Pediatric burn injuries: pattern and management outcome at Muhimbili National Hospital

Ahmed A. Ahmed, MD

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PAEDIATRIC BURN INJURIES: PATTERN AND MANAGEMENT OUTCOME AT MUHIMBILI NATIONAL HOSPITAL

By

Ahmed A. Ahmed

A Dissertation Submitted in (Partial) Fulfillment of the Requirements for the Degree of Master of Medicine (Surgery) of

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CERTIFICATION

The under signed certifies that he has read and hereby recommend for acceptance by Muhimbili University of Health and Allied sciences a dissertation entitled: **"Paediatric burn injuries: pattern and management outcome at Muhimbili National Hospital",** in (partial) fulfillment of the requirements for the degree of Master of Medicine (General surgery) of Muhimbili University of Health and Allied Sciences.

_____

Dr. Larry O. Akoko

(Supervisor)

_____

Date

DECLARATION AND COPYRIGHT

I, Dr. **Ahmed A. Ahmed**, declare that this **dissertation** is my own 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**…….

ACKNOWLEDGEMENT

I am utterly grateful to the **Almighty God** for keeping mentally and physically well during study period.

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DEDICATION

I dedicate my dissertation work to the following:

My Parents, The **late Abubakar Ahmed** and my **Mother Shamshad A. Jaffer**, for their love, encouragement and motivation through the entire study period.

My beloved Wife Dr. Lucie A. Okonda, for her emotional support, prayers and courage during hard times.

My lovely daughters **Rania A. Ahmed** and **Raeesah A. Ahmed**.

ABSTRACT

Introduction: Burn is defined as an injury caused by heat (hot objects, gases, or flames), chemicals, electricity and lightning, friction, or radiation. It is the common cause of childhood injuries throughout the world with male predominance. The burden is high in low- and middle-income countries with more than 90% of the burden of burn injury. It is regarded as the second most common cause of accidental death in children less than 5 years and the most common cause of accidental death in the home. Pediatric burn injuries are reported to be a major public health problem responsible for significant morbidity and mortality within the sub Saharan region.

Aim: To determine the pattern and management outcome of pediatric burn injuries in children admitted at Muhimbili National Hospital (MNH)

Methodology: This was descriptive prospective study design, a hospital-based study that was conducted at MNH for a period of 12months (from April 2018 to March 2019). All children sustained burn injuries admitted at MNH with age between 2 months and 10 years were enrolled and studied. The enrolled children were followed from admission to discharge for assessment of management and outcome. Participants were interviewed direct by using a well-structured questionnaire. Data was analyzed by using SPSS Version 23.0 package.

Results: A total of 111 patients were enrolled in the study, where their median age was 20 months(IQR 12-35 months).Majority were in the age group of 15-35 months contributing 83(74.8%) participants and male patients contributing 58% of the studied population. We found that provision of appropriate treatment was associated with reduction in mortality, as seen here in a logistic regression model adjusted for age, sex, first aid, type of burn, neck involvement, right leg involvement, buttocks involved, extent of burn – the odds of death were reduced by 65% as compared to those who did not receive appropriate treatment i.e., adjusted odds ratio (aOR) 0.35, 95% CI 0.05-2.36, p value 0.28. And for each one unit increase in body surface area that sustain burns, the odds of mortality increase by 12%. Burns involving buttocks had increased risk of mortality aOR 5.08, 95% CI 0.65-39.78, p value 0.12.

Conclusion: In conclusion, we have established the causes and pattern of burn injuries and risk factors associated with mortality. It was observed that burns involving buttocks are associated with higher mortality among children. Our study show that increased body surface area is associated with increased risk of mortality.

Key words: Burn, TBSA,

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HIC	High Income Countries
LMIC	Low- and middle-income countries
MNH	Muhimbili National Hospital
MUHAS	Muhimbili University of Health and Allied Sciences
OR	Odds Ratio
aOR	Adjusted Odds Ratio
SPS	Statistical Package for the Social Sciences
TBSA	Total Burn Surface Area

DEFINITION OF TERMS

Burn is a type of injury to skin, or other tissues, caused by heat, cold, electricity, chemicals, friction, or radiation.

Burn pattern was defined as the visible, measurable physical change or identifiable shape(s) formed by a burn injury (1,2).

Appropriate management-include all patients with who received intravenous fluid, antibiotics, high protein diet and physiotherapy.

Outcome was defined as that which is produced or occurs as a result of an event or process

Pediatric is the branch of medicine that involves the medical care of infants, children, and adolescents from neonates to fifteen years. In this instance, we recruited pediatric patients from 2 months to 10 years.

Permanent house was defined as house built with blocks.

Caretaker was defined as either a parent or a relative who were responsible for taking care of a child.

Pre-existing condition was defined as children who had any medical condition at the time of burn injury such as pneumonia, epilepsy, asthma etc.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Globally, burn injuries is a major public health problem ranging from LMIC to HIC with approximated more than 300,000 people annually die of fire related burn injuries. The burden of burn injuries is significantly marked in majority of developing countries (over 95%) of fire-related injuries, whilst the mortality rate is six time high in LMIC when compared to HIC(3,4).

In Africa, similar findings from WHO revealed estimated 18’000 to 30’000 children under five years or less die annually due to fire-related injuries(3,5)**.** Difference in burn mortality rate among regions of LMIC and HIC, vary across different age groups, such as fire-related burns is the sixth leading cause of death in children aged 5 to 14year old. Female gender is more affected as highest rates of fire related deaths were estimated to be 16.9 deaths per 100,000 population per year(5).

In East Africa, the most affected age is below 3 years with male predominant to female with a ratio of 1.4;1.Majority of burn-related injuries were domestic with particular scald burn injuries in the presence of competent adults(6). In Tanzania, the study done at Bugando Medical Centre revealed burn injuries in children to be a major public health problem responsible for significant morbidity and mortality at Bugando Medical Centre and the majority of injured patients were aged 2 years and below with male predominance (7). This resembles with studies done in India and Ghana(8,9).

The common causes of burn injuries in Tanzania have been reported more than 90% of children’s burn injuries to be related to cooking, 39% related to hot water, 31% to hot food, 14% due to open flame and 9% due to cooking oil. A child may fall into a fire, or more likely tip a pot of boiling liquid onto him or herself (10). The studies done shows that scald burns were the most frequent causes of burn injury, followed by flame(11–13)**.**

Children suffer the severe form of burn injuries when compared to adult, this is explained by a thinner dermis and children’s body proportion differ, thus resulting in greater evaporative water and heat loss. The risk factors for burn injuries in children differ

according to regions, age less than six years, seasons(cooler months), impairment, use of ground level stoves for cooking, number of people in home(potentially for supervision),type of fuel and lighting sources use, residency, high set temperature in hot water heaters and substandard electrical wiring which are more marked in low and middle income countries(LMIC)(3,4,14).

Pathophysiology of burn

For effective management of burn injuries, it is important to understand the pathophysiology of burn in which it tends to induce the local and systemic responses which affect the pattern and management. Locally, there are three zones of burn injuries as described by Jackson in 1947. Zone of coagulation is the point of maximum damage, irreversible tissues loss due to coagulation of constituent protein. Zone of stasis is characterized by decrease tissue perfusion; salvageable. The aim of resuscitation is to prevent the irreversibility to stasis zone by any further insult such as prolonged hypotension, infection and edema. Zone of hyperemia, it is the outermost zone, tissue perfusion; there is increased tissue perfusion unless there is prolonged hypoperfusion. All these three zones are three dimensional thus loss of tissue in the stasis zone will lead to the wound deepening and widening(15,16).

Systemic response is marked when the burn injury reaches 30% of total body surface area and is associated with the release of cytokines and other inflammatory mediators at site of injury. The most affected systems are: Cardiovascular system, respiratory changes, there is bronchoconstriction, Metabolic changes-there is increase in basal metabolic rate in three times the original rate(15,16).

Mechanism of burn injury

Various mechanism have been shown to associate with burn injuries and the most common described as thermal injuries, which include scald which is commonly due to spilling hot drinks or liquids, or being exposed to hot bathing water that contributed up to 70% of children burns and it is more of superficial dermal burn. An electrical injury is another mechanism of burn injury. it is caused by electrocution injuries. It is characterized with entry and exit point where the current travels through the body which further divided to low voltage domestic and high voltage current. A chemical injury is another mechanism of

burn injury which may be from an industrial accident but also may occur from household chemical products(15,16).

Extent of burn injury

Severity of burn injury depends on the depth of burn and percentage of total burn surface area (TBSA) Depth varies with the degree of tissues damage, which also depends with mechanism of injury, can be classified into degree of injury in epidermis, dermis, subcutaneous fat and underlying structures. There are four degree of burn injuries, first to fourth degree burn(15–17)**.**

Management of burn injury

The management of burn injuries varies from the initial resuscitation fluid management to a specific treatment. It begins with pre-hospital management which aim at cessation the source of burn injury and initial assessment which involves primary and secondary survey, initial wound care. Fluid management is vital in the management of burn injuries; the goal is to maintain the tissue perfusion in the early phase of burn shock. Delayed resuscitation of burn patient results in poorer outcome. There are different formulas used in fluid management in the initial 24 hour of burn injuries, those formulas are the Parkland, modified Parkland, Brooke, and modified Brooke. These formulas take into account the body weight and the burn surface area. The most common used formula is parkland formula(15,18,19)**.** In initial fluid management there is a great variation in the preferred type of fluid for resuscitation. Crystalloid Hartmann's solution is the preferred resuscitation fluid which. Normal saline is avoided as it may result hyper-chloraemic metabolic acidosis(9).

Most of burn injuries are treated at hospital conservatively with analgesics, antibiotics, tetanus toxoid, topical antimicrobial agents, and antiseptics and wound dressing. Surgical treatment involves wound debridement, fasciotomy, escharotomy, skin grafting, contracture release, hip spica and amputations(4,15–17).

1.2 Literature Review

Burn injuries is a major public health in the world and mortality rate among regions of LMIC and HIC varies across different age groups, such as fire-related burns and it is noted that fire contributed to more death among children aged 5 to 14 year old and female gender is more affected(5). In developed countries, it accounts for 2-6% of all childhood injuries and 1deaths per 100,000 populations per year whilst in Africa is 6.1 deaths per 100,000 populations per year of all burn injuries. Burns also reported to be the second most common cause of accidental death in children under 5 years and the most common cause of accidental death in the home(3,20). Similarly, a study done in East Africa has shown the most affected age is below 3 years with male predominant at a ratio of 1.4:1 and majority of burn-related injuries were domestic with particular scald burn injuries(6).

In Tanzania the burden is similar to other parts of the world and a study done at Bugando Medical Centre noted burn injuries in children as a major public health problem resulting to significant morbidity and mortality and the majority of injured patients were below the age of 2 years with male predominance(7). Similarly, a study done in India and Ghana(8,21). The common causes of burn injuries in Tanzania reported in a review done showed that more than 90% of children's burn injuries to be related to cooking, 39% related to hot water, 31% to hot food, 14% due to open flame and 9% due to cooking oil(10). The finding in mentioned review were similar to other studies done that scald burns was the most frequent causes of burn injury, followed by flame(11,12).

Most burn injuries occurred at home by 90.6% and specifically in the kitchen and vast majority were unintentional by 97.1% and scald being the most common type of burn that occurred during day. Other associated injuries were noticed like fractures, head and neck injuries which associated with high mortality(7). Majority of burn injuries involved the trunk followed with upper limbs, lower limbs and head and neck. In terms of percentage of TBSA mostly ranged from 5% to 50% of majority of studies and partial thickness burn was the leading followed with full thickness type of burn injury. Some studies revealed pre--hospital treatment which included irrigation with cold water, application of topical antibiotics, wound dressing and intake of analgesic and /or antibiotics. Others include the use of salt, raw eggs, aloe vera, palm oil, engine oil, cutting and opening the blebs and sometimes beating the children. Such studies also reported different times for attending

hospitals after the injuries where47.2% came early to the hospital after burn injury, that is less than 6hours whilst 43.4% came after 24hours and the rest of came in between(7).
Premorbid conditions that usually associated with patients with burn injures included epilepsy, misuse alcohol and or drugs, congenital heart disease, sickle cell disease, pulmonary tuberculosis and recurrent UTI. However, recently HIV/AIDS was seen in 25% of some of the studies with different level of viral load and CD4 count with majority presents with CD4 count were more than 200 cells/microliter(7).

Globally, there is decrease in morbidity due to pediatric burn injury especially in HIC in millions suffer from physical to psychological effects of burn such as disfigurements, burn wound contractures and psychological part of stigmatism. Similar presentation has been reflected in Tanzania as pediatrics burn injuries caries significant morbidity and mortality especially in developing countries, some risks factors related with mortality in LMIC were age less than 6years, etiology (hot water& soup), TBSA more than 36%, inhalation injury, sepsis, absence of burn Centre as a result majority of patients managed in general wards which are not well equipped in managing burn injury patients(11,22). Other factors contributed to mortality and morbidity includes duration of injury and mechanism of injury. In a study done in Ghana the risk factors identified were Age <6 years, scald and Inhalation injury(15,18).

There are other parental factors such as education, income, knowledge of burn prevention and care, supervision and some particular home features have been significantly associated with pediatric burn injuries. Underlying health problems like epilepsy noncompliance with anticonvulsant therapies and others conditions such as pneumonia, meningitis, gastroenteritis and tuberculosis which associated with febrile seizures has been associated with increased risk of falling into open flames and was also reported that disabled children has higher incidence of burn injuries as compared to non-disabled children(21,23). Non-accidental burn injuries are approximated to cause 3-10% of pediatric burns. It is significant detecting these injuries, since up to 30% children less than 3years die of repeatedly abuse. A social history and pattern of non-accidental burns is crucial for diagnosis and its management(15,16).

Burn injuries results into various complication as immediate and late complications, the common complications reported includes shock due to hypovolemia and wound infections with *Staphylococcus* aureus and with *Pseudomonas aeruginosa* becoming more evident after 10th day and is the commonest isolated bacteria(7,12). Other complications reported includes excessive scarring, contractures and eschar with pulmonary compromise as well as thromboembolic phenomenon(9).

1.3 Problem Statement

Pediatric burn has seen significant improvement in outcome in high income countries with low mortality and excellent functional outcome. Most of burn injuries in children are preventable etiologies to all HIC and LIC. Recently, there is increase incidences of burn injures (unpublished data) from pediatric burn unit at MNH in Dar es salaam. However, there was no recent data regarding pattern and management outcomes of burn injury in our local settings with regard to burn injuries among children being the most affected age group with scald injuries due to poor cooking environments in this setting. It was from this background that this study was founded to systematically assess the pattern and management outcomes of pediatric burn injuries at MNH so as to update the body of knowledge among researchers in Tanzania.

1.4 Rationale

Children are of great important for the future development of our nation. Burn injuries can be prevented and when it occurs can be treated, so knowing the outcome and the factors contributing to poor outcome in our environment will help to address or to lower the morbidity and mortality related to burn injuries among children and allow children to live to their fullest potential. So to attain the safety and well-being of these children by identification of their risk of burn injuries and outcome management, this will guide us to establish preventive and therapeutic measures in these children with burn injury and hence improve the quality of living at individual to national level, hence it is crucial for institution to know the clinical and demographic characteristics, management outcome of pediatric burn injuries for appropriate treatment and preventive measures.

1.5 Research Questions

i. What are the clinical characteristics of burn injuries at MNH?
ii. What are the preexisting co morbidities conditions among burn patients at MNH?
iii. Is the recommended clinical management administered to all children with burn injuries at MNH?
iv. What is the prevalence of mortality due to burn among children and the associated risk factors at MNH?

1.6 Objectives

1.6.1 Broad Objective

The broad objective of the study was to describe the pattern, management and outcomes of pediatric burn injuries at Muhimbili National Hospital.

1.6.2 Specific Objectives

Specifically, the study aimed at;

1. Describing the pattern of burn injuries among children admitted at MNH,
2. Documenting pre- existing co-morbid conditions among burn children,
3. Determining how appropriate was the clinical management given among children with burn injuries, and at;
4. Determining the prevalence of mortality and associated risk factors among pediatric patients admitted with burn injury at MNH.

CHAPTER TWO

2.0 METHODOLOGY

2.1 Study design

This was a hospital based cross-sectional prospective descriptive study in design.

2.2 Study area

The study was conducted in pediatric burn ward at Muhimbili National Hospital in Dar-es-Salaam Tanzania, a Tertiary care referral hospital and also the teaching hospital of Muhimbili University of Health and Allied Sciences (MUHAS). It provides its services to mainly the people living in Dar es Salaam whose population is about 5 million as well as receives patients from all over the country. It receives patients with burn injury from municipal hospital in Dar es Salaam and nearby regions Tanzania is a country of about 60 million people with four main tertiary medical care hospitals.

2.3 Study duration

This study involved all patients who were admitted at between April 2018 and March 2019.

2.4 Study population

All children admitted to the “burn unit” at MNH with ages between 2 months to 10 years were studied.

2.5 Inclusion Criteria and Exclusion Criteria

2.5.1 Inclusion

All children with burn injuries admitted at MNH who were less than 10 years in age were invited to participate in the study.

2.5.2 Exclusion criteria

Children admitted at MNH who have already developed complications and managed.

2.6 Sample size

The estimated sample size N was calculated as follows;

$$N = \frac{Z^2 p(1-p)}{e^2}$$

Where;

N = Estimated Minimum Sample Size

Z = is the standard deviation in normal population, which turns out to be 1.96 on using the 95% confidence interval.

P= From the previous study done study at Yekatit 12 hospital, Addis Ababa, Ethiopia, the mortality rate of pediatric burn injuries was 7.85 %(24).

e= margin of error (5%)

Hence from the formula above the sample size was

$$N = \frac{1.96 \times 1.96 \times 7.85 (100-7.85)}{5 \times 5}$$

Minimum Sample Size, n = 111

2.7 Recruitment procedure

Participants were obtained from burn ward and their parents were interviewed by using a well-structured questionnaire. All children between ages of 2 month to 10 years with burn injuries were enrolled and studied. Short history were taken and physical examination done during enrollment to determine the characteristic of participant, etiology of burn and characteristics of burn injury to individual participant. Fluids management and management outcome were studied over a period of admission; the participants were followed from the day of enrolment until the day of discharge from hospital or death during admission period. Data was collected for a period of 12 months from April 2018 to March 2019.

2.8 Data collection procedure

Enrollment and training of research assistance was done before data collection, and then a pretest study was conducted by research assistant under supervision and then data was collected.

Participants were interviewed directly by using well-structured questionnaire.

Other required information (data) was obtained from patients file or computer (Doctors consultation).

2.9 Data management and analysis

Data was analyzed by using SPSS Version 23.0 package. Means, median, mode and standard deviation will be used to summarize continuous variables. Categorical variables were summarized in form of proportions and frequency tables. Data was categorized into categorical variables and Chi-square test was used to test for significance of associations between the predictor and outcome variables in the categorical variables.

2.10 Study limitation

Difficult in measuring anthropometric measurement in very sick children.

2.11 Ethical consideration

Ethical clearance to conduct the study was sought from MUHAS Research and Publication Committee. Muhimbili National Hospital management was asked for permission to allow provision of information necessary for the study. Informed consent for participation in the study was sought from parents/guardian. Privacy and confidentiality was assured and the questionnaire were not contain client's name, only codes were used, for confidentiality. The participant was asked to volunteer, and no benefits were obtained by participating in this study. Patients had the right of getting proper management even if they refuse to participate in the study.

CHAPTER THREE

3.0 RESULTS

During the study period of 12 months, a total of 111 patients were enrolled in the study, table 1 below shows the demographic and clinical characteristics of the study participants were median age was found to be 20 months (12-35).Majority of study participants were in the age group of 0-24 months contributing 83(74.8%) participants and male patients contributing 58% of the studied population. The study revealed majority of the children were living with their care takers 84 (87%) and among them 69 were having primary school education. Also 87 participants live in house with multiple rooms and majority 99 (89.2%) have an unprotected kitchen.

Table 1: Demographic and clinical characteristics among children admitted with burn injury and their caretakers presented with burn injury at MNH.

Children characteristics	**n = 111 (100%)**
Median age in months (IQR)	20 (12-35)
Age group, n (%)	
0-24 months	83 (74.8)
25-72 months	21 (18.9)
>72 months	7 (6.3)
Sex, n (%)	
Male	65 (58.56)
Female	46 (41.44)
Presence of caretaker, n (%)	
No	3 (2.7)
Yes	108 (97.3)
Care takers' characteristics	n = 111 (100%)
Median age in years (IQR)	30.28 (28-32)
Sex, n (%)	
Male	4 (3.6)
Female	107 (96.4)
Education status, n (%)	
No formal education	1 (0.90)
Primary education	69 (62.16)
Secondary education	27 (24.32)
College/University	14 (12.61)
Marital status, n (%)	
Single	24 (21.62)
Married	84 (75.68)
Separated	3 (2.70)
Permanent housing, n (%)	
Single	24 (21.6)
Multiple rooms	87 (78.4)
Separate kitchen,	
No	1 (0.9)
Yes	110 (99.1)
Protected kitchen	
No	99 (89.2)
Yes	12 (10.8)

In this study, we found the main cause of burn injury to be caused by scald which caused injuries to 104 (93.7%) and fire in only 7 (6.3%) of the studied population (**Table 2**). In the study also majority 90 (81.1%) of the injuries occurred in the kitchen. Also, the study had come out showed majority of the burnt children occurred in the morning 54 (48.6%) as compared to afternoon and evening time. Majority 77 (69.4) had first aid soon after burn injury and also it revealed 72% of the population had less than 15% TBSA of burn.

Table 2: Baseline characteristics of burn injury among children who were admitted at MNH from April 2018 until March 2019

Characteristic	All, 111
Cause of burn, n (%)	
Hot liquid (scald)	104 (93.7)
Fire	7 (6.3)
Burning location, n (%)	
Kitchen	90 (81.1)
Dining room	15 (13.5)
Corridor	2 (1.8)
Bedroom	2 (1.8)
Road	2 (1.8)
Time of injury (in 24hours), n (%)	
0700 hours-1100 hours	54 (48.6)
1200 hours-1800 hours	38 (34.2)
>1800 hours	19 (17.1)
First aid, n (%)	
No	34 (30.6)
Yes	77 (69.4)
TBSA in% grouped, n (%)	
0 to 5	15 (13.5)
06 to 10	33 (29.7)
11 to 15	24 (21.6)
16 to 20	13 (11.7)
>20	26 (23.4)
Pre-existing conditions, n (%)	
No	105 (94.59)
Yes	6 (5.41)

TBSA, Total Burn Surface Area; n, number

From the figure below, we observed that, comorbidities that were studied among patients who were involved in the study were 5 (4.5%) among all children who sustained burn injuries at MNH.

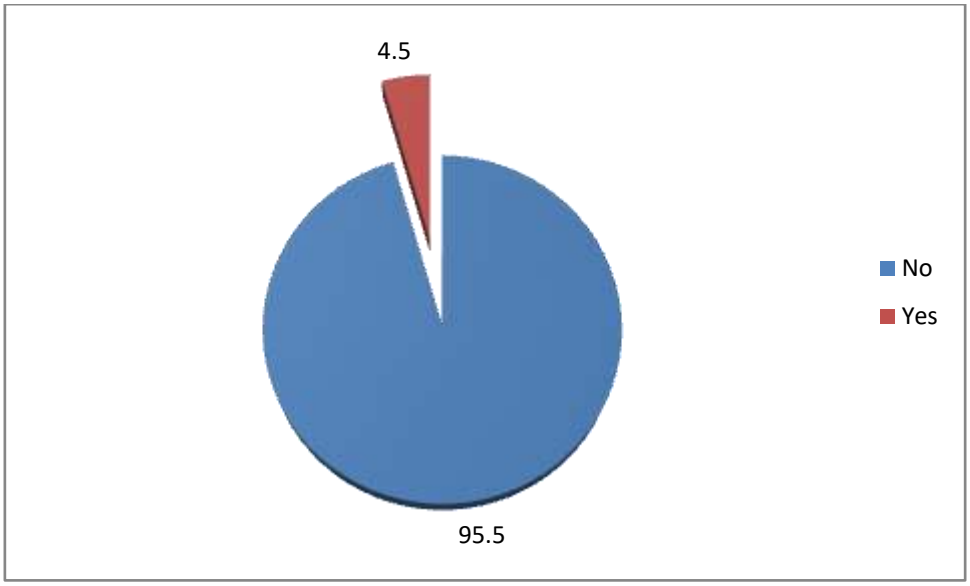

Figure 1; Showing comorbidities among children who had burn injury

Appropriateness of treatment to all burn patients were also studied. In this aspect appropriate intravenous fluid, antibiotics, physiotherapy and highly protein diet were regarded as appropriate treatment. It revealed majority of the patients had no appropriate treatment as depicted in **Figure 2** below. All participants with TBSA of less than 5% were receiving inappropriate burn treatment, 61.5% of those with TBSA more than 20% also received inappropriate treatment.

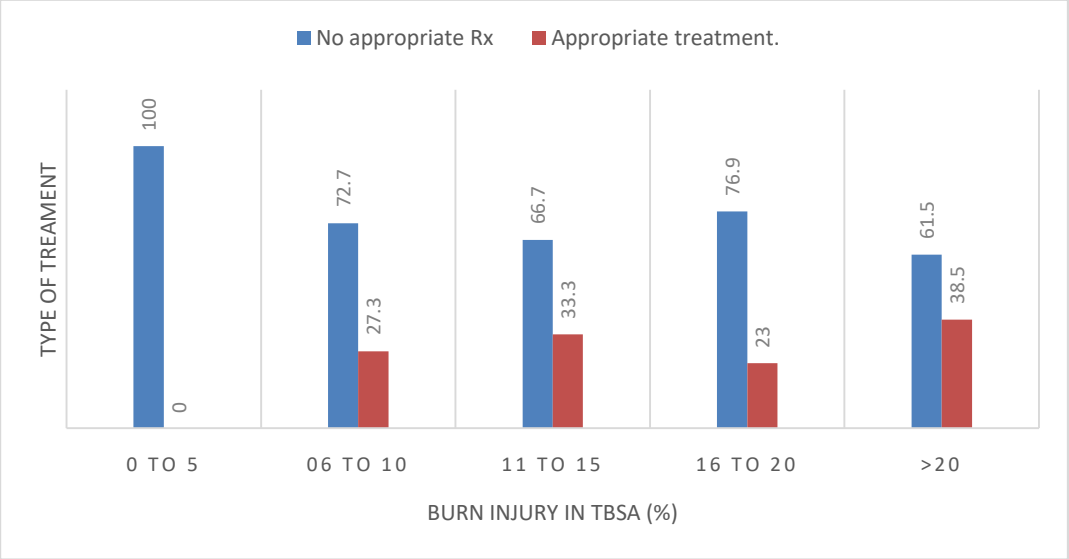

Figure 2: Bar chart showing different types of treatments children received.

Our study showed that over two thirds of children with burn injury recover completely without and post burn sequelae (Figure 3). Unfortunately, 13% of children succumbed to death due to burn injuries while 1% and 2% had hypertrophic scars and contractures respectively.

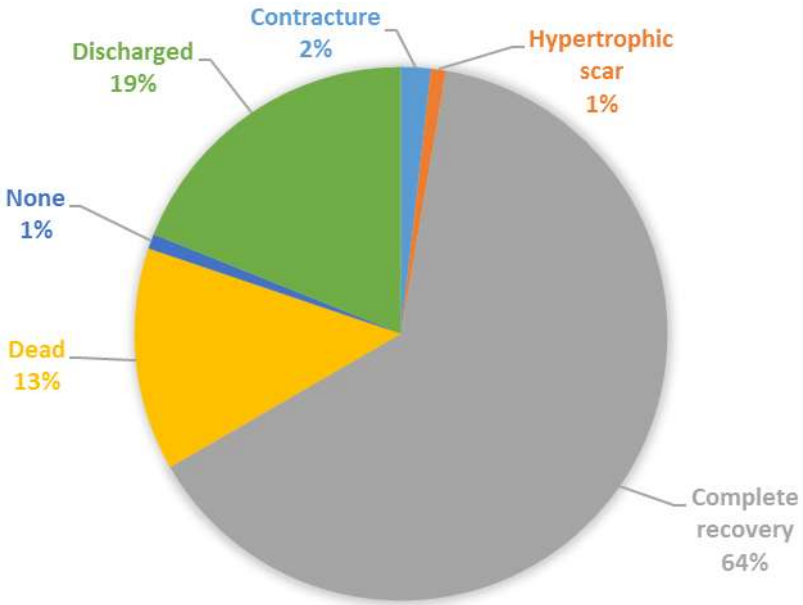

Figure 3: Pie chart showing the distribution of outcome of children who sustained burn injuries

From **table 3** below and **figure 4**; Appropriate treatment contribute to reduction in mortality, as seen here in a logistic regression model adjusted for age, sex, first aid, type of burn, neck involvement, right leg involvement, buttocks involved, extent of burn – the odds of death were reduced by 65% as compared to those who did not receive appropriate treatment i.e., OR 0.35, 95% CI 0.05-2.36, p value 0.28. However, this finding was not statistically significant.
Likewise receiving first aid reduces the odds of mortality by nearly 54% as compared to those who do not receive any form of first aid.

Again, in multivariate logistic regression, patients who had burns involving the buttocks had approximately 5 times higher odds of death than those who did not have burns involving buttocks i.e., OR 5.08, 95% CI 0.65-39.78, p value 0.12. This predictor had shown significance during univariate analysis but potentially this association was lost when we considered other predictors in the adjusted model. Thiss is because the study was not powered to specifically answer this question. However, the strength of association warrants future studies which will be appropriately powered so as to inform better care of children with such types of burns.

Lastly, for each one unit increase in body surface area that sustain burns, the odds of mortality increase by 12%, and this will be true if we repeat this study in the true population this increase will range from 4% up to 20% i.e., OR 1.12, 95% CI 1.04-1.2, p value 0.03.

Table 3: Multivariate analysis table showing different risk factors associated with mortality from burn injury among children admitted at MNH

Characteristics	Univariate analysis			Multivariate analysis		
	Unadjusted OR	**95% CI**	***P value***	**OR**	**95% CI**	***P value***
Age (months[§])	1.01	0.89-1.13	0.918	0.87	0.64-1.18	0.36
Females	0.5	0.16-1.6	0.244	0.26	0.04-1.72	0.16
Appropriate treatment	0.71	0.19-2.51	0.592	0.35	0.05-2.36	0.28
First aid	0.45	0.15-1.32	0.144	0.46	0.07-3.07	0.42
Burn from fire	10.45	2.27-48.05	0.003	9.36	0.86-102.3	0.07
Head involved	1.46	0.5-4.24	0.484	-		
Neck involved	2.82	0.87-9.16	0.084	4.85	0.75-31.2	0.09
Anterior truck involved	1.69	0.56-5.09	0.354	-		
Posterior truck involved	1.32	0.43-4.07	0.624	-		
Right arm involved	1.96	0.68-5.69	0.214	-		
Left arm involved	1.24	0.42-3.65	0.697	-		
Right leg involved	2.53	0.86-7.45	0.092	1.06	0.2-5.49	0.94
Left leg involved	3.19	1.08-9.44	0.036	-		
Buttocks involved	3.51	1.17-10.5	0.025	5.08	0.65-39.78	0.12
Pulse rate per minutes	1.002	0.98-1.03	0.844	-		
Electrolyte imbalance	51.38	2.98-884.72	0.007	-		
Burn extent (TBSA%)	1.15	1.08-1.24	<0.001	1.12	1.04-1.2	0.03

Note: OR, Odds ratio, TBSA, Total body surface area; 95% CI, 95% Confidence interval

[§] Age was modelled with 6 months increment steps i.e., for every 6 months increase in age.

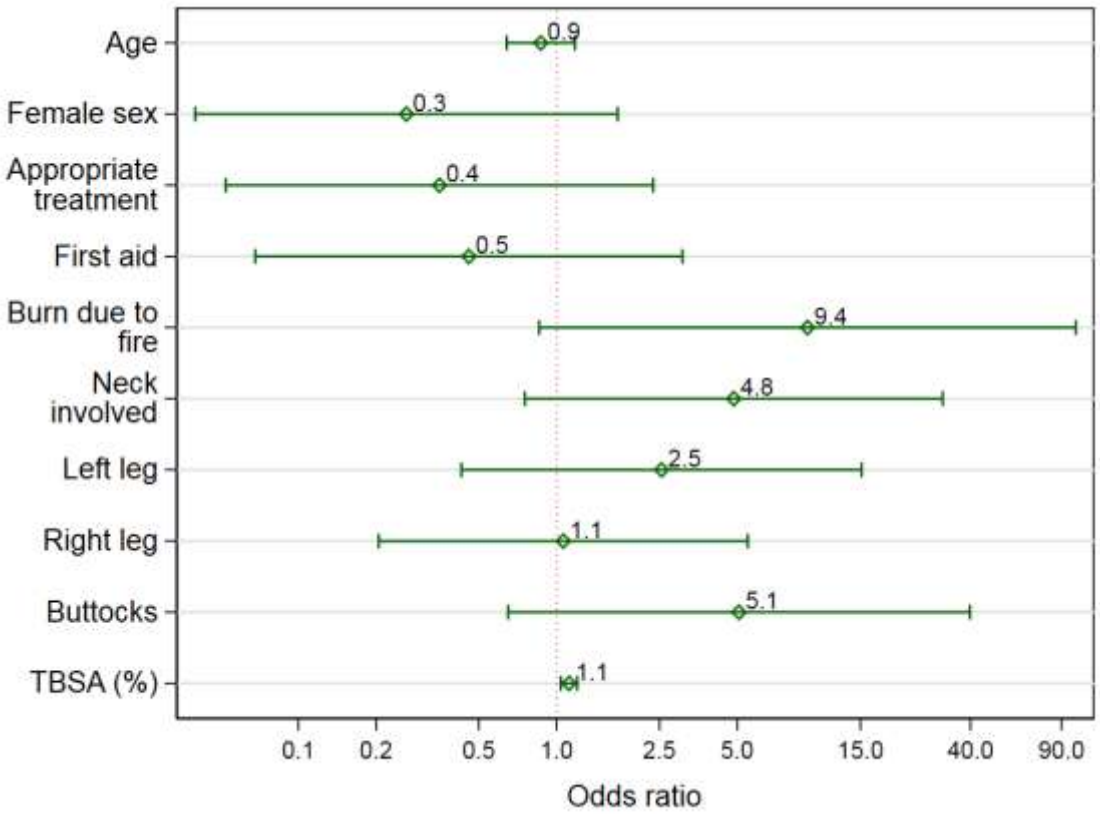

Figure 4: Coefficient plot showing odds ratio and corresponding confidence intervals estimated from a multivariate logistic regression between predictors of mortality from burn injury among children at MNH.

CHAPTER FOUR

4.0 DISCUSSION

We have established the general characteristics of children admitted at MNH who sustained burn injury. Briefly, their median age is around 20 months who are predominantly males (58%) which was similarly seen from a study in Ghana and Tanzania (7,14). Majority of patients do recover fully from their injuries (71%) while unfortunately 9.9% succumb to death due to burn. Most children succumbed to burn from hot liquids 93.7% which was similarly seen in a study in Ghana(5,14).

Most burn injuries occurred in the kitchen especially at the beginning of the day i.e., mornings. It was encouraging to find that nearly two thirds of patients (69.4%) had received first aid prior to reaching MNH by parents/guardians which is known to improve the outcome of burn injury. Few patients had pre-existing conditions (comorbidities) which could have contributed to their burn injuries (4.5%). The mortality rates seen at MNH due to burn was slightly lower than that seen at Bugando Referral Hospital which was 13%(10).

It is known that appropriate treatment is the crucial in improving treatment outcomes of burn injury contributing to complete recovery and averting long lasting sequelae such as contractures etc.,(25). In this study, we found only a third of all patients received appropriate treatment involving antibiotics, intravenous fluids, physiotherapy and high protein diet(25).

We found burn injuries involving buttocks were associated with increased mortality due to burn injury. This is likely because the perineal area is associated increased risk with infection from bacteria resulting into bacteremia(26). Clemens et al., looked retrospectively among soldiers who served in the Iraq and Afghanistan and observed an increased risk of death among soldiers who sustained complete perineal burn injury where the crude risk of mortality was five times (crude hazard ratio 5.3; 95% CI 2.9-9.7). However, their observation lost statistical significance in a multivariate cox regression model similarly as in our study (26). However, in this case, our study was not powered to answer if burns involving buttocks as associated with increased mortality. This is an

interesting observation for future studies where this association can be systematically studied as it could improve care given among children and avert premature mortality due to burn.

Lastly, we found that increased total body surface area is associated with increased mortality. This finding is causal as such increased injury area should and is always associated with mortality. Previous studies elsewhere also showed similar finding in different populations and is very intuitive to be used in health promotion(14,26,27). This alone can be used in health promotion campaign to encourage parents and guardians to protect children from burn injuries and thus the importance of first aid which contributes in reducing the effective total burnt surface area and overall mortality.

This study although had important findings was without its limitation. Firstly, the study was limited due to its design where we could only recruit from a national referral hospital. This could result into overrepresentation of severe burns which are likely to associated with significant complications as the nature of the hospital is a tertiary referral receiving complicated cases. Secondly, we the study was limited in finding long term sequelae of burn due to lack of funds to properly follow patients after discharge. However, we tried to collect outcomes among patients who came for follow up in the outpatient clinics. Lastly, our study could have potential recall bias for variables reported by parents/guardians. However, we tried as much as possible to triangulate the information collected from parents/guardians so as to come to as close as possible to the events leading and after burn injury at home.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In conclusion, we have established the causes and pattern of burn injuries and risk factors associated with mortality. It was observed that burns involving buttocks are associated with higher mortality among children. Our study could show that increased body surface area is associated with increased risk of mortality. This study has set the grounds for future studies which could explore further different risk factors and identify associations of burn injuries among children. Public health specialists could already set health promotion campaigns that target parents, guardians and care health care workers that encourage provision of first aid among children suffering from burn injury as this is likely to lower deaths among children.

5.2 Recommendations

From our study findings, we would like to put several recommendations towards care givers and health care providers or public health at large.

To the care givers, we recommend that they should watch closely children especially when children are around kitchen areas. Also, care givers should keep hot water away from children and keep close observation of children and hot water during preparation of bathing water. Lastly, care givers should learn and provide first aid in case of burn injuries immediately and should visit the nearest health care facility. If these are taken into practice there will be less burn injuries and if they do occur, we expect fewer poor outcomes related to burn injuries.

To the health care providers and public health, we recommend that the health system should be in a position to – and should provide first aid among children with burn injury who reach health facilities. This should be done to all children even those who will need referral to higher levels of health care provision. And lastly, health promotion campaigns should be done in the community on burn injuries to aid in preventing premature mortality which is associated with burn injuries among children.

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APPENDICES

Appendix I: Informed Consent (English Version)

A. INFORMATION

Introduction

Greetings! My name is Dr. Ahmed A. Ahmed from Muhimbili University of Health and Allied Sciences. I invite you to participate in a study on the pattern and management outcome of Pediatric burn injured patient at MNH Tanzania 2018.

I am conducting this study to help to identify the pattern and management outcome among burn injured children

What does your participation mean? If you agree to participate in this study, then I am going to ask you some questions that might take you five minutes to identify pattern, comorbidity and management

What are my benefits and risks by participating? We believe by participating in this study you will provide important information that will help future patients to be identified earlier and hence improve care among burn injured patients. Your participation will increase your awareness and hence develop health seeking behaviour. I do not foresee any risk by you taking part in this study.

Confidentiality: The information that you will provide during the study will be kept confidential. Only the researcher will have access to the questionnaires. Your identity will not appear anywhere.

Right to withdrawal: Your participation in this study is voluntary. You have the right to get out of the study anytime if you change your mind even after you have signed the consent form. You won't lose your health or social rights to which you are entitled even if you decide not participate.

Who to contact: In case you have questions about this study, you should contact the following: **Dr. Ahmed A. Ahmed (Principal Investigator**), department of Surgery, Muhimbili University of Health and Allied Sciences, P.O. Box 65001, Dar es Salaam, mobile phone: 0715990992

In case of questions about your rights as a participant, you may contact Dr. Joyce Masalu, Chairperson of the Senate Research and Publications Committee, Muhimbili University of Health and Allied Sciences, P.O. Box 65001, Dar es Salaam. Tel (022) 2150302-6

B. Certificate Of Consent

I have read the above information (has been read for me). I have asked (had opportunity to ask) questions and have been answered. I have understood the aim of the study. I understand the benefits, risks and my rights to withdrawal from the study. I hereby consent voluntarily to participate in this study.

Signature of participant…….. Date……

Signature of researcher……... Date……

Kiambatanisho: II: Fomu Ya Ridhaa

I. TAARIFA KWA UJUMLA

Utangulizi:

Salamu! Kwa majina naitwa Dr.Ahmed A. Ahmed wa Chuo Kikuu cha Afya na Sayansi shirikishi Muhimbili. Ninakualika kushiriki katika utafiti unaohusu Hali na mazingira pamoja na matokeo ya matibatu ya watoto walioungua katika hospitali yaTaifa ya Muhimbili.

Dhumuni: Kutambua mazingira ya kuungua moto na matokeo ya matibabu.

Ushiriki:
Nitakuulizamaswalimachachekuhusuufahamuwakokatikakutambuahalinamazingirayawatotokuungua.

Faidanahatari: Kwakushirikikwakokatikautafitihuuutasaidiaupatikanajiwataarifamuhimuzitakazowezeshakutengeneza sera nauandaajiwamipangokazikatikamatibabuyawatotowaliounguanakuzuiamadhara zaidi katikajamiinanchinzima. Hakunahatariyoyoteyakiafya au kiuchumiitawezakukutokeakwakushirikikatikautafitihuu.

Usiri: Taarifautakazotoakatikautafitihuunisiri.
Mtafitipekeendiyeatakayewezakuzionataarifahizi.Hatakatikautoajiwataarifa au uchapishajiwataarifazautafitijinalakohalitatajwa sehemu yoyote.

Hakiyakujitoa: Ushirikiwakokatikautafitihuunihiari.
Unahakiyakujitoawakatiwowoteukibadilimawazohatakamaulisainifomuyaidhiniyakushiriki. Hautopotezahakiyakoyoyoteyakiafya au yakijamiihata pale utakapoamuakujitoakushirikikatikautafitihuu.

Kwamawasiliano: Endapoutakuwanaswalilolotelinalohusuutafitihuu,
wasilianawafuatao: Dr. Ahmed A.Ahmed (Mtafitimkuu) idarayaupasuaji, Chuo kikuu cha Afyanasayansishirikishi Muhimbili, S.L.P.65001, Dares Salaam. Simu 0715 990 992

Kwamaswalikuhusuhakizakokamamshiriki, unawezakuwasilianaDr. Bruno Sunguya, Mwenyekitiwakitengo cha utafiti, Chuo cha Afyanasayansishirikishi Muhimbili, P.O.Box 65001, Dar es salaam. Simu: 2150302-6.

Idhini Ya Kushiriki

Nimesoma/nimesomewa taarifa hii kama ilivyoelezwa hapo juu.Nimeuliza (endapo ulipata nafasi ya kuuliza)maswali na nimejibiwa. Nimeelewa dhumuni la utafiti huu.Nimeelewa faida, athari na haki yangu ya kujitoa katika utafiti wakati wowote. Ninakubali kwa hiari yangu kushiriki katika utafit ihuu.

Sahihi ya mshiriki……..Tarehe……...

Sahihi ya mtafiti…… Tarehe……...

Appendix III: Questionnaire English Version

1. Child ID ……
2. Hospital reg. no……..
3. Age …….(yrs) …….. (mouth)
4. Sex: Male /Female…….
5. Residence
6. History of known medical condition: Yes /No …. (specify)

Home information

7. Type of housing.
8. Temporary (mud - walled)
9. Permanent (specify single/ multiple rooms)
10. Number of occupants ……..
11. Is the kitchen separate from the living room? Yes/ No…
12. Is the kitchen protected from reach of children Yes/ No……
13. If yes, how? ……
14. Does the child have a caretaker? ----- Yes/No----------

Caretaker information

15. Age ---------- (yrs) 1.2.2. Sex M/F----------
16. Marital Status ----------
17. What is your highest level of education?
    A. Primary----------
    B. Secondary(ordinary level)
    C. Secondary (advanced level) -------
    D. College/ diploma level
    E. University degree/master degree/Phd----------
    F. None ----------
    G. Are you the breadwinner in the family? Yes/No----------
18. What is your relationship to the patient?
    A. Mother
    B. Father

C. Aunt

D. Other …….

19. Have you ever had any information about preventing the child from burn injury? Yes/No.
20. If yes where? ----------
21. Was it enough? ----------

Circumstances of injury

22. Where did the burn occur? (State exact place e.g. kitchen etc) ----------
23. When did the injury occur? (State time) ----------
24. Was the caretaker present when the injury occurred?
25. At event of burn, what was the child doing? ……..
26. Did you administer any first aid to the child? ----- Yes/ No……..
27. If yes, mention what type of first aid ……
28. Does the child have premorbid condition yes/no……
29. If yes mention…….
30. How did you transport the injured child to the hospital?
31. Walking
32. Bicycle
33. Motorbike
34. Tricycle bike
35. Motor vehicle
36. Others ----------

Pattern of burn injury

37. What caused the burn injury?
    A. Hot liquid ----------
    B. Fire ----------
    C. Chemical ----------

D. Electricity ----------
E. Other (specify) ……

38. Region of the body burnt-------
39. What is the extent of the burn injury? (Indicate depth and estimated TBSA)---------
40. Is there evidence of burn wound infection? -----Yes/ No---------- (check the wound and record from file).
41. Duration of time before going to hospital ----------
42. Duration of time before coming to MNH? …….

Management of patient

43. Was the IV fluid given to the child? (Yes/ No)
44. Was fluid given at (nearby hospital/MNH?)
45. If fluid given, how much, type and for how long. (From patient file) ----------
46. Any complications while on / after IV fluid. (From patient file) specify ----------
47. Surgical procedures done (tick all applicable)
    A. Amputation
    B. Escharotomy
    C. Faschiotomy
    D. Debridement
    E. Skin grafting
    F. Other (specify)
48. Other management given to the child. Specify ----------
49. Management outcome
50. Hemodynamic status on admission
    51. BP …….
    52. PR …….
53. Level of consciousness ……
54. Did the child developed electrolytes imbalance while in the hospital? Yes/ No (from record)
    A. Potassium ……
    B. Sodium ……

C. Chloride ……..

D. If yes specify ----------

55. Did the child developed infection? Yes/ No
56. WBC count ……
57. Fever……
58. Wound discharge……..
59. Culture results if done (wound/blood)……..
60. Condition of child at discharge
    A. Contracture
    B. Hypertrophic scar
    C. Completely recovered
    D. Dead
    E. Length of hospital stay ----------(days)

Appendix IV: Chart For Estimating Severity Of Burn Wound

MINSTRY OF HEALTH - TANZANIA
MUHIMBILI NATIONAL HOSPITAL
P.O. BOX 65000
DAR ES SALAAM
PHONE: 2151367/9 2151351/2

CHART ROR ESTMATING SEVERITY OF BURN WOUND

Hospital Reg. Number:.....

Surname.....
(In capital)

Other names.....

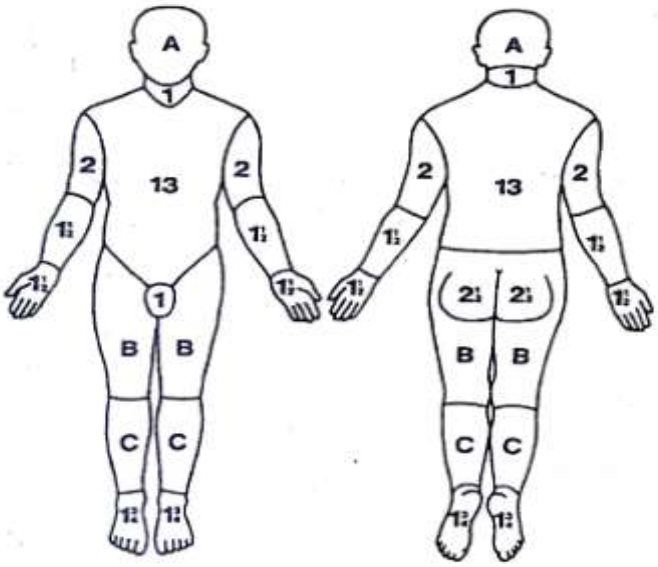
Postal / residential address .....

Date of birth ..... Sex.....

Religion ..... Clinic/Ward

Next of kin name and address

Hypersensitivity special observation



Partial thickness loss (PTL) - SUPERFIGAL

Full thickness loss (FTL) - DEEP

REGION	% PTL	% FTL
HEAD		
NECK		
ANT. TRUNK		
POST. TRUNK		
RIGHT ARM		
LEFT ARM		
BUTTOCKS		
GENITALIA		
RIGHT LEG		
LEFT LEG		
TOTAL BURN		

RELATIVE PERCENTAGE OF BODY SURFACE AREA AFFECTED BY GROWTH

AREA	AGE 0	1	5	10	15	ADULT
A = ½ OF HEAD	9½	8½	6½	5½	4½	3½
B = ½ OF ONE THIGH	2¾	3¼	4	4½	4½	4¾
C = ½ OF ONE LEG	2½	2½	2¾	3	3¼	3½

Kiambatanisho V: Dodoso ;Kiswahili

1. Kifupi cha majina ya mtoto ……
2. Namba ya faili ya hospitali……..
3. Umri …….(miaka) …….. (miezi)
4. Jinsi: ME /KE…….
5. Makazi…….
6. Historia ya magonjwa mengine Ndiyo /Hapana …. (Fafanua)

Taarifa za nyumbani

7. Una aina gani ya Makazi?
8. Ya mda mfupi? (ukuta wa matope)
9. Ya mda kudumu? (chumba kimoja/ vyumba vingi)
10. Idadi ya watu wanaoishi ndani ……..
11. Jiko limetenganishwa na vyumba vya kupumzikia? Ndiyo / Hapana …
12. Jiko lipo mbali na watoto kufika kirahisi? Ndiyo / Hapana ……
13. Kama ndiyo,elezea? ……
14. Mtoto ana mtu wa kumtunza? ----- Ndiyo /Hapana----------

Mtunza watoto

15. Umri ---------- (miaka) 1.2.2. Jinsi Me/Ke ----------
16. Hali ya ndoa ----------
17. Una kiwango gani cha elimu?
    A. Shule ya msingi----------
    B. Elimu ya sekondari(kidato cha nne)
    C. Elimu ya sekondari(kidato cha sita)/chuo ngazi ya cheti-------
    D. Chuo ngazi ya shahada
    E. Chuo kikuu(shahada/uzamili/uzamivu)----------
    F. Sikuwahi kwenda shule ----------
18. Una uhusiano gani na mgonjwa?
    A. Mama
    B. Baba

C. Shangazi
D. Wengine …….

19. Una ufahamu wowote kuhusu Habari yeyote jinsi ya kuzuia ajari za moto kwa watoto? Ndiyo /Hapana .
20. Kama ndiyo,wapi? ----------
21. Ufahamu ulijitosheleza? ----------

Namna ya kuungua

22. Ajari ya moto ilitokea wap?((taja Sehemu husika ,mfano.jikoni) ----------
23. Mda gani ajari ilitokea? (mda) ----------
24. Mtunza/msaidizi wa watoto alikuwepo wakati wa ajari inatokea?, mtoto alikuwa anafanya nn? ……..
25. Mtoto alipewa huduma ya kwanza? ----- Ndiyo /Hapana ……..
26. Kama ndiyo,elezea aina gani ya huduma ya kwanza. ……
27. Mtoto ana ugonjwa/kilema kingine kabla ya kuungua? Ndiyo/Hapana……
28. Kama ndiyo,taja…….
29. Mtoto aliyeungua kwa ajari ya moto alitumia usafiri gani kufika hospitali?
30. Kutembea
31. Baiskeli
32. Pikipiki
33. Bajaji
34. Gari
35. Vingine ----------

Aina ya ajari ya kuungu moto

36. Kipi kilisababisha ajari ya moto?
    A. Maji ya moto ----------
    B. Moto ----------
    C. kemikali ----------
    D. Umeme ----------

E. Aina nyingine (Taja)……

37. Sehemu gani ya mwili iliyoungua?-------
38. Jeraha la moto lilikuwa na ukubwa gani? (taja kima na ukubwa wa jeraha la moto?)-------
39. Kuna udhibitisho wa maambukizi kwenye kidonda?-----Ndiyo/Hapana---------- (Angalia kidonda na andika kwenye faili).
40. Ulitumia Mda gani kabla ya kwenda hospitali baada ya kuungua? ----------
41. Mda gani umepita kabla ya kuja hospitali ya Taifa ya Muhimbili baada ya kuungua? …….

Matibabu ya mgonjwa

42. Je mgonjwa alipewa maji ya dripu ?.....(Ndiyo/Hapana)
43. Maji ya dripu alipewa karibu wapi?Maji ya dripu alipewa (karibu na hospitali/MHN) alipewa maji ya dripu ni kiasi gani?(Angalia faili la mgonjwa---------- ----------
44. Kuna matatizo yeyote wakati/baada ya kupewa maji ya dripu?(taja) ----------
45. Matibabu gani ya upasuaji yaliyofanyika?(weka alama ya vema panapohusika)
    A. Kukatwa kiungo
    B. Kuondoa kovu
    C. Kukata sindromu ya Sehemu husika
    D. Kusafisha kidonda
    E. Kupandikiza nyama
    F. Mengineyo
46. Matibabu gani mengine alipewa mtoto?Taja? ----------
47. Matokeo ya matibabu
48. Hali ya mgonjwa wakati wa kulazwa
    49. Shinikizo la damu …….
    50. Mapigo ya moyo…….
51. Hali ya ufahamu ……
52. Je mtoto alipata upungufu wa madini mwilini wakati akiwa hospitali?ndiyo/Hapana (angalia kumbukumbu za faili)

A. Potasiamu ……
B. Sodiamu ……
C. Kloraidi ……..
D. Mengineyo taja ----------

53. Je mtoto alipata maambukizi?ndiyo/Hapana
54. Chembe hai nyeupe za damu ……
55. Homa……
56. Kidonda kinatoa uchafu/maji……..
57. Kupandikiza wadudu kutoka kwenye kidonda……
58. Hali ya mtoto baada ya kuruhusiwa
    A. Ulemavu wa kushindwa kunyoosha viungio
    B. Kovu kubwa
    C. Alipona vizuri
    D. Alifariki
    E. Alikaa mda gani hospitali? ----------(siku)

Kiambatanisho VI: Chati Ya Kujua Ukubwa Wa Jeraha La Kuungua Moto

MINSTRY OF HEALTH - TANZANIA
MUHIMBILI NATIONAL HOSPITAL
P.O. BOX 65000
DAR ES SALAAM
PHONE: 2151360/9 2151351/2

CHART ROR ESTMATING SEVERITY OF BURN WOUND

Hospital Reg. Number:.....

Surname.....
(In capital)

Other names.....

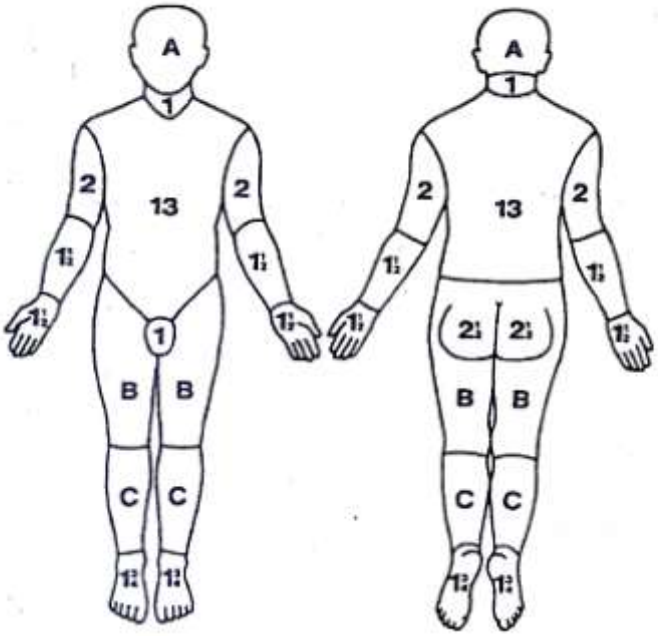
Postal / residential address .....

Date of birth ..... Sex .....

Religion ..... Clinic/Ward

Next of kin name and address

Hypersensitivity special observation



Partial thickness loss (PTL) - SUPERFIGAL

Full thickness loss (FTL) - DEEP

	%	
REGION	PTL	FTL
HEAD		
NECK		
ANT. TRUNK		
POST. TRUNK		
RIGHT ARM		
LEFT ARM		
BUTTOCKS		
GENITALIA		
RIGHT LEG		
LEFT LEG		
TOTAL BURN		

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