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Burn care delivery in a sub-Saharan African unit: A cost analysis study

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HIGHLIGHTS

- This study demonstrated affordable comprehensive burn care in a low or middle-income country.
- In our unit, the mean cost per in-patient admission was $559.85 (SD ± $736.17).
- The mean daily cost per 1% total burn surface per patient at our center was $2.65 (SD ± $3.01).
- Accurate patient level hospital cost information on burn care delivery is invaluable.

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ABSTRACT

Introduction: There are significant resource challenges to burn surgical care delivery in low and middle-income countries at baseline and only a few burn cost analysis studies from sub-Saharan Africa have been performed.
Methods: This is a retrospective database analysis of prospectively collected data from all patients recorded in the burn registry between June 2011 and August 2014 located at the Kamuzu Central Hospital Burn Unit in Lilongwe, Malawi. We utilized activity-based costing, a bottom-up cost analysis methodology with cost allocation that allows determination of unit cost or cost per service.
Results: 905 patients were admitted to the burn unit during the study period. The calculated total monthly burn expenditure for all cost centers was $11,622.66. Per day, the total unit cost was $387.42 with a mean daily per-patient cost of $24.26 (SD ± $6.44). Consequently, the mean cost per in-patient admission was $559.85 (SD ± $736.17). The mean daily cost per 1% total burn surface per patient at our center is $2.65 (SD ± $3.01).
Discussion: This burn care cost analysis study helps quantify the relative contribution of differing cost centers that comprise burn care delivery and hospital costs in a sub-Saharan African setting. Accurate and relevant cost information on hospital services at the patient level is therefore fundamental for policy makers, payers, and hospitals.
Conclusion: Our study has demonstrated that comprehensive burn care is possible at a cost much lower than found in other burn centers in low or middle-income countries and can be sustained with moderate funding.

1. Introduction

Globally, burn injuries are a significant cause of morbidity and mortality. Burn injury ranks fourth in all causes of injuries [1] and low and middle-income countries (LMIC) are disproportionally affected, accounting for 90% of all mortality from burn injury [2]. Africa alone accounts for 15% of the total burn-associated mortality worldwide and data has shown a positive correlation between poverty and fire-associated mortality [3]. Consequently, countries and communities with the least resources are the most burdened with the sequelae and cost of burn care delivery.

There are significant challenges to overall surgical care delivery in LMIC at baseline [4]. There is a lack of basic surgical infrastructure such as operating theaters, as well as a dearth of physician and nursing personnel. In addition, most LMIC experience severe and

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unpredictable supply chain constraints of basic drugs and wound dressing. Burn care is particularly resource intensive, costing up to $1000 USD a day per patient in developed countries [5]. While efforts on burn prevention are critical to an overall public health and governmental public and fiscal policy strategy, this will take time to implement [5]. Inpatient care is vital to a comprehensive burn strategy and gaining insights into the cost of burn care will help inform policy decision-making on health care expenditures.

There are only a few burn cost analysis studies from sub-Saharan Africa and they are affected by significant limitations. There can be high variability in several cost centers especially in human resources and consumables that make regional analysis critical for accurate measurements of resource utilization. Therefore we sought to estimate the costs of daily inpatient care at a tertiary burn center in Malawi.

2. Methods

This study was conducted at the Kamuzu Central Hospital (KCH) Burn Unit in Lilongwe, Malawi. KCH is a 600-bed tertiary care public hospital and serves as a referral center for approximately 5 million people in the central region of Malawi. Patients do not pay for health care in Malawi as it is completely subsidized by the government. The KCH Burn Unit has 31 beds and admits both pediatric and adult patients. A consultant general surgeon supervises the unit and two specially burn trained clinical officers and five full-time nurses perform most clinical duties with a small support staff. Demographics, clinical, operative variables, and outcomes are recorded into the burn registry for all patients admitted to this unit.

This is a retrospective study including all patients recorded in the KCH burn registry between June 2011 and August 2014. Data were used to calculate mean census, % total body surface area burn (TBSA), mean length of stay, and use of blood transfusions and laboratory studies.

2.1. Costing methodology

Allocating hospital costs to patients involves three steps: the allocation of hospital overhead costs to the burn unit, the allocation of burn unit overhead costs to patients, and the allocation of burn unit direct costs to patients [6]. We utilized activity-based costing, which is a well-known bottom up cost analysis methodology with cost allocation that allows determination of unit cost or cost per service and accounts for overhead [7,8]. The activity mapping consisted of first systematically analyzing the standard operation procedures within the burn unit and then performing semi-structured interviews with administration, and medical staff.

2.2. Cost centers

Data collection efforts were organized around the primary cost centers for inpatient care. Those identified were: clinical consumables/supplies, medications, ancillary, human resources, operative costs, and facility costs. (Table 1) Facility costs including building depreciation, maintenance, utilities, and the associated hospital administration costs were estimated by the inclusion of the lowest tier facility charges established by the hospital on a theoretical billing scale for Malawian residents. An exact building depreciation estimate was not available. Lastly, outpatient costs were excluded in the analysis (Table 2).

2.3. Data Collection

General pricing for a particular medication or dressing was primarily obtained directly from the hospital purchaser but if unavailable, costs were obtained from a local wholesale medical supplier. Monthly use of consumables and medications were estimated based on previous purchasing records, historical usage, and burn unit utilization patterns. General ward supplies and disposables were estimated in a similar fashion to clinical consumables and human resource information was obtained from hospital administration. The supervising surgeon's salary was not included as their income was not dependent on burn unit clinical activity.

For operative procedure costs, the hospital assigns charges that reflect supplies, facility costs, and human resources such as theater nurses. At KCH, burn debridement operative charges are approximately $5 USD per 1% TBSA. For those who received an operation over the last three years, the mean % TBSA was 18% meaning the average operation charge would be less than $100 USD. Operative charges were distributed across all patients in the final cost analysis because the remaining cost centers represented a mixed population of operative and non-operative patients.

2.4. Cost analysis

There are many ways to ascertain cost depending on the cost centers that are utilized [9]. In our study, we report the cost of care for the burn hospitalization, the cost of burn care per day, and the cost of daily burn care per % TBSA. The mean per-patient daily cost of burn care was calculated using historical census data for our unit. Using the calculated daily cost to provide care, we used each month's mean daily census during the study period to calculate a mean daily per-patient cost and used these values for our analysis. Mean total costs for each patient's hospital stay was calculated using each patient's actual length of stay and the mean daily per-patient cost. Lastly, costs per %TBSA was calculated using the mean daily per-patient cost and each patient's recorded %TBSA.

Burn patients are a very diverse group in terms of their clinical needs. Patients with small % TBSA burns may only be admitted for a few days with few needs, while larger burns may require multiple operations, blood transfusions, laboratory studies, and intense nursing care. We estimated costs on a per patient basis using mean costs across the spectrum of burn patients using three years of retrospective clinical data to determine cost estimation for the “average burn patient.” This means that our cost data represent a burn patient cohort that includes both operative and non-operative patients. We estimated the differential between operative and non-operative patients using length of stay for each patient and the mean per-patient daily cost.

United States dollar (USD) amounts were converted from the Malawi Kwacha (MWK) at a conversion rate of 500 MWK = $1 based on market values at the time of study completion. All costs will be reported in USD.

All statistical analysis was performed using Stata/SE 13.1 (StataCorp LP, College Station, TX). This study is fully compliant with the STROBE criteria [10]. Both the Institutional Review Board at The University of North Carolina and the National Health Science and Research Council of Malawi approved this study.

3. Results

Over the study period, 905 patients were admitted to the KCH Burn Unit. Median age was 3 years (IQR 2–10 years) with 721 patients (80%) being less than 18 years old. 497 patients (55%) were male. For all patients, median %TBSA was 15% (IQR 8–23%) and mean was 17.9% (SD ± 15.3%). 275 patients (30%) received an operation with 135 (45%) of those patients receiving more than one operation for a total of 534 operations during the study period. Over 90% of these operations were debridement or skin grafting. Median length of stay was 12 days (IQR 6–30) with a mean of 23.1