

## Original Article

# Prehospital treatment of burns in Tanzania: a mini-meta-analysis

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**Abstract:** The present study describes initial burn injury care in Tanzania-materials applied, sources of information, reasons for applying the materials, and time to a health centre-in order to suggest ways to optimize initial care. Eight small studies were conducted in which burn-injured patients were interviewed who had been admitted to referral hospitals in four regions in Tanzania. Most burn injuries in Tanzania occur in the home cooking area, and it was found that the first responders were family members, friends, and neighbours. A total of 710 burn victims were interviewed. Twenty-four different materials were applied to the patients' wounds. The most common application was honey. Only 14.3% of the victims received the recommended form of care: application of cool water. It was also found that nothing was applied to the wounds of 17.5% of these patients by first responders. Sources of information on burn treatment were family, friends and neighbours, and, less often, health workers or the media. Most of the burn victims' households had enough water to enable administration of recommended initial care. The main impediment to the provision of appropriate initial treatment of a burn appears to be lack of correct and useful knowledge about what to do immediately after the injury. A two-pronged educational approach should be used to improve care. A national mass media campaign should start immediately to inform ordinary citizens about proper initial treatment of burns. In addition, curricula of all schools that train health workers need to be reviewed for accuracy, and appropriate knowledge about initial care of burn victims should be added if necessary. Measures to improve burn first aid, are relatively easy, even in a low-income country such as Tanzania.

**Keywords:** Prehospital care, Africa, Tanzania, burn injuries, first aid, community education, health worker curriculum

## Introduction

Burn injury is common in low- and middle-income countries, particularly those of Africa, where its incidence is disproportionately high [1, 2]. Severe burn injury can have profound and prolonged consequences for the victim [3] and the family. The sequelae of such injuries all too often include hypermetabolic and inflammatory responses, disfiguration, disability and death.

Children are the most common victims of burn injury. In a community-based study conducted in Dar es Salaam, Tanzania, it was found that burns made up 16.3% of reported injuries; the

1-month prevalence was calculated as 1.73% overall, and 3.05% in children ages 0-4 years [4]. In Tanzania, most burns are suffered by toddlers, who are scalded in the home kitchen or cooking area [4, 5].

Quality of initial care has an impact on injury outcomes [6, 7]. Application of any substance that could delay healing can lead to increased harmful sequelae. For example, Delays of more than 14 days in the onset of healing increase the likelihood of hypertrophic scarring [8].

Initial care for a burn wound involves removing the source of heat and running water with a temperature 10-15 degrees C on the burn

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wound for at least 10 minutes [9, 10]; 30 minutes has also been recommended [7, 11, 12]. The benefits of cold water as a first-aid treatment for burn injuries include decreased mortality, pain relief, decreased cell damage, reduction of skin temperature to below dangerous levels, greater likelihood of cell survival because of decreased cell metabolism in hypoxic tissue, stabilization of vasculature, reduced edema, better wound healing and scar formation, and decreased inflammatory response [13].

Appropriate prehospital care is simple, so it is likely that even laypeople can implement best practices. In spite of the importance of this health-care need, limited data exist on the initial care received by burn-injured patients in Tanzania. In an initial study, Justin-Temu et al. found that a variety of substances were applied to burns, from water and honey to dung and kerosene [14]. Ringo and Chilonga concluded that inappropriate management of burn wounds started just after injury and continued even in hospital [15].

The main research gaps concerning initial care for burn patients in Tanzania relate to (a) the actual initial care given to burn victims, (b) caregivers' sources of information, (c) reasons for applying (or not applying) particular materials, and (d) the amount of time that elapses before victims arrive at a health-care centre. Information that will fill these four research gaps should be sufficient to develop communication for interventions that will enable burn victims to receive appropriate and immediate initial treatment. Therefore, the aim of the present article is to describe the initial care being given to burn victims in Tanzania, in order to propose a way forward.

### Method

#### *Study design*

The study design is a simple mini-meta-analysis comparing and combining eight similar descriptive, cross-sectional, hospital-based quantitative studies with the same research aim: to describe prehospital care of burn-injured patients. The eight studies' methods are similar, and the goal of the present article is to summarize the studies.

An important advantage of the mini-meta-analysis is the quantity of data that can be analysed. A large sample clarifies results. A sufficiently large volume of data with relatively lower per datum information content can contain more information for addressing broad-scale problems than a small amount of higher-quality data [16].

#### *Site*

The study site was the United Republic of Tanzania, a nation on the east coast of Africa. The population of Tanzania was estimated in 2015 to be about 50 million people, making it the sixth most populous country in Africa [17]. Their median age is 18 years, which is average for Africa, but low for the rest of the world. Approximately 30% of the population lives in urban areas. Tanzania is representative of many other low-income African countries; the healthworker: population ratio is low; most citizens are poorly educated and many of them live in rural areas with large families.

#### *Settings*

Tanzania has a health-care infrastructure that includes 25 referral hospitals strategically placed throughout the country. Minor burn injuries are treated at home. Other burn injuries are treated at ward- or district-level health centres. Patients with burn wounds covering more than 5%-10% of their body area will be sent to regional or the national referral hospitals. (These data were collected at regional and the national referral hospitals).

#### *Population*

The study population consisted of people hospitalized in referral hospitals in Tanzania due to burn injury.

#### *Sampling procedure*

All victims at a specific site were interviewed until the calculated sample size or the 2-month window for collecting data was reached.

#### *Data collection*

Face-to-face interviews were conducted in all studies. Burn victims, or their caregivers in the case of children, were interviewed at their hospital bedsides.

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**Table 1.** Characteristics of the data sets ( $N = 710$ )

Author (year of data collection)	Age group (years)	Site	$n$
Justin-Temu et al. (2006)*	< 5	Dar es Salaam	204
Melkior (2014)	< 5	Dar es Salaam	96
Mtavangu (2015)	< 5	Dar es Salaam	96
Nyamle (2016)	< 5	Dar es Salaam	61
Lusajo (2015)	< 5	Mbeya	83
Lekule (2011)	< 10	Moshi	47
Ismail (2010)	> 18	Dar es Salaam	27
Thobias (2017)	All ages	Mwanza	96

\*Previously published data.

Data were collected by students pursuing Bachelor and Master degrees at Muhimbili University of Health and Allied Sciences (MUHAS), in Dar es Salaam, Tanzania. In 2006, one undergraduate pharmacy student collected data on initial care of burns [14]. From 2010 to 2017, six undergraduate students in the MUHAS School of Nursing and one Master degree student (Lekule, 2011) collected data on prehospital treatment of burns. These eight students were participating in a research course that used a competency-based education approach [18]. The first and last authors supervised all students who participated in data collection.

### *Data collection instruments*

The survey instrument was adapted from the first study of prehospital care of burn patients ever conducted in Tanzania [14]. The original instrument included questions about materials applied to the wound, sources of information, causes, motives and site of injury. Several care-related items were added, such as description of the caregiver at the time of the accident, reasons for applying the materials, availability of water, and time until arrival at the hospital.

Both closed- and open-ended questions were used. The latter included questions about materials applied and reasons for applying them.

As prescribed by Ledley, Taber, Lynds, Domenico and Dahlman [19], the survey instrument was fine-tuned each time it was used, based on insights gathered from previously collected data and the expanding body of peer-reviewed literature. The refinements were made to increase the robustness of the questionnaire

and, by adding items, make it more comprehensive. The question about the materials that were applied was asked of all 710 respondents. As the data began to reveal great variation in materials applied, the question about information sources was added; it was answered by 511 respondents. When the definition of initial care was expanded to include “the event, to arrival at a health care centre”, a question about

that length of time was added ( $n = 396$ ). In order to design an intervention, we wanted to devise a question about the reasoning behind people's choice of materials to apply to the burn; 129 respondents answered this question. Finally, the availability of cool safe water, in order to meet World Health Organization guidelines for initial care of burn injuries, became an important concern, so three questions were added that were used by the two researchers and were answered by 110 respondents.

### *Data analysis*

The studies were all descriptive. Each data set was unique. The responses to the open-ended questions were converted to quantitative data for analysis. Data on initial care providers, materials applied, reasons they were applied, sources of information, and time to hospital were extracted from the eight data sets and input into matrices.

The data sets were merged and set into proportion and frequency tables and figures. Statistical significance was considered at  $P \leq .05$ . Analyses were conducted with Statistical Package for Social Sciences (SPSS) software.

### *Ethics*

Each study received ethical clearance from the MUHAS Directorate of Research and Publications. Permission to enter the settings was granted by the government district or regional medical officer and the institution from which data were collected. Each respondent or his or her caregiver granted informed written consent before being interviewed. Data were kept anonymous.

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**Table 2.** Materials most frequently used for initial care of burn injuries in Tanzania (N = 710)

Material	Site (study)								n	%
	DSM (Justin-Temu et al. 2006) (n = 204)	DSM (Nyamle 2016) (n = 61)	DSM (Mtavan-gu 2016) (n = 96)	DSM (Melkior 2014) (n = 96)	Mbeya (Lusajo 2015) (n = 83)	Moshi (Lekule 2011) (n = 47)	DSM (Ismail 2010) (n = 27)	Mwanza (Thobias 2017) (n = 96)		
Honey	67	28	47	32	41	10	11	34	270	37.8
Nothing	26	8	23	24	13	5	11	15	125	17.5
Water	34	14	12	14	9	8	0	11	102	14.3
Raw egg	17	1	7	19	7	10	4	6	71	9.9
Sugar	20	5	2	0	0	0	0	1	28	3.9
Vaseline	6	0	0	0	0	4	0	6	16	2.2
Cooking oil	7	0	0	0	0	0	1	6	14	2
Burn cream	11	0	0	0	0	0	0	2	13	1.8
Mud	2	1	0	0	0	3	0	3	9	1.3
Other	14	4	5	7	13	7	0	12	62	8.9

Notes: DSM, Dar es Salaam. Percentages in some instances do not total 100.0 because of rounding.

### Results

#### Description of data sets

Eight studies were included, as shown in **Table 1**. The data were skewed by age and geography; the 0-4 years age group and the site of Dar es Salaam (DSM) were over-represented. Of the 710 respondents, 484 (68.2%) were in Tanzania's most populated region, DSM. Other sites were the regions of Mbeya in the southern highlands, Moshi in the north around Mt. Kilimanjaro, and Mwanza in the northwest on Lake Victoria. Most data were for children ages 1-4 years; only 42 (5.9%) of the respondents were older than 18 years.

#### Initial care providers

Initial care was provided by people who were nearby at the time of the injury: family members, house servants, friends, and neighbours. The fourth author of the present article, Nyamle (2016), found that among 61 first responders, a large majority, 53 (86.9%), were parents; 5 (8.2%) were siblings and 3 (4.9%) were caretakers.

The second author, Thobias (2017), also found that first responders were most likely to be parents (n = 59; 61%). Other initial care providers were neighbors/friends (n = 20; 21%) and house servants (n = 15; 16%). Teachers were initial care providers when a burn injury

occurred at school; this was the case in 2 instances (2%).

#### Materials applied

Nothing was applied to 17.6% of the injuries (125 of 710). Twenty-four different materials were reported to have been applied to the other injuries (see **Table 2**).

Among all sites, eight materials were applied at least 1% of the time, the most commonly used being honey (applied to 38% of victims). The second most commonly applied material was water (14%), the recommended form of care; a gap in the data leaves unknown the number of cases that received the recommended 10 minutes of exposure. Other materials, applied less than 1% of the time, were fur, tomato, maize flour, flour, toothpaste, kerosene, dung, charcoal, urine, cow's milk, coconut oil, salt, lotion, glycerine, local herbs and perfume.

At least 6% of victims had multiple materials applied. Honey was reported to have been applied before or after eggs, water, milk, mud, flour, or kerosene. There was one use of flour and perfume, and another of sugar and egg.

A significant difference between materials used in DSM and those used in other places was not found for applying nothing (P = .15), honey (P = .88), water (P = .31), raw eggs (P = .9),

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**Table 3.** Time from a burn injury to arrival at a health-care facility (N = 396)

Research	Age group (years)	Location	< 2 hours % (n)	< 24 hours % (n)	> 24 hours % (n)
Nyamle (2016)	< 5	DSM	NA	95 (58)	5 (3)
Shirima (2014)	< 5	DSM	NA	93 (89)	7 (7)
Mtavangu (2015)	< 5	DSM	98 (94)	100 (96)	0
Lekule (2011)	< 10	Moshi	NA	100 (47)	0
Thobias (2017)	All ages	Mwanza	57 (55)	100 (96)	0
Total				(386) <sup>a</sup>	(10)

Note: NA, not asked. <sup>a</sup>The total of 386 includes the 149 burn victims who were treated within 2 hours or less.

cooking oil ( $P = .38$ ), or burn cream ( $P = .2$ ). Significance was found only for the use of sugar, which was more common in DSM ( $P = .0009$ ), and Vaseline, which was more commonly used in non-DSM locations ( $P = .01$ ).

### Availability of water

Two of the eight studies examined the availability of clean water. In her study of burn victims in DSM ( $N = 61$ ), Nyamle (2016) found that of the 14 adults who had water applied to their wound, 11 received water from improved sources such as taps (10) or rainwater (1); 3 were treated with unboiled water from unimproved sources: a well (2) and a river (1). In his study in Mwanza ( $N = 96$ ), Thobias (2017) found that 90% of respondents had access to tap water in their own or nearby houses, an additional 8% used well water, and 2% retrieved water from Lake Victoria. The tap water, which was also drawn from Lake Victoria, was centrally treated under Mwanza Urban Water and Sanitation Authority. All households in Mwanza stored water in amounts ranging from 20 to 500 litres. The association between the amount of water kept at home and the use of water for first aid was not significant ( $P = .053$ ) in Mwanza.

### Reasons materials were applied

Materials were applied as first aid for various reasons. Most people applied materials to the wound to relieve pain, cool the burn, and prevent blistering. Other reasons were to cover, clean and treat the wound, and to prevent infection.

The substance that respondents were most likely to use to relieve pain was honey; less

often, cool water, raw eggs, cooking oil and mud were used. Cool water, honey and eggs were used to cool the burn and prevent heat from penetrating into the body. Materials used to cover the wound were sugar, Vaseline, mud and flour. Honey, kerosene and Vaseline were believed to prevent infection.

### Sources of information

By far, the main sources of information (68% of cases) about what to apply to a fresh burn wound were people nearby: family members, neighbours and friends. Less common sources of information were media or seminars (14%), health-care workers (11%), school or books (3%) and observation (1%). Two percent cited other sources. Traditional healers were not reported as a source of information about burn care.

### Time to the hospital

Most burn injuries were treated as emergencies, and victims arrived at health facilities quickly (see **Table 3**). Most were brought on motorcycles; others arrived by foot, private car, taxi, public bus, police car, or *bajaj* (three-wheeled motorcycle).

Of the 192 respondents who were asked if they arrived at the health center within two hours, 149, about 78% reported they had. Almost 98% reported reaching a health centre within 24 hours.

In summary, these data indicate that caregivers of burn victims in Tanzania reacted urgently, but in confusion. They applied a broad variety of materials to the wound, depending on what was available and on the immediate advice of those nearby: relatives and neighbours. The advice was often inappropriate. Most households had resources available to give recommended initial care. Explanations for why particular materials were applied were in concordance with professional concerns to cool the burn, decrease pain, and keep the wound uninfected. Almost without exception, victims were brought to the health centre quickly. The main deficiency in initial burn care

appears to have been a lack of useful knowledge about what to do immediately after an injury.

### Discussion

#### *Initial care providers*

The finding that the first responders to a burn injury were the persons nearest the victim, usually the caregiver, confirms what other studies in Tanzania have found [4, 20].

#### *Materials applied*

A wide variety of materials were applied to the burn wound; a similar finding has been made in African countries other than Tanzania, such as Ghana [21] and South Africa [22, 23]. Ringo and Chilonga [15] found that in the Tanzanian region of Moshi, applying honey was the most common form of prehospital first aid. Using qualitative methods in Moshi and Arusha, Tanzania, van Braekel [20] found that more than one substance was commonly applied, for example, honey and raw egg, honey and water, water and salt, or baby oil and mud. This occurred when a caregiver applied a substance, and, after being given different advice, added a second substance atop the first.

Some materials, such as salt and kerosene, increase the pain of a burn tremendously. Applying mud and dung increases tetanus risk. Other materials can contribute to septicaemia, which is the most common cause of burn injury mortality in many places, including the Kilimanjaro region of Tanzania, where, incidentally, many of the cases in the present study were found [15], Zimbabwe [24], South Africa [25], and Nigeria [26]. Even in an advanced care centre in the state of Texas, in the United States, sepsis accounted for 35% of deaths from 1989 to 1999; this proportion increased to 54% from 1999 to 2009, with a significant increase in the proportion due to antibiotic resistant organisms [27]. In the Tanzanian region of Mwanza, the rate of burn wound infection was 32.4% on admission and 39.8% on the 10th day after the injury, indicating that many victims arrived at the hospital with wounds that were already infected [6].

Data from the MUHAS studies indicate that few, if any, of the burn victims received minimally

appropriate care. Likewise, in South Africa, it was found that of 90 patients who were admitted with severe burns, one quarter had received some cooling of their burns, but none had received sufficient cooling [12]. In a study of 353 children with burn injuries in Cape Town, South Africa, Cox et al. [23] found that 47% had been treated with water. Of those treated with water, only one third received the recommended treatment of more than 10 minutes of exposure, and only about 16% received adequate initial care. In Mwanza, Chalya et al. found that 6.4% of the patients in their study had received appropriate prehospital care [6].

#### *Water availability*

Ninety-five per cent of households in Tanzania use wood or charcoal for cooking at ground level [28]. Most burn injuries occur in the cooking area [5], a finding that implies that water for cooking and cleaning is also close by. The data from DSM and Mwanza used in the present study suggest that most families had adequate stored clean water to cool a burn injury. However, this may not be indicative of the whole country, since only 37% of the population have access to water being piped into a dwelling, or from a public tap or stand pipe [29].

#### *Reasons for applying particular materials*

The top priorities from the caregivers' point of view were to cool the wound and to decrease pain. Because these objectives are the same as those provided in treatment recommendations from medical professionals (e.g., [10, 13]), they can be used as the basis for public health messages about burn care.

#### *Sources of information*

The data revealed that few caregivers had adequate knowledge about prehospital care for burn treatment. Evidently, few respondents had received information about burn care from health workers. Yet in Tanzania, health-care workers are usually reported to be important sources of information [30]. Unfortunately, in the Kilimanjaro and Arusha regions of Tanzania, van Braekel found that even the advice of health-care workers in regard to burn injury was potentially harmful [20]. For example, some health-care workers were advising people to apply egg yolk to burns, and at one small hospi-

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tal, health-care workers routinely dipped their burn patients in saltwater baths.

Lack of knowledge about appropriate first aid for burns is not unique to Tanzania. In Ghana, a community-based study of 200 caregivers found that when all initial treatment of all injuries was considered, burns were associated with the highest percentage (61%) of potentially harmful practices [21]. A prospective audit study in Perth, Australia, showed that of all new patients with burns admitted to care at the minor burn facility at Royal Perth Hospital ( $N = 227$ ), only 39% received appropriate first aid [7]. Half of the patients at Royal Perth who were given inappropriate first aid received it from their primary health-care contact.

### *Transport and time to the hospital*

The data collected for the present study show that 97.5% of burn victims reached the health-care centre within 24 hours. This is faster than was found in other studies conducted in Tanzania. In Kilimanjaro region, only 41.5% of burn victims reported reaching the referral hospital in 24 hours [15]. In the region of Mwanza, it was found that 89.8% of the burn victims arrived at the referral hospital after 24 hours [6]. In KwaZulu-Natal Province, South Africa, it was found that the median time it took for local residents to reach the specialized burns unit was 6 hours, but median referral delay from a district hospital was 6 days [22]. These data suggest that if victims arrive at a lesser health-care centre and need to be referred to the larger hospital, there is a potentially long delay.

### *Data collection*

The data sets appear reliable. For example, burn victims had a similarly wide variety of materials applied to their wounds, with honey being the most common in each data set. That the data sets were collected in diverse areas from referral hospitals with a catchment area of at least 20,000,000 people and yet show such consistency, gives strength to the generalizability of the results to other places in Tanzania. The results describe a reliable picture of prehospital care for burn victims.

### *Limitations*

The eight studies that provided the research for the present study were all hospital based, so information on people who did not come to the

hospital was not captured. An unknown proportion of burn sufferers may have been attended by traditional healers.

Gaps in detailed knowledge of prehospital care of burn injuries remain in regard to the use of water. Water was sometimes applied, but it is not clear for how long. Access to clean water was only assessed at two sites. No water was tested for contaminants.

Even with such limitations, the gap in Tanzania between what is known professionally and what is practiced by laypeople is clear, and leads to the conclusion that almost all first responders to a burn injury in the present study did not know what to do, although appropriate initial care was within the reach of most households.

### *Recommendations*

It has been suggested that the presence of just a few trained responders in the community might benefit many families [21]. But trained responders often may not be available when an emergency happens.

Rather, we recommend a two-pronged educational approach. One part would consist of a national mass media campaign to inform family members and neighbours about proper initial treatment for burns; this would be most efficient in combination with information about how to prevent burn injury. An important benefit of this campaign would be that, if properly executed, it would bring quick results in the form of better-informed initial burn care by family members and other non-clinicians. The second part of this approach would yield results over the longer term: a review of the curriculum at all schools training all cadres of health-care workers for accuracy and efficacy in regard to initial care of burn victims. On-the-job training about burn first aid for health-care workers has already been shown to be effective [7].

Implementing the two-pronged approach, we have recommended here, can provide a relatively easy means of improving burn first aid, particularly in low-income countries such as Tanzania.

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None.

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