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## The Epidemiology, Management, Outcomes and Areas for Improvement of Burn Care in Central Malawi: an Observational Study

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### Abstract

This report describes the epidemiology of burn injuries and quantifies the appropriateness of use of available interventions at Kamuzu Central Hospital, Malawi, between July 2008 and June 2009 (370 burn patients). Burns accounted for 4.4% of all injuries and 25.9% of all burns presenting to the hospital were admitted. Most patients (67.6%) were < 15 years old and 56.2% were male. The most frequent cause was scalding (51.4%). Burns occurred most frequently in the cool, dry season and in the evening. The mean burn surface area (second/third degree) was 14.1% and most burns (74%) presented within 8 h. The commonest procedure was debridement and/or amputation. The mean hospital stay was 21.1 days, in-hospital mortality was 27% and wound infection rate was 31%. Available interventions (intravenous fluids, nutrition therapy, physiotherapy) were misapplied in 59% of cases. It is concluded that primary prevention should address paediatric and scald burns, and secondary prevention should train providers to use available interventions appropriately.

### Keywords

Burns; Africa south of the Sahara; Malawi; Wounds and injuries; Cross-sectional studies; Retrospective studies

### Introduction

Burn injuries contribute significantly to morbidity and mortality in developing countries. In the African region, burns are a significant cause of death and disproportionately affect those < 15 years of age.<sup>1</sup> Burn care is a significant financial burden on both the hospital and the patients' families.<sup>2</sup> Outcomes are made worse by a lack of resources, which contributes to unacceptably high levels of complications, such as wound infection, contractures and death.<sup>3,4</sup>

Despite the burden of burn injury, there are limited data on the status of burn care and the current need to improve delivery of care.<sup>5</sup> The status of burn care at Kamuzu Central

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Conflicts of interest

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Hospital (KCH) in Lilongwe, Malawi, is similar to that of burn care in other parts of sub-Saharan Africa; burns contribute significantly to morbidity and mortality, yet data on burn mechanisms, patient demographics, treatment modalities and outcomes are insufficient.<sup>6</sup>

Kamuzu Central Hospital is a 1000-bed tertiary care centre located in Lilongwe, the capital of Malawi, and it serves approximately 5 million persons living in the central region of the country. Despite its status as the principal tertiary referral centre conditions are similar to those at other nearby tertiary centres, which lack basic supplies and operative resources, and outcomes are consequently poor. A recent study from another strikingly under-resourced hospital, St Francis Hospital in Lusaka, Zambia, demonstrated improvement in burn care, particularly regarding the documentation of burn size and the administration of analgesics, after periodic visits from burns teams.<sup>7</sup> A similar effort to improve burn care at Queen Elizabeth Central Hospital in the southern region of Malawi included improvements to infrastructure, training of nursing and physician staff members, and education of patients and caregivers.<sup>8</sup> These approaches were successful at both institutions but, before implementing efforts to improve care in a new setting, a needs assessment should be conducted.<sup>9,10</sup> Such an assessment reveals particular areas in need of improvement, defines goals for interventions and identifies appropriate metrics necessary for programme evaluation.

The aims of this study were to describe the epidemiology and burden of burn injuries, to quantify treatment and outcome measures, including physiotherapy, wound infection and mortality levels, and to determine strategies for improving burn care in a sustainable and quantifiable way in this resource-constrained setting.

## Patients and methods

### PATIENTS AND STUDY DESIGN

This was a retrospective analysis of data on burns patients presenting to KCH between July 2008 and June 2009 as identified from all patient records in the trauma registry at KCH, which has been described previously.<sup>6</sup>

The study was conducted at KCH in Lilongwe, Malawi, and was approved by the ethics review committees of Malawi (National Health Sciences Research Committee) and the University of North Carolina.

### DATA SOURCES

Data were collected from three sources: the KCH trauma registry, operative records and in-patient charts.

The trauma registry included data on gender, age, cause of burn and time of day when the burn was sustained. Although incompletely recorded, data on burn size, length of stay and outcome from this source were also analysed when available.

Operative records at KCH were reviewed for the period from July 2008 to June 2009 and all burns-related procedures were recorded. These data were merged with those from the trauma registry and in-patient records. Only procedures performed in the operating theatre were identified; bedside procedures, such as debridement, were not included.

In-patient charts for burn patients admitted to KCH were reviewed for the 1-month period preceding November 2009. This cross-sectional analysis used treatment and outcomes data extracted from in-patient paper charts.

## STATISTICAL ANALYSES

Retrospective data and cross-sectional data were pooled for a descriptive statistical analysis of burns epidemiology. Only the cross-sectional data were used for the descriptive statistical analysis of burns treatments. All analyses were done using Stata® version 10 (StataCorp, College Station, TX, USA). Correlations between patient demographics and burn factors were analysed using the  $\chi^2$  test. A *P*-value < 0.05 was considered statistically significant.

## Results

### PATIENT DEMOGRAPHICS

During the 1-year study period, burns injuries (*n* = 370) constituted 4.45% of all injuries recorded in the trauma registry at KCH (*n* = 8309). The admissions rate for burn patients was 25.9% (96/370), over twice the rate for all injury types (12.8%, 1067/8309). Most burns patients were males (56.2%, 208/370; male : female ratio 1.3 : 1) and < 15-year olds (67.6% [250/370]; median age 4 years, mean age 10.7 years).

Thirty-nine burns patients were in-patients during the November 2009 cross-sectional analysis of in-patient paper charts.

### INJURIES, CAUSES AND ENVIRONMENTAL FACTORS

The commonest cause of burns was scalding, followed by exposure to flames (Table 1). Seasonal and diurnal patterns of occurrence existed among both age groups of burn patients (< 15 and ≥ 15 years), with burns more frequent in the cool, dry season than in other seasons, and in the early morning or evening than in the daytime and night-time (*P* < 0.05 for both seasonal and diurnal patterns; Table 2). Children < 15 years old were more likely to be burned in the early morning or daylight hours compared with the evening or night (*P* < 0.05; Table 2). No statistically significant correlation was observed between age and season (Table 2) or between cause of burn and time of day or season (data not shown).

The mean total burn surface area as a percentage of total body surface area for second- and third-degree burns was 14.1% (median 10%, range 1 – 76%), and the commonest body location burned was the trunk (Table 3). Most (74%) burns were presented within 8 h of injury. A total of 19 burns-related operations were identified. The commonest procedures were amputation (26%, 5/19) and contracture release (26%, 5/19), followed by skin grafting (16%, 3/19), tracheostomy (11%, 2/19) and debridement (11%, 2/19) followed by amputation (11%, 2/19). A total of 2601 general surgery procedures were performed at KCH during the study period.

### CROSS-SECTIONAL ANALYSIS: BURN TREATMENT AND OUTCOMES

Intravenous fluids (IVF) were administered to 44% (17/39) of patients; however, four of these 17 patients did not have indications for IVF and three of the 22 (14%) patients who did not receive IVF did have indications for IVF. Appropriate use of IVF was defined by the following indications: burns to > 10% of total body surface area in the first 24 h, inability to take liquids, and sepsis and/or oliguria.

Nutritional supplementation therapy that met the calorific requirements of burn patients and had a high protein component was available but was administered to only 28% (11/39) of patients. This therapy was indicated in 18 of the 28 patients who did not receive it. Appropriate use of nutritional supplementation was defined as burns to > 10% of total body surface area and ability to tolerate oral nutrition.

Only 8% (3/39) of victims received physiotherapy, although physiotherapy was ordered for 31% (12/39) of patients. Overall, inappropriate use or lack of use when appropriate for three key interventions (IVF, nutrition supplementation therapy and physiotherapy) was noted in 59% (23/39) of cases.

In-hospital mortality for burns victims, as calculated from combined cross-sectional ( $n = 39$ ) and registry ( $n = 16$ ) data, was 27% (15/55). Mean length of stay was 21.1 days (median 14 days, range 0.5–109 days). The rate of documented burn wound infection was 31% (12/39).

## Discussion

In the population studied, burns disproportionately affected children and the most common type was scald burn. This was similar to findings in other studies from Zambia, South Africa and Peru.<sup>11–13</sup> Children were more likely to be burned in the morning or day than the evening and night. This may be a multifactorial effect: children tend to remain inside the home during morning cooking whereas they are playing outside in the evening. Burns in adults at night are likely in night-time workers, such as guards, who keep fires for cooking and warmth.

The documented burn wound infection rate at KCH was 31%. Although microbiological cultures are rarely available within the hospital and infection was, in all instances, a clinical diagnosis, this high rate indicates that better wound care through debridement, periodic washing and topical treatment has potential to improve outcomes for a significant proportion of patients. The overall mortality rate for burns admissions was 27%, which is higher than the reported mortality rates for burns patients (16.9 – 19.3%) from Queen Elizabeth Central Hospital in Blantyre, Malawi.<sup>8,14</sup> This difference in mortality rate between the hospitals may be explained by the fact that Blantyre has a dedicated burns unit with better infrastructure and staffing. The lower mortality rate at Blantyre is a goal to strive for as care improvement efforts at KCH are implemented.

Few burns procedures were carried out during the study period and, of those that were, a high proportion were amputations and contracture procedures. This raises the question of whether simple improvements in the immediate care of burns, such as physiotherapy and improved wound care using procedures such as debridement and cleaning, could have a significant impact on long-term quality of life and the prevention of long-term sequelae of burns, such as contractures. Only three skin grafts were performed during the 1-month chart review study. Experiences in other resource-constrained settings indicate that this is a surprisingly low number of burns patients receiving skin grafts. A study in Harare, Zimbabwe, noted that 3% of burns patients underwent immediate skin grafting and 27% received delayed grafting.<sup>15</sup> A study from New Delhi of > 10 000 burns patients concluded that conservative treatment of burns patients had acceptable outcomes and that, given the limited resources in many settings, conservative treatment was much more feasible than resource-intensive strategies using multiple surgeries.<sup>16</sup>

Overall, for 59% of in-patients there was inappropriate use of at least one key intervention: physiotherapy, IVF or nutrition therapy. These three resources are readily available and their appropriate use is essential in improving care. Moreover, all three of these interventions are easily measured and currently available at KCH, making them key targets for sustainable improvements in patient care.

This study had several limitations. First, it was hospital-based rather than community-based and, as such, could not include burn victims who did not present to KCH. The findings relevant to primary prevention may, therefore, be biased. Another limitation inherent in the study was the difficulty in collecting outcomes data because the records used were

incomplete. Only 55 patients had known outcomes, which precluded analysis of correlations between outcomes and factors such as burn size, age, infections and length of hospital stay.<sup>17</sup> Lastly, no data were collected on factors that might contribute to burns, such as epilepsy, unsafe home conditions or insufficient child supervision.

Although the study was hospital-based, the findings indicate that primary prevention of burns should target children who are most at risk of scald burns during the morning and daytime, through parents and caregivers. This is consistent with recommendations from other epidemiological studies in other regions in Africa.<sup>11,18</sup>

The operative treatment of burns at KCH is limited and improving this capacity will require either additional funding or substituting burns cases for other general surgical cases. As the backlog of general surgical cases is always high, the ideal approach would be to increase operating capacity. Until such resources are available, however, the simplest and most sustainable improvement will come from increased knowledge and skills through provider training. The University of North Carolina continues to develop a partnership with KCH and a central focus of this effort is the training of local providers.<sup>19</sup> By identifying key interventions for improvement (IVF resuscitation, nutrition support and physiotherapy) it will be possible to focus on relatively weak aspects of care at KCH. Furthermore, these interventions utilize resources already available at KCH, making improvements achievable without major infrastructure projects. Understanding the current status of the use of these resources will provide a baseline against which future improvement efforts can be assessed.

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**TABLE 1**

Causes of burns in patients presenting to the Kamuzu Central Hospital, Malawi, between June 2008 and July 2009

Cause of burn	No. (%) of patients
Scalds, overall	190 (51.4)
Water	106 (28.6)
Steam	47 (12.7)
Porridge	29 (7.8)
Cooking oil	6 (1.6)
Other scalds	2 (0.5)
Flames, overall	80 (21.6)
Fire	71 (19.2)
Petrol/diesel	3 (0.8)
Paraffin lamp	3 (0.8)
Candle	2 (0.5)
Explosion	1 (0.3)
Other	11 (3.0)
Unknown	89 (24.1)
Total	370 (100.0)

TABLE 2

Burns presenting to Kamuzu Central Hospital, Malawi, between June 2008 and July 2009 according to time of day, season and age

When injury sustained	Total No. of burn patients	Frequency of burns (patients/h or patients/month)	Statistical significance <sup>a</sup>	< 15 years old	≥ 15 years old	Statistical significance <sup>a</sup>
Time of day			<i>P</i> < 0.05			<i>P</i> < 0.05
Morning (06.00 – 08.00 h)	51	25.5		40	6	
Day (08.00 – 18.00 h)	188	18.8		138	35	
Evening (18.00 – 20.00 h)	67	33.5		43	17	
Night (20.00 – 06.00 h)	52	5.2		23	23	
Unknown	12	–				
Season			<i>P</i> < 0.05			NS
Cool/dry (March – July)	182	36.4		128	44	
Hot/dry (August – October)	73	24.3		44	20	
Rainy (November – February)	107	26.8		73	20	
Unknown	8	–				

<sup>a</sup>  $\chi^2$  test; NS, not statistically significant (*P* > 0.05).

Age-specific data were not available for all patients: time of day unknown, 12 patients; season unknown, 8 patients; age unknown, 33 patients.



**TABLE 3**

Second- and third-degree burns as a percentage of total body surface area and primary body location in patients presenting to Kamuzu Central Hospital, Malawi, between June 2008 and July 2009

Extent and location of burns	No. (%) of patients
Total body surface area	
< 10%	22 (43.1)
10 – 19%	20 (39.2)
20 – 29%	4 (7.9)
≥ 30%	5 (9.8)
Primary body location	
Trunk	91 (24.6)
Arm	89 (24.1)
Leg	78 (21.1)
Head and neck	75 (20.3)
Hand	17 (4.6)
Other/unknown	20 (5.3)