with multiple contact burns. 37.5% of patients had a burn area of 16%-50% and 4.2% had burn more than 50%(Table 3)

Table 3: Assessment of the burn among patients at the ED

Variable	Category	Frequency (n)	Percent (%)
Depth of injury	First degree burn	13	9.0
	Second degree burn	125	86.8
	Fourth degree burn	1	0.7
	Third degree burn	5	3.5
Pattern of injury	Symmetrical	12	8.3
	Gloves/stocking distribution	1	0.7
	Skin fold sparing	37	25.7
	Multiple contact burn	94	65.3
Total surface area burnt	>50%	6	4.2
	16% - 50%	54	37.5
	10% – 15%	42	29.2
	2% - 9%	40	27.8
	≤ 1%	2	1.4

The burn was classified by the body area burnt. The anterior body trunk was burned in 63.2% of the patients followed by the Left upper limbs and Right upper limbs in almost half of the patients; 52.8% and 52.1% respectively (Figure 3). The least frequently burnt body areas were the buttocks (22.2%), the neck (11.1%) and the genitalia (9.7%)

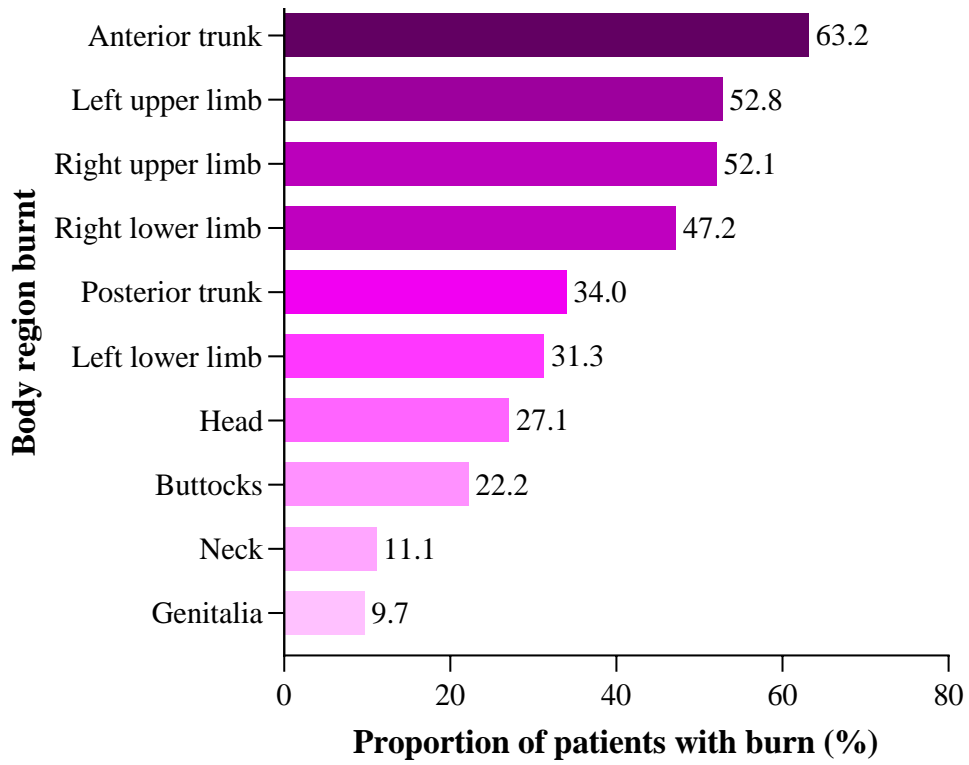


Figure 4: Classification of burns by body region

4.4 Geospatial distribution of burns in Dar es Salaam

Figure 5, heat map shows the location of burns in Dar es Salaam. The pattern indicates that most burns were spotted at the convergence of the four districts of Ilala, Temeke, Ubungo and Kinondoni. The burn mapping also indicate that Ilala and Kinondoni had the highest proportion of burns presenting of the MNH's ED, 32.0 – 36.1% and 16.01 – 32.6% respectively

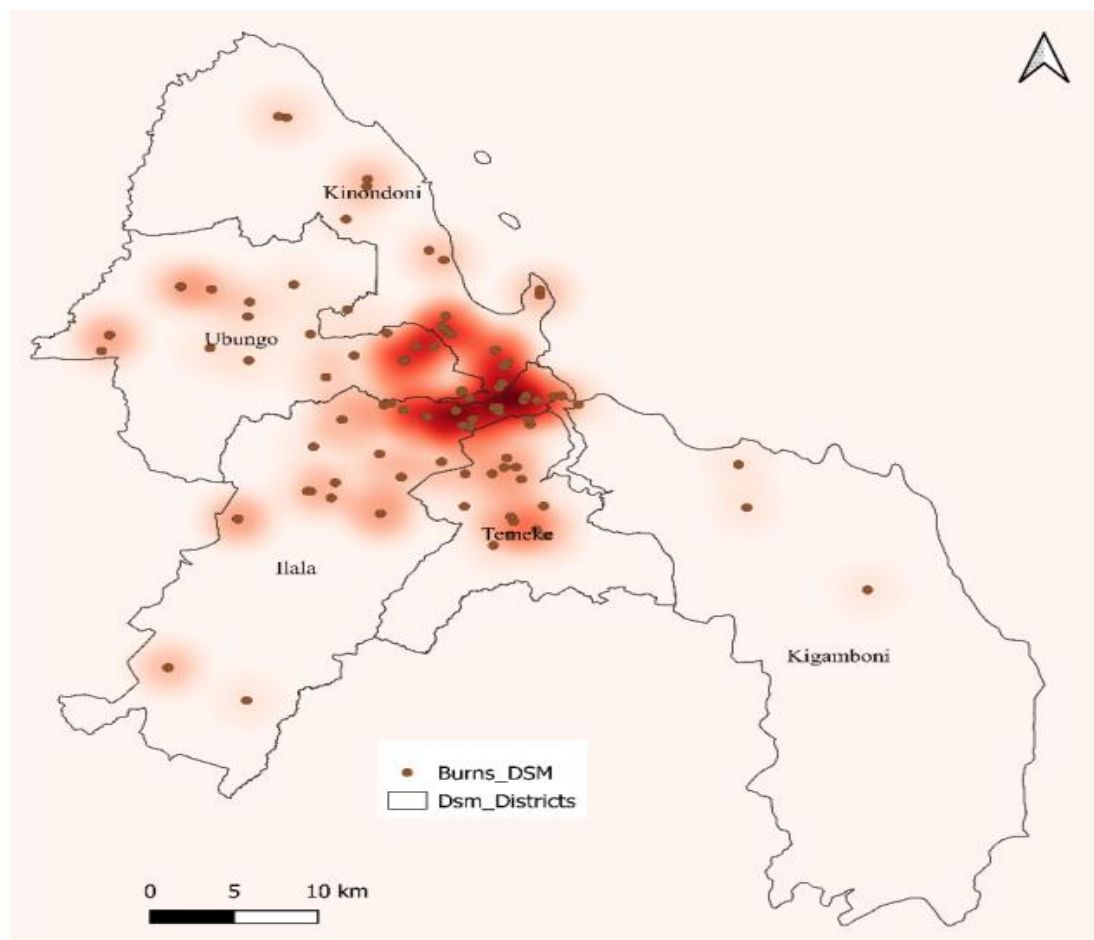


Figure 5: Geospatial distribution of burns in Dar es Salaam

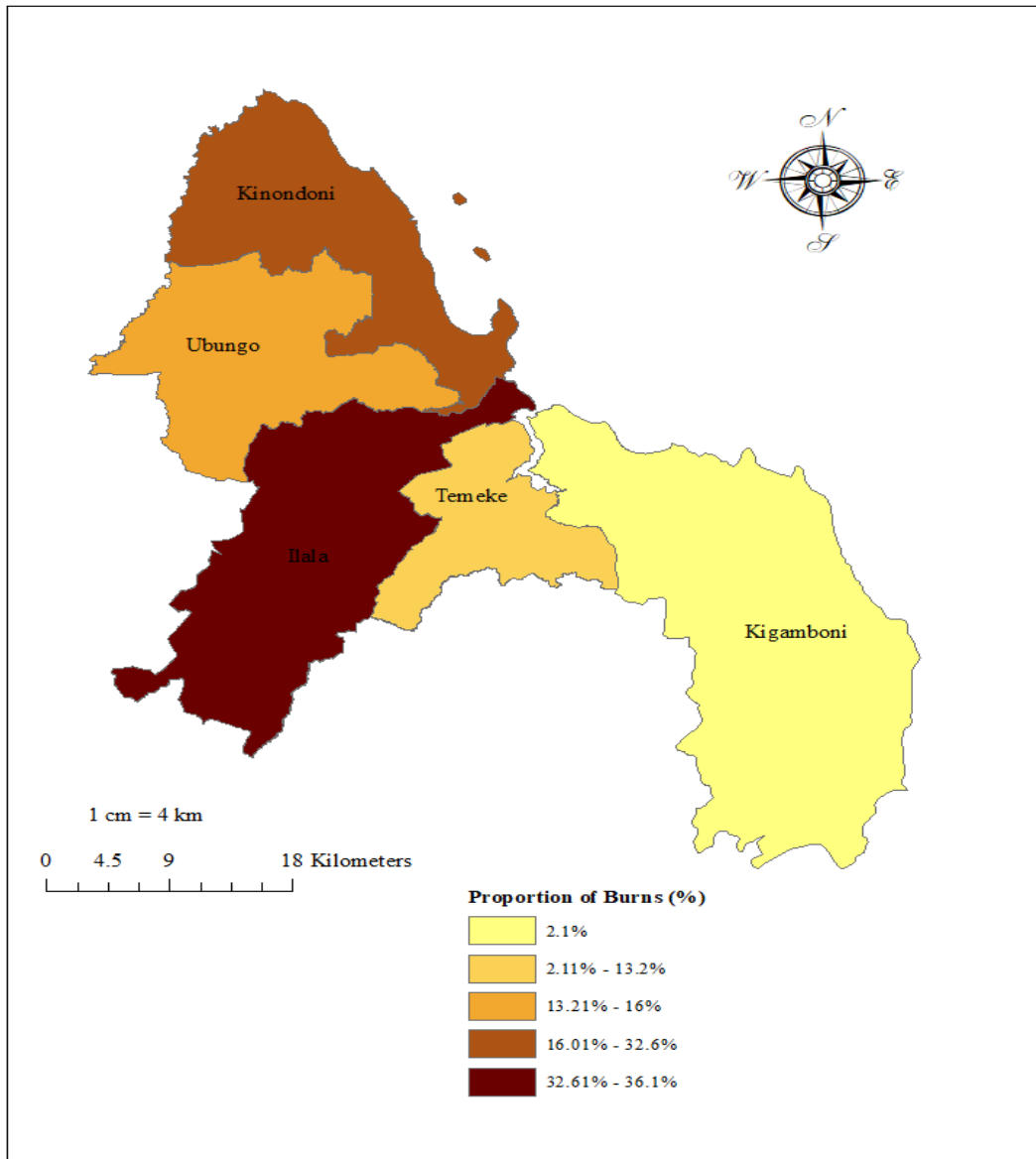


Figure 6: Proportion of burns by district in Dar es Salaam

4.5 Etiology of burn in Dar es Salaam

The type of burn was scald in the majority of patients, 86.1% (124/144). And most burns were caused by hot fluid, 86.8% (125/144). For almost half of participants, the liquid fell on the victim or the victim ran into it, followed by the liquid splash at 27.8% (40/144).

Table 4: Etiologies and trigger of burn among patients with burns injuries

Variable	Category	Frequency (n)	Percent (%)
Type of burn injury	Scald	124	86.1
	Contact burn	11	7.6
	Electrical burn	2	1.4
	Hot flame	4	2.8
	Chemical	3	2.1
Source of burn	Hot fluid e.g., drink, oil	125	86.8
	Oven hob / door	1	0.7
	Hot object	5	3.5
	Cloth catch fire	3	2.1
	Open flame	4	2.8
	Electrical burn	6	4.2
	How did you get burn	Touch / pull down	16
	Immersion	4	2.8
	Fell / ran into	81	56.3
	Spill / Splash	39	27.1
	Fire set by villagers	1	0.7
	Electrical work	3	2.1

1.1 Circumstances of burn

Table 5: Circumstances of burn incident

Variable	Category	Frequency (n)	Percent (%)
Location of burn	Home	131	91.0
	Cafeteria / Restaurant	2	1.4
	School	1	0.7
	Road / Street	4	2.8
	Work place	6	4.2
Was there anyone in the room	Yes	53	36.8
	No	91	63.2
Who was in the room	Parent	44	30.6
	Caregiver	2	1.4
	Sibling	6	4.2
	Co-worker	1	0.7
Activity performed by patient	Running or walking	40	27.8
	Laying down	5	3.5
	Sitting or standing	55	38.2
	Playing	34	23.6
	Sleeping	3	2.1
	Stealing	2	1.4
	Car accident	3	2.1
	Cooking	2	1.4
Location of the hot item	Kitchen surface	128	88.9
	Dining table	2	1.4
	Street / road	5	3.5
	Work place	5	3.5
	Bed room	4	2.8
Alcohol ingested	Yes	3	2.1
	No	141	97.9

Ninety one percent of the burns happened at home, the majority (87.5%) of the burns happening in the kitchen. In one third of the patients, the parent was also in the room. Almost one third of the victims were either running, walking or sitting. A small percent, 2.1% of the patients had alcohol ingestion during the incident (Table 5).

1.2 Burn Management

Burn management started at home immediately after the burn occurred. The study has categorized burn management as the first aid measured undertaken soon after the burn; before specialized services is sought, and the management at the Emergency Department.

1.2.1 Management before arriving at the ED

Table 6: First aid before arrival at the Emergency Department

Variable	Category	Frequency (n)	Percent (%)
Given first aid before hospital	Yes	79	54.9
	No	65	45.1
First aids provided (n = 79)	Cold water	34	43.0
	Powder / honey	43	54.4
	Ice / wet compress	2	1.4
Burn covered	Yes	93	64.6
	No	51	35.4

Soon after the burn occurred, a form of first aid was given to the patient in slightly more than half of the patients, 54.9% (79/144), which included cold water 43% (33/79). Other remedy given was powder or honey in more than half of the patients given first aid, mostly through running water or shower. In almost two third of the patients, 54.4% (43/79) the burn area was covered (Table 6)

4.5.1 Management at the Emergency Department

On arrival at the Emergency department, the patients were given, as part of comprehensive management, treatment as per burn protocol. In total, 15.4% (22/144) were given anti-tetanus, 54.2% (78/144) IV fluids, and 33.3% (48/144) were given IV antibiotics (Table 7).

Table 7: Burn management at the Emergency Department

Variable	Category	Frequency (n)	Percent (%)
Management done	Yes	126	87.5
	No	18	12.5
Tetanus toxoid given	Yes	22	15.4
	No	121	84.6
IV fluid given	Yes	82	56.9
	No	62	40.1
Amount of fluid given	< 1 liter	35	42.7
	1 – 2 liters	43	52.4
	>3 liters	4	4.9
Dressing done	Yes	112	77.8
	No	32	22.2
Analgesic given	Yes	79	54.9
	No	65	45.1
Type of analgesia given	Paracetamol	39	50.0
	NSAIDS	10	12.8
	Opioids	7	9.0
	Ketamine	20	25.6
	Other	2	2.6
IV antibiotic given	Yes	48	33.3
	No	96	66.7

4.6 Management and Disposition.

A small proportion of participants (0 – 2.1%), children in particular, were referred for protection and social intervention, due to suspected domestic violence (2.1%), and suspicious recurring burns (1.4%). However, 11.0% (16/144) of the participants attending to the ED were discharged home after management, whereas, the majority, 84.7% (122/144) were admitted in the burn's ward for further management (Table 8).

Table 8: Treatment outcome at the Emergency Department

Variable	Frequency (n)	Percent (%)
Discharged home	16	11.1
Admitted to burn unit	122	84.7
Admitted to ICU/HDU	3	2.1
Admitted to the Orthopedic Institute	3	2.1

CHAPTER FIVE

5 DISCUSSIONS

The incidence of burns being more in children than in other ages was demonstrated by this study. We report the median age of three years (IQR 2 – 9 years), almost similar to studies conducted in LMIC, in particular in the sub-Saharan Africa(9,27,41–44). Because of high burden of burns among this group no wonder some health facilities in Africa established specialized burn units for children (41,45).

The type and the causes of burns matched, pointing to the hot fluid as the major cause, at home and in the kitchen, also reported by other studies in Tanzania (26,46,47). The finding are similar to other studies elsewhere in Africa: in Africa region (43,48), in Kenya (49), and Togo (42). Through reconstruction of the causes, circumstances and body surfaces, of most of the burn took place in the kitchen, by hot liquid; we could postulate that the liquid spilling from the hot port to the anterior trunk and fore limbs (Figure 4). Through understanding of burns happens in our communities, the preventive strategies could be formulated(27,50).

Supported by the geospatial mapping, Ilala district in Dar es Salaam, had the highest incidence of burns. Although economic status of the family was beyond the scope of this study, a study in the similar urban context reported a high incidence of burns in the unplanned settlements and low social economic status, including overcrowding(45,49). Ascertaining actual location where the burn occurred is one of the strength of this study, could be helpful in targeting specific locations in the city where the burn incidences are the highest. The community members might not be aware of the administrative boundaries. As we noted, although the self-reported area of residence when clustered using coordinates, the actual most affected zone is at the confluence of the three districts: Ilala, Kinondoni and Temeke. The reasons could be common lifestyles at these areas as well as been closer to MNH.

Management of burn includes life-saving interventions, for example, maintaining patent airways and adequate circulation, which are important life saving measure soon

after the burn has occurred(50). At this level care should be taken to ensure the right remedy is given, ideally, all burns should be give first aid, depending on the area of burn, which includes covering the burnt area and washing the area with cold water(43). Unfortunately, because of lack of initial burn management knowledge only a small proportion of patients received appropriate initial management at home or the first level health facility, prior to referral to the tertiary facilities, similar to other studies in Tanzania (46,51). Higher appropriate first aid management that improved burn management has been reported (52). Appropriate prevention and management soon at the onset of burns could significantly reduce the management cost: cost for operation and hospital stay (44,45).

Referring to the management, most of the burns presenting at the MNH's ED were admitted to the burn unit. This is different to a study done in Togo's similar setting, where most patients were outpatient (42), presumably older children were enrolled in a former study than in our study. We could therefore infer that the younger the children the more the burn severity; requiring hospitalization. Our finding supports specialized units for children with burn (41). Because of pressure of time and resources, there were a few occasion where children were referred to the social workers for further counseling and, if required protection. More children would have benefited from an extended term follow up and social intervention.

CHAPTER SIX

6 CONCLUSIONS

The GIS technique has enabled the research objectively identify the actual site of the burns rather than relying on the places of residence, this was reflected in this study, where by using the coordinates, we found that, most burns came from the convergence of Ilala, Temeke and Kinondoni district in Dar es Salaam, with almost two-thirds of participants coming from Ilala District. Besides, the added benefits include the most predominant causes of burns and the circumstances which the victim got burnt. These are the important underlying factors for primary prevention at the community level.

Also, the study has shown a weak skills and knowledge in burn management, at home and probably at the referring institutions as revealed by the high proportion of referred patients, who did not receive proper initial management. Calling for an action to strengthen burn management at the four regional referral hospital, rather than the facility becoming highly dependence of the Muhimbili National Hospital. It through this action, the national hospital could be exclusively reserved for a tertiary care such reconstruction surgery.

Finally, the study suggests a comprehensive burn prevention and control plan, including a community dialogue to burn prevention, advocacy, and awareness reaction, including the best first aid techniques for burns. Lastly, investing in the burn prevention at the household level, for antispilling stoves and limited access for children to the kitchen could significantly reduce morbidity and mortality among the burn survivals.

CHAPTER SEVEN

7 RECOMMENDATIONS

Recommendation for policy makers

- i. Given the debilitating nature of burns, policy makers should integrate comprehensive burn management: prevention and care
- ii. Continuously advocate for burns prevention at the community, in the households, wherever an opportunity become available: in churches, at schools, at maternal and child health clinics

Recommendations of local government and planners

- i. Commence or finalize, if already started, burn friendly residences, including burn free stoves, especially in the areas where burns are more prevalent
- ii. As burns are of public health concern, establish a burn surveillance system, possibly integrated in the routine health information systems.

Recommendation for further research

- i. As we observed higher incidence of the burns in the congested parts of the city, with limited access to basic infrastructure, qualitative studies to complement our quantitative study, in an attempt to further explain the basic and underlying causes of burn. In particular the densely populated settlements.
- ii. A longitudinal study, to investigate the long term consequences of burn, including deaths, disability and socio-economic impact of burns in Tanzania. In particular in the metropolitan settings
- iii. Large scale studies in Dar Es Salaam, preferably population-based. There is likelihood many burns goes under-reported

REFERENCES

1. Fletcher-Lartey SM, Caprarelli G. Application of GIS technology in public health: Successes and challenges. *Parasitology*. 2016;143(4):401–15.
2. Microsoft. ArcGIS Pro 10.8 system requirement [Internet]. Available from: <https://desktop.arcgis.com/en/system-requirements/latest/arcgis-desktop-system-requirements.htm>
3. ESRI Newsroom. Arch Desktop overview.pdf [Internet]. Available from: www.esri.com/about/newsroom/overview/
4. World Health Organization (WHO). Burns Factsheet [Internet]. WHO. World Health Organization; 2018. Available from: <https://www.who.int/newsroom/fact-sheets/detail/burns>
5. World Health Organization (WHO). Essential and Emergency Surgical Care (EESC) Global Database. WHO. World Health Organization; 2019.
6. Peck MD. Epidemiology of burns throughout the world. Part I: Distribution and risk factors. Vol. 37, *Burns*. Elsevier; 2011. p. 1087–100.
7. Soori H, Khodakarim S. Child unintentional injury prevention in Eastern Mediterranean Region. *Int J Crit Illn Inj Sci*. 2016 Jan;6(1):33–9.
8. Loro A, Franceschi F, Dal Lago A. The reasons for amputations in children (0–18 years) in a developing country. *Trop Doct*. 1994;24(3):99–102.
9. Hyder A, Kashyap K, Fishman S, Wali S. Literature Review: Review of childhood burn injuries in sub-Saharan Africa: a forgotten public health challenge. *African Saf Promot A J Inj Violence Prev*. 2008 Nov;2(2).
10. Arshi S, Sadeghi-Bazargani H, Mohammadi R, Ekman R, Hudson D, Djafarzadeh H, et al. Prevention oriented epidemiologic study of accidental burns in rural areas of Ardabil, Iran. *Burns*. 2006 May;32(3):366–71.
11. Seyed-Foroortan K, Karimi H, Motevalian SA, Momeni M, Safari R, Ghadarjani M. LA50 in burn injuries. *Ann Burns Fire Disasters*. 2016 Mar;29(1):14–7.
12. Onarheim H, Jensen SA, Rosenberg BE, Guttormsen AB. The epidemiology of patients with burn injuries admitted to Norwegian hospitals in 2007. *Burns*. 2009 Dec;35(8):1142–6.
13. Falder S, Browne A, Edgar D, Staples E, Fong J, Rea S, et al. Core outcomes

- for adult burn survivors: A clinical overview. Vol. 35, Burns. Elsevier; 2009. p. 618–41.
14. Maghsoudi H, Samnia N. Etiology and outcome of pediatric burns in Tabriz, Iran. *Burns*. 2005 Sep;31(6):721–5.
 15. Brusselaers N, Monstrey S, Vogelaers D, Hoste E, Blot S. Severe burn injury in europe: a systematic review of the incidence, etiology, morbidity, and mortality. *Crit Care*. 2010;14(5):R188.
 16. Rawlins JM, Khan AA, Shenton AF, Sharpe DT. Epidemiology and outcome analysis of 208 children with burns attending an emergency department. *Pediatr Emerg Care*. 2007 May;23(5):289–93.
 17. Timothy J.Schaefer SCT. Thermal burns [Internet]. *StatPearls*; 2020. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK430773/?report=printable>
 18. Abrol A, Saraf R, Singh S. Thermal and electrical burns in Jammu province. *JK Sci*. 2005;7(2):87–9.
 19. Mannan A, Ghani S, Clarke A, Butler PEM. Cases of chemical assault worldwide: A literature review. *Burns*. 2007 Mar;33(2):149–54.
 20. Kearns RD, Holmes IH, Cairns BA. Burn injury: What’s in a name? Labels used for burn injury classification: A review of the data from 2000-2012. *Ann Burns Fire Disasters*. 2013;26(3):115–9.
 21. Peck MD. Epidemiology of burn injuries globally [Internet]. *UpToDate*. 2017 [cited 2019 Dec 20]. Available from: <https://www.uptodate.com/contents/epidemiology-of-burn-injuries-globally>
 22. Nguyen DQA, Tobin S, Dickson WA, Potokar TS. Infants under 1 year of age have a significant risk of burn injury. *Burns*. 2008 Sep;34(6):863–7.
 23. Tung KY, Chen ML, Wang HJ, Chen GS, Peck M, Yang J, et al. A seven-year epidemiology study of 12,381 admitted burn patients in Taiwan - Using the Internet registration system of the Childhood Burn Foundation. In: *Burns*. Burns; 2005.
 24. Phillip L Rice, Dennis P Orgill M. Assessment and classification of burn injury - *UpToDate* [Internet]. *UpToDate*. 2021 [cited 2021 Mar 30]. Available from: <https://www.uptodate.com/contents/assessment-and-classification-of-burn-injury>

25. Murari A, Singh KN. *Acute and Critical Care*. 2019;34(4):276–81.
26. Roman IM, Lewis ER, Kigwangalla HA, Wilson ML. Child burn injury in Dar es Salaam, Tanzania: Results from a community survey. *Int J Inj Contr Saf Promot*. 2012;19(2):135–9.
27. Outwater AH, Ismail H, Mgalilwa L, Justin Temu M, Mbembati NA. Burns in Tanzania: morbidity and mortality, causes and risk factors: a review. *Int J Burns Trauma*. 2013;3(1):18–29.
28. Fordyce TA, Kelsh M, Lu ET, Sahl JD, Yager JW. Thermal burn and electrical injuries among electric utility workers, 1995-2004. *Burns*. 2007 Mar;33(2):209–20.
29. Ahuja RB, Bhattacharya S. ABC of burns: Burns in the developing world and burn disasters. Vol. 329, *British Medical Journal*. BMJ Publishing Group; 2004. p. 447–9.
30. Ahuja RB, Bhattacharya S. Burns in the developing world and burn disasters. *BMJ*. 2004 Aug;329(7463):447–9.
31. Smolle C, Cambiaso-Daniel J, Forbes AA, Wurzer P, Hundeshagen G, Branski LK, et al. Recent trends in burn epidemiology worldwide: A systematic review. *Burns*. 2017 Mar;43(2):249–57.
32. Kearns RD, Holmes IH, Cairns BA. Burn injury. *Ann Burns Fire Disasters*. 2013;23(3).
33. Opaluwa AS, Orkar SK. Emphasise burns prevention in developing countries [6]. Vol. 329, *British Medical Journal*. 2004. p. 801.
34. Asaria J, Kobusingye OC, Khingi BA, Balikuddembe R, Gomez M, Beveridge M. Acid burns from personal assault in Uganda. *Burns*. 2004 Feb;30(1):78–81.
35. Mzezewa S, Jonsson K, Åberg M, Salemark L. A prospective study of suicidal burns admitted to the Harare burns unit. *Burns*. 2000 Aug;26(5):460–4.
36. Musa GJ, Chiang PH, Sylk T, Bavley R, Keating W, Lakew B, et al. Use of GIS Mapping as a Public Health Tool—From Cholera to Cancer. Vol. 6, *Health Services Insights*. SAGE Publications Ltd; 2013. p. 111.
37. Ettinger WH, Casan JA, Coon PJ, Muller DC, Appel KP. Patterns of Use of the Emergency Department by Elderly Patients. *J Gerontol* [Internet]. 1987 Nov 1;42(6):638–42. Available from: <https://doi.org/10.1093/geronj/42.6.638>

38. O'Mahony E, Ni Shé É, Bailey J, Mannan H, Mcauliffe E, Ryan J, et al. Using geographic information systems to map older people's emergency department attendance for future health planning. *Emerg Med J*. 2019 Dec;36(12):748–53.
39. Lasecki CH, Mujica FC, Stutsman S, Williams AY, Ding L, Simmons JD, et al. Geospatial mapping can be used to identify geographic areas and social factors associated with intentional injury as targets for prevention efforts distinct to a given community. In: *Journal of Trauma and Acute Care Surgery*. Lippincott Williams and Wilkins; 2018. p. 70–4.
40. Walker BB, Schuurman N, Hameed SM. A GIS-based spatiotemporal analysis of violent trauma hotspots in Vancouver, Canada: Identification, contextualisation and intervention. *BMJ Open*. 2014;4(2).
41. D. Parizh, Kuijs BA, Nkubi OT, Rabbitts A, Heffernan, J., Gallagher J. A pediatric burn unit in sub-Saharan Africa. In: 50th Annual Meeting of the American Burn Association. p. 467.
42. Amouzou KS, Kouevi-Koko TE, Egbohoun P, Tchétike P, Hounmenou AKF. Epidemiology and outcomes of in-hospital acute burn-patients in Togo: A retrospective analysis. *Burn Open* [Internet]. 2019;3(4):141–6. Available from: <https://doi.org/10.1016/j.burnso.2019.07.002>
43. Dans B, Tiers LE, Des M, Satisfaire BÀ, Stokes MAR, Johnson WD. Burns in the third world: an unmet need. *Ann Burns Fire Disasters*. 2017;xxx(4):243–6.
44. Gallaher JR, Mjuweni S, Cairns BA, Charles AG. Burn care delivery in a sub-Saharan African unit: A cost analysis study. *Int J Surg* [Internet]. 2015;19:116–20. Available from: <http://dx.doi.org/10.1016/j.ijssu.2015.05.015>
45. Delgado J, Ramírez-Cardich ME, Gilman RH, Lavarello R, Dahodwala N, Bazán A V., et al. Risk factors for burns in children: Crowding, poverty, and poor maternal education. *Inj Prev*. 2002 Mar;8(1):38–41.
46. Justin-Temu M, Rimoy G, Premji Z, Matemtu G. Causes, magnitude and management of burns in under-fives in district hospitals in Dar es Salaam, Tanzania. *East J Public Heal*. 2008;5(January):38–42.
47. Chalya PL, Mabula JB, Dass RM, Giiti G, Chandika AB, Kanumba ES. Pattern of childhood burn injuries and their management outcome at Bugando Medical Centre in Northwestern Tanzania. *BMC Res Notes* [Internet]. 2011;4(1):485.

Available from: <http://www.biomedcentral.com/1756-0500/4/485>

48. Rybarczyk MM, Schafer JM, Elm CM, Sarvepalli S, Vaswani PA, Balhara KS, et al. Revue systématique des cas de blessures par brûlure dans les pays à revenu faible et intermédiaire: épidémiologie dans la région africaine de l’OMS. *African J Emerg Med* [Internet]. 2017;7(1):30–7. Available from: <http://dx.doi.org/10.1016/j.afjem.2017.01.006>
49. Kate Shannon . GODPJSJMCFRN. Sustained high incidence of injuries from burns in a densely populated urban slum in Kenya: An emerging public health priority. *Burns*. 2016;176(1):139–48.
50. World Health Organization (WHO). *A WHO Plan for Burn Prevention and Care*. Geneva, Switzerland; 2008.
51. Outwater AH, Thobias A, Shirima PM, Nyamle N, Mtavangu G. Prehospital treatment of burns in Tanzania : a mini-meta-analysis. 2018;(August).
52. Harish V, Tiwari N, Fisher OM, Liz Z MP. First Aid Improves burn.pdf. *Burns*. 2019;45(2):433–9.

Appendix 1. CONSENT FORM (ENGLISH VERSION)

STUDY TITLE: Geospatial mapping and circumstances of burn among patients presenting to the emergency department of tertiary health care hospital

Introduction

Greetings, I Dr. EMANUEL FARESS KISANGA a second-year resident undertaking Emergency Medicine course at Muhimbili University of Health and Allied Sciences (MUHAS).

I am currently conducting a study as titled above as part of my study requirements. I hereby request your participation and support in my study once I or my research assistant approaches you. Your choice to participate or not will have no any effect on the care and management beloved one.

Please you may ask questions, any time if you do not understand anything patterning this study.

Aim of the study

The purpose of this study is to determine geospatial mapping of burn injury patients who present to a National referral hospital in Tanzania.

Benefits

No payment or any fringe benefits for your participation in the study as personal in steady the results and its implication will be beneficial for the hospital and general population using the hospital.

Risks

There is no risk in participating in this study.

What does this study involve?

This study involves the research assistant or principal investigator asking structured questions to you, the patient, or relatives and filling the responses in the prepared questionnaire. Also, information about you will be obtained from your hospital file.

Consent

Your consent to be enrolled in the study is entirely voluntary and amenable by signing the consent form. You are free not to consent and this will not affect care and management offered to your patient. You may decide on to stop participating in this study at any time for any reason.

Confidentiality

The information you provide is extremely respected and will be preserved strictly confidential. The study information will be stored in protected computer files and in paper records stored in a locked filing cabinet. Only study staff will have access to the information.

Access of information

By signing this form, you allow the research team to use the information and give it to others involved in the research. The research team includes the researcher, facilitators plus others working on this study at MUHAS and EMD-MNH.

For further information, questions or queries, you can contact:

The Principal Investigator,
Dr. EMANUEL FARESS KISANGA.
Department of Emergency Medicine,
MUHAS,
P. O. Box 65001,
Dar es Salaam, Tanzania.
Mobile Number: +255768687539
Email: kisanga.emmanuel@gmail.com

Dr. Bruno Sunguya
Director of Research and Publications,
Research and Publication Committee,
Muhimbili University of Health and Allied Sciences,
P.O Box 65001, Dar Es Salaam.
Telephone Number: 2150302-6

Signature:

I, _____ have read/been told the contents of this form. My questions have been answered. I agree to participate in this study.

Signature of participant _____

Date of signed consent _____

Appendix 2: CONSENT FORM (SWAHILI VERSION)

FOMU YA RIDHAA YA KUSHIRIKI KATIKA UTAFITI

Utangulizi

Jina langunaitwa Dkt. Emanuel Faress Kisanga,
 mwanafunzi wa daktari bingwawamagonjwayadharura (Emergency Medicine)
 katika Chuo Kikuu Cha Afyana Sayansi Shirikishi Muhimbili (MUHAS).
 Ninaomba shiriki wako au
 kwani abaya mgonjwa wako katika utafiti huu endapo mimiamamsaidizi wangu atakapokuf
 uatailikuku ulizataarifamuhimu zamgonjwawako.

Madhumuni ya utafiti:

Utafiti huu unalengakuangaliamaeneo yanayoadhiri wasananamajeraha ya tokenayonamoto
 opamojanavyanzovinyosababishakuungua Tanzania.

Ushirikikati ya utafiti:

Watoto wali oletwawaki wama hutitunakutibi wakati kavyumbavyamagonjwayadharura

Hatari:

Hatutaraji kuwepona athari/hatari yeyote itokanayona ushirikikati ya utafiti huu.

Faidaza ya utafiti:

Ushiriki wako ama Ridhaa yamgonjwawako ushirikikati ya utafiti huu,
 utawezeshakujuasababuzinazo letazinazosababishakuunganamaeneo yanayoadhiri was
 ananamadharayatokenayonamoto.

Usiri:

Taarifa zote zitakazokusanywa katika utafiti huu zitakuwa siri, hivyo ushiriki wako
 hautajulikana na mtu asiyehusika na utafiti bali timu ya watafiti tu.

Malipo:

Kwa kushiriki kwenye utafiti huu, hautalipwa wala hautalipa gharama yeyote.

Ukiwa na swali au tatizo lolote, unaweza kuwasiliana na wafuatao:

Mkuu wa Utafiti

Dkt. Emanuel Faress Kisanga,

Idaraya Magonjwaya Dharura na Mahututi (Emergency Medicine), MUHAS,

S.L.P 65001,

Dar es Salaam, Tanzania.

Simu: +255768687539

Baruapepe: kisanga.emmanuel@gmail.com

Dr.Bruno Sunguya

Mkurugenzi wa Utafiti na Machapisho

Kamati ya Utafiti na Machapisho

Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili

Sanduku la Posta 65001

Dar es Salaam.

Telephone Number: 2150302-6

Kuweka sahihi ya makubaliano:

Mimi, _____, nimesoma/nimesomewa maelezo yote yaliyomo kwenye fomu hii na nimeelewa .Maswali yangu yamejibiwa vizuri na niko tayari kushiriki.

Sahihi ya mshiriki _____

Sahihi ya Mtafiti _____ Tarehe _____

Appendix 3: Questionnaire (English version)

Geospatial mapping and circumstances of burn among patients presenting to the emergency department of tertiary health care hospital

Confidential

GEOSPATIAL MAPPING AND PREDICTORS OF BURN AMONG PATIENTS

Page 1

My First Instrument

Record ID

DEMOGRAPHIC DETAILS

Hospital registration number:

Age/ Date of birth:

Weight (in kg):

Gender:

Home Address:

Occupation:

- employed
 self employed
 unemployed

Marital status?

- single
 married
 divorced
 separated
 cohabited

Education level

- primary
 secondary
 college/university
 None

SOCIAL ECONOMIC STATUS

Do you have a domestic servant?

- Yes
 No

Does any member of the household own land?

- Yes
 No

Does your household have the following?

- Electricity
 Radio
 TV
 Non-mobile telephone
 Refrigerator
 Computer
 non of the above

Does any family member own bank account?

- Yes
 No

12/05/2021 5:04pm

projectredcap.org



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Page 2

What is the main material of the floor of your dwelling?	<input type="radio"/> Earth/dung <input type="radio"/> palm/bamboo/wound planks <input type="radio"/> polished woods/ceramic tile/cement/carpet <input type="radio"/> other
What is the roof material of your dwelling?	<input type="radio"/> no roof/palm <input type="radio"/> Rusting mat/card board <input type="radio"/> metal/wood/cement/ceramic tiles <input type="radio"/> others
What is the main exterior walls material of your dwelling?	<input type="radio"/> no walls/palm/cane/dirty <input type="radio"/> bamboo with mud/store with mud <input type="radio"/> cement/stone with lime <input type="radio"/> other
What is the type of toilet at your household?	<input type="radio"/> Asian/squatting pan <input type="radio"/> European/western <input type="radio"/> pit latrine
Is the toilet shared?	<input type="radio"/> Yes <input type="radio"/> No
What type of fuel does your house hold mainly use for cooking?	<input type="radio"/> Electricity <input type="radio"/> gas cooker <input type="radio"/> Kerosene <input type="radio"/> charcoal <input type="radio"/> Firewood
What is the main water source?	<input type="radio"/> Tap water <input type="radio"/> well water <input type="radio"/> Pond water <input type="radio"/> Sea/river <input type="radio"/> Other
1. Patient is?	<input type="radio"/> Infant (birth to less than 1 year) <input type="radio"/> Child (above 1 year to 18 years) <input type="radio"/> Adult(equal or above 18 years)
2. Who is accompanying the patient/child?	<input type="radio"/> parents <input type="radio"/> caregiver/relative <input type="radio"/> grand parents <input type="radio"/> friend <input type="radio"/> other(specify) <input type="radio"/> Alone
3. Name of health facility?	<input type="radio"/> MNH-mloganzila <input type="radio"/> MNH-upanga
4. was the patient reffered from another health facility?	<input type="radio"/> Yes <input type="radio"/> No
5. chief complaints	_____

6. mode of arrival?

- Ambulance
 Bicycle
 Bus
 car(private or tax)
 commercial vehicle
 mini bus
 motorcycle
 police
 truck
 unknown
 walk in

7. Vital signs

BP

PR

RR

SPO2

which oxygen source is used?

- RA
 OXYGEN

if oxygen, please specify

- NC
 oxygen mask
 NRBM
 BVM
 NON INVASIVE VENTILATION
 INVASIVE VENTILATION
 7. NONE

TEMP

RBG

8. Do you have pain?

- Yes
 No

Pain scale

0 1 2 3 4 5 6 7 8 9 10

Airway assessment

- Normal
 Abnormal

Confidential

Page 4

if airway abnormal (please specify)	<input type="checkbox"/> angioedema <input type="checkbox"/> stridor <input type="checkbox"/> voice changes <input type="checkbox"/> oral/airway burn <input type="checkbox"/> obstructed by tongue <input type="checkbox"/> obstructed by secretions <input type="checkbox"/> obstructed by vomits <input type="checkbox"/> obstructed by foreign body
what management of compromised airway done?	<input type="checkbox"/> reposition <input type="checkbox"/> suction <input type="checkbox"/> oral airway <input type="checkbox"/> nasal airway <input type="checkbox"/> laryngeal mask airway <input type="checkbox"/> endotracheal intubation <input type="checkbox"/> none
is cervical neck collar placed?	<input type="checkbox"/> none/not needed <input type="checkbox"/> placed before arrival <input type="checkbox"/> placed in EMD <input type="checkbox"/> needed but not placed
breathing assessment	<input type="checkbox"/> Normal <input type="checkbox"/> Abnormal
if breathing assessment abnormal, please specify	<input type="checkbox"/> shallow chest rise <input type="checkbox"/> retraction chest rise <input type="checkbox"/> paradoxical chest rise <input type="checkbox"/> deviated to the left <input type="checkbox"/> deviated to the right <input type="checkbox"/> abnormal breath sound to the left <input type="checkbox"/> abnormal breath sound to the right
spontaneous respiration	<input type="checkbox"/> Yes <input type="checkbox"/> No
when this current burn injury occurred?	_____

ETIOLOGY**9. History of injury**

Type of burn injury?	<input type="checkbox"/> scald <input type="checkbox"/> sunburn <input type="checkbox"/> contact burn <input type="checkbox"/> electrical burn <input type="checkbox"/> hot flame <input type="checkbox"/> chemical <input type="checkbox"/> other(specify)
Location of burn?	<input type="checkbox"/> home <input type="checkbox"/> cafeteria/restaurant <input type="checkbox"/> school <input type="checkbox"/> road/street <input type="checkbox"/> work place <input type="checkbox"/> other(specify)
street/closest area where burn occurred?	_____

Point and record on an I PAD google map the precise possible/closest GOOGLE coordinates where burn occurred

Latitude

Longitude

CARDINAL DIRECTION POINTS

10. DETAILS OF THE INCIDENT

was anyone in the room?

- Yes
 No

If yes, who?

- parent
 grand parent
 caregiver
 sibling
 none
 co-worker
 other(specify)

what was the child/patient doing just before the incident?

- Running or walking
 been carried
 laying down
 sitting/standing
 playing
 sleeping
 stealing
 car accident
 cooking
 other specify

what was the location of the hot item/fire?

- kitchen surface
 low table/floor
 on cooker hob
 dining table
 street/ road
 school
 work place
 bed room
 other specify

11. AGENTS/MECHANISM(Please complete all applicable)

what was the source of burn?

- hot fluid eg. drink,fat,oil
 oven hob/door
 hot object
 cloth catch fire
 open flame
 Electrical burn
 chemical
 other specify

Confidential

Page 6

how did you get burnt?	<input type="radio"/> touch/pull down <input type="radio"/> immersion <input type="radio"/> fell/ran into <input type="radio"/> spill/splash <input type="radio"/> house catch fire <input type="radio"/> fire set by villager <input type="radio"/> electrical work <input type="radio"/> other specify
were you drunkard?	<input type="radio"/> Yes <input type="radio"/> No
was first aid given before arrival to the hospital?	<input type="radio"/> Yes <input type="radio"/> No
if yes, what was it?(check all that apply)	<input type="checkbox"/> cold water <input type="checkbox"/> powder/honey <input type="checkbox"/> ice/wet compress <input type="checkbox"/> tooth paste/cream/gel/ointment/egg <input type="checkbox"/> other specify
if cold water, how was it applied	<input type="radio"/> tap/shower(running water) <input type="radio"/> put into water(immersion)
was the burn wound covered?	<input type="radio"/> Yes <input type="radio"/> No
was analgesia administered prior arrival to the emergency department?	<input type="radio"/> Yes <input type="radio"/> No
which analgesia given?	<input type="checkbox"/> none <input type="checkbox"/> paracetamol <input type="checkbox"/> NSAIDS <input type="checkbox"/> herbal medicine <input type="checkbox"/> opioids <input type="checkbox"/> ketamine <input type="checkbox"/> other specify
is there any developmental impairment?	<input type="radio"/> Yes <input type="radio"/> No
if yes, please check all that apply	<input type="checkbox"/> motor <input type="checkbox"/> neurological <input type="checkbox"/> hearing/vision <input type="checkbox"/> behavioral/learning <input type="checkbox"/> other specify
what is the current best stage of development? (please complete for children less than 3 yrs)	<input type="radio"/> non-mobile baby <input type="radio"/> baby able to roll over <input type="radio"/> sitting/crawling <input type="radio"/> walking <input type="radio"/> running <input type="radio"/> other specify

(This to be done by Assistant researcher/principle investigator) shade the PRINTED LUND AND BROWDER CHARTS WITH BODY MAP AND RELATIVE PERCENTAGE OF BODY SURFACE AREA AFFECTED BY GROWTH so that, the percentage of body surface burnt can be estimated.

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Page 7

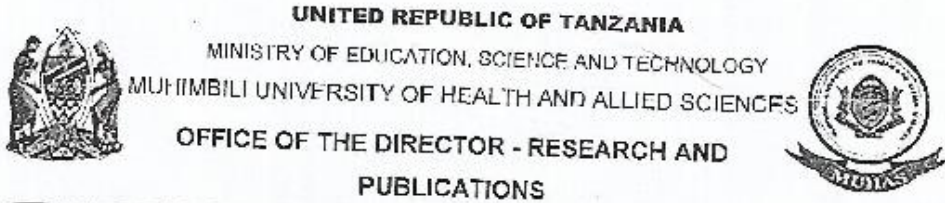
BODY REGION BURNT AND RELATIVE PERCENTAGE (%)	
HEAD	_____
NECK	_____
ANTERIOR TRUNK	_____
POSTERIOR TRUNK	_____
RIGHT UPPER LIMB	_____
LEFT UPPER LIMB	_____
BUTTOCKS	_____
GENITALIA	_____
RIGHT LOWER LIMB	_____
LEFT LOWER LIMB	_____
TOTAL BURN SURFACE AREA (TBSA%)	_____
what was the pattern of injury?	<input type="radio"/> symmetrical (both sides of the body) <input type="radio"/> gloves/stocking distribution <input type="radio"/> skin fold sparing <input type="radio"/> multiple contact burn(more than one)
what is the depth of injury?	<input type="radio"/> erythema/redness <input type="radio"/> not burnt <input type="radio"/> wet/pink <input type="radio"/> white or charred
what percentage is the total burn surface area?	<input type="radio"/> N/A <input type="radio"/> less or equal to 1% <input type="radio"/> 2-9% <input type="radio"/> 10-14% <input type="radio"/> greater or equal to 15%
was the management done at EMD?	<input type="radio"/> Yes <input type="radio"/> No

Confidential

Page 8

if yes, was tetanus toxoid given?	<input type="radio"/> Yes <input type="radio"/> No
was iv-fluid given at ED?	<input type="radio"/> Yes <input type="radio"/> No
if yes, amount of fluid given?	<input type="radio"/> LESS THAN 1 LITRE <input type="radio"/> 1 TO 2 LITRES <input type="radio"/> MORE THAN 3 LITRES
was dressing done?	<input type="radio"/> Yes <input type="radio"/> No
was analgesic given?	<input type="radio"/> Yes <input type="radio"/> No
was iv-antibiotics given?	<input type="radio"/> Yes <input type="radio"/> No
have there been previous ED attendance for burn injury?	<input type="radio"/> Yes <input type="radio"/> No
does the child/family have a social worker?	<input type="radio"/> Yes <input type="radio"/> No
did the child/family have a social worker or any social service involvement in the past?	<input type="radio"/> Yes <input type="radio"/> No
is there domestic violence in the home?	<input type="radio"/> Yes <input type="radio"/> No
was the child protection referral made?	<input type="radio"/> none <input type="radio"/> social services <input type="radio"/> hospital safeguarding team <input type="radio"/> other(specify) <input type="radio"/> Not Applicable
Do you have any chronic illness?	<input type="radio"/> epilepsy <input type="radio"/> seizure disorder <input type="radio"/> heart disease <input type="radio"/> muscle related disease like myosthenia gravis <input type="radio"/> neurological disorder <input type="radio"/> none
what was the outcome?	<input type="radio"/> discharged home <input type="radio"/> admitted in burn unity <input type="radio"/> admitted in icu/Hdu <input type="radio"/> transfer to acute ward <input type="radio"/> MOI <input type="radio"/> other specify

Appendix 4: Ethics research approval



In reply quote;

Ref. No. DA.282/298/01.C/

Date: 22/12/2020

MUHAB-REC-12-2020-447

Dr. Emanuel Faress Kisanga
MMed in Emergency Medicine,
School of Medicine,
MUHAS

**RE: APPROVAL FOR ETHICAL CLEARANCE FOR A STUDY TITLED:
Geospatial mapping and predictors of burn among patients presenting
to the emergency department of tertiary health care hospital**

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 accordance with MUHAS research policy and Tanzania regulations governing human and animal subjects research.

APPROVAL DATE: 22/12/2020

EXPIRATION DATE OF APPROVAL: 21/12/2021

STUDY DESCRIPTION:

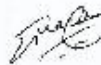
Purpose:

The purpose of this prospective observational study is to determine the geographical location of burn patients and socio-demographic factors of patients with burns injuries presenting to Muhimbili National Hospital in Dar es Salaam, Tanzania.

The approved protocol and procedures for this study is attached and stamped with this letter, and can be found in the link provided: <https://irb.muhas.ac.tz/storage/Certificates/Certificate%20-%20286.pdf> and in the MUHAS archives.

The PI is required to:

1. Submit bi-annual progress reports and final report upon completion of the study.
2. Report to the IRB any unanticipated problem involving risks to subjects or others including adverse events where applicable.
3. Apply for renewal of approval of ethical clearance one (1) month prior its expiration if the study is not completed at the end of this ethical approval. You may not continue with any research activity beyond the expiration date without the approval of the IRB. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.
4. Obtain IRB amendment (s) approval for any changes to any aspect of this study before they can be implemented.
5. Data security is ultimately the responsibility of the investigator.
6. Apply for and obtain data transfer agreement (DTA) from NIMR if data will be transferred to a foreign country.
7. Apply for and obtain data transfer agreement (DTA) from NIMR if data will be transferred to a foreign country.
8. Apply for and obtain material transfer agreement (MTA) from NIMR, if research materials (samples) will be shipped to a foreign country.
9. Any researcher, who contravenes or fail to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine as per NIMR Act No. 23 of 1979, PART III section 10 (2)
10. The PI is required to ensure that the findings of the study are disseminated to relevant stake holders.
11. PI is required to be versed with necessary laws and regulatory policies that govern research in Tanzania. Some guidance is available on our website <https://drp.muhas.ac.tz/>.

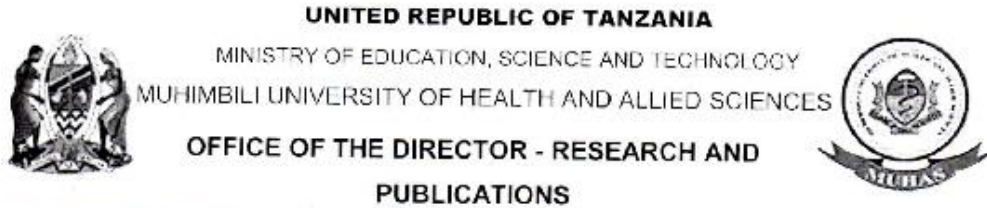


Dr. Emmanuel Balandya
Chairman, MUHAS Research and Ethics Committee

Cc: Director of Postgraduate Studies, MUHAS



Appendix 5: Ethics approval –Amendment



Ref. No.DA.282/298/06/C/767

Date: 09/04/2021

MUHAS-REC-12-2020-447
 EMANUEL FARESS KISANGA
 MMed Emergency Medicine
 MMed - Emergency Medicine, School of Medicine
 MUHAS

RE: APPROVAL FOR AMENDMENT

Reference is made to your letter dated Apr 6, 2021 concerning the above heading.

I am pleased to inform you that the Chairman has on behalf of the Senate, approved your request for protocol amendments of your study titled "*Geospatial mapping and circumstances of burn among burn patients presenting to the emergency department of tertiary health care hospital*" as requested.

The amendments include:

1. Rephrasing the research title from "geospatial mapping and predictors of burn among burn patients presenting to the emergency department of a tertiary health care hospital" to "geospatial mapping and circumstances of burn among burn patients presenting to the emergency department of a tertiary health care hospital"
2. Rephrasing the 4th specific objective from "to determine factors influences burn injuries among patients with burn injuries presenting to MNH in Dar es Salaam Tanzania" to "To describe circumstances of burn among patients with burn injuries presenting to MNH in Dar es Salaam Tanzania"


 Dr. Bruno Sunguya
 Chairman, MUHAS Research and Ethics Committee



Appendix 6: Letter of authorization from MNH management to conduct the study



In reply please quote:

Ref. No.: MNH/TRCU/Perm/2021/004

Date: 06th January, 2021

Head of department
Emergency Medicine
Muhimbili National Hospital.

RE: PERMISSION TO COLLECT DATA AT MNH.

Name of student	Dr. Emmanuel Faress Kisanga
Title	"Geospatial Mapping and Predictors of Burn among Patients Presenting to the Emergency Department of tertiary Health Care Hospital".
Institution	Muhimbili University of Health and Allied Sciences
Supervisor	Dr. Hendry Sawe
Co-Supervisor	Dr. Said S. Kilindimo
Period	06 th January, 2021 to 21 st May, 2021

Approval has been granted to the above mentioned student to collect data at MNH.

Kindly ensure that the student abide to the ethical principles and other conditions of the research approval.

Sincerely,



Dr. Faraja Chiwanga

Head of Teaching, Research and Consultancy Unit

c. c DMS

c. c **Dr. Emmanuel Faress Kisanga**

Appendix 7: Lund and Browder chart used for burn estimation

