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Cost Analysis of 48 Burn Patients in a Mass Casualty Explosion Treated at Chang Gung Memorial Hospital

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A R T I C L E I N F O

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A B S T R A C T

Introduction: Little is known about the costs of treating burn patients after a mass casualty event. A devastating Color Dust explosion that injured 499 patients occurred on June 27, 2015 in Taiwan. This study was performed to investigate the economic effects of treating burn patients at a single medical center after an explosion disaster.
Methods: A detailed retrospective analysis on 48 patient expense records at Chang Gung Memorial Hospital after the Color Dust explosion was performed. Data were collected during the acute treatment period between June 27, 2015 and September 30, 2015. The distribution of cost drivers for the entire patient cohort (n = 48), patients with a percent total body surface area burn (%TBSA) ≥ 50 (n = 20), and those with %TBSA <50 (n = 28) were analyzed.
Results: The total cost of 48 burn patients over the acute 3-month time period was $2,440,688, with a mean cost per patient of $50,848 ±36,438. Inpatient ward fees (30%), therapeutic treatment fees (22%), and medication fees (11%) were found to be the three highest cost drivers. The 20 patients with a %TBSA ≥50 consumed $1,559,300 (63.8%) of the total expenses, at an average cost of $77,965 ± 34,226 per patient. The 28 patients with a %TBSA <50 consumed $881,387 (36.1%) of care expenses, at an average cost of $31,478 ± 23,518 per patient.
Conclusions: In response to this mass casualty event, inpatient ward fees represented the largest expense. Hospitals can reduce this fee by ensuring wound dressing and skin substitute materials are regionally stocked and accessible. Medication fees may be higher than expected when treating a mass burn cohort. In preparation for a future event, hospitals should anticipate patients with a %TBSA ≥ 50 will contribute the majority of inpatient expenses.

Introduction

In the current economy, health care institutions are increasingly scrutinized for their management of costs, specifically their efforts to reduce the national burden of growing health care expenditure [1]. Compared to other forms of trauma, burns are one of the most costly injuries for health care systems [2]. Burn patients require prolonged hospitalization, extensive numbers of treatment sessions, and often undergo multiple surgical procedures [3]. In an effort to identify potential sources of high expense in the management of burn individuals, many studies have retrospectively examined the cost of delivering burn care at diverse institutions [4–6]. Some of these studies undertook a detailed inventory of cost for a small number of patients, whereas others surveyed longitudinal cohorts [4,5]. Despite differences in methodologies, researchers demonstrated that burn care is an expensive therapy both in terms of total spending as well as cost per patient. Given the intensive resources necessary for treating

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these patients, advance preparation becomes crucial to saving more lives [7]. Cost studies remain an important tool in promoting this anticipated resource allocation, and also in developing specific cost-reduction strategies for the treatments consumed [2].

Although recent studies have analyzed costs of diverse patient cohorts, a cost analysis in the wake of a mass casualty burn event has not been fully examined. The care of patients following a mass burn accident is different from typical burn management because of the extensive simultaneous consumption of physician services and materials for burn wound coverage [8]. Additionally, treatment supplies including costly wound dressing materials and skin substitutes become limited after mass burn accidents, which may increase the length of a patient's hospital stay and result in increased charges [8,9]. These observations suggest the costs of treating mass casualty burn populations differ from caring for individual burn patients.

We performed a cost analysis of inpatient hospital expenses at Chang Gung Memorial Hospital (CGMH) after the June 27, 2015 Color Dust explosion at the Formosa Waterpark in Taiwan to assess the economic effects of treating burn patients after a mass trauma event. The patients involved in the explosion were sprayed with a thick cloud of colored dust powder while attending a stage show [10]. The powder ignited, causing extensive burns and inhalation injuries among 499 of the partygoers. This disaster presented a unique patient population to the regional hospitals in Taiwan, with a low mean age of 22 years (15–37) and a large mean burn surface area of 43.5% [10]. The cost distribution of resources used to treat the CGMH patients was analyzed to identify the most significant cost drivers in caring for an acute mass burn patient population. Furthermore, the distribution of cost drivers was compared among the entire cohort, the severely burned patients with percent total body surface area burned (%TBSA) ≥ 50, and less severely burned patients with %TBSA < 50.

Methods

After obtaining institutional review board approval for data collection and analysis, we examined expense records for 48 patients injured in the Formosa Waterpark Color Dust explosion who were treated at CGMH. This analysis included all inpatient expenses beginning June 27, 2015 and ending September 30, 2015. This period encompassed the acute phase of care that included key treatments and extensive hospitalization. To assess the complete cost of care, we included both living and deceased patients who received treatment during this acute period.

To ensure accuracy, we cross-checked each patient record against hospital billing records at CGMH and Taiwan's National Health Insurance (NHI). The cost data were reported in units of insurance points because Taiwan's health care institutions use a reimbursement system based on a schedule set by the NHI department [11]. The fee schedule sets the maximum reimbursement points for each medical service claimed. These are then reimbursed according to annual budget allocations. For this study we assumed full reimbursement rates for all patient costs, using the conversion equation 1 point = 1 New Taiwan (NT) dollar. We then used a July 2015 exchange rate to approximate the value assessed in US dollars ($31 NT dollars = $1 USD).

Each patient record was examined for demographic and expense statistics. These included gender, age, %TBSA burned, number of admits, total days of hospital treatment, days spent in intensive care, respirator and Extracorporeal Membrane Oxygenation (ECMO) use, and summaries of burn treatments. We then calculated summary expense statistics for the whole patient group (n = 48), and also by subgroups of %TBSA ≥ 50 (n = 20) and %TBSA < 50 (n = 28). These statistics describe the total cost of inpatient burn care, and mean costs per patient, per day of hospitalization, per ICU/Burn ICU day, per Burn Ward/general hospital ward day, and per 1% burn surface area. We calculated overall means in each category from individual patient means because of population heterogeneity (e.g. some patients had short hospital stays and others had prolonged ones). For example, each individual patient's total cost per day was averaged first, and then the overall cohort average was calculated based on these values.

Next we compared cost drivers between three cohorts: the entire set of patient expense records, the patients with %TBSA ≥ 50, and patients with %TBSA <50. Cost driver categories were defined according to divisions in Taiwan's NHI fee schedule [12]. Appendix A displays the items for reimbursement included in each of these insurance categories. We analyzed each expense category to show overall spending on separate cost drivers, and also to show expenses by the cohort subgroups.

Finally, we retrieved a breakdown of wound care materials consumed by the CGMH burn patients during their entire recovery. This dataset covered materials used from June 27, 2015 to February 29, 2016. Using this breakdown, we calculated material fees with price per dressing unit figures. Additionally, we calculated the cumulative surface area treated with dressings and skin substitutes, and also the costs by patient cohort (burn %TBSA ≥ 50 or <50) for each wound care material subcategory.

Results

The expense records for patient burn treatment between June 27th, 2015 and September 30th 2015 at CGMH included 22 male (46%) and 26 female (54%) patients. Patient age ranged from 15-37 years with a mean of 22 ± 4.6 years. The mean percent TBSA was 43.5% ± 20, and the mean length of hospital stay was 57 ± 29.6 days, with a mean number of times admitted of 1.33. Each 1% TBSA burned corresponded to a mean hospital stay of 1.34 days. Seven patient expense records included intubation charges, 7 reported fasciotomy procedures, 14 recorded debridement, and 40 reported STSG fees. One expense record included ECMO use for cardiomegaly with heart failure, and 2 reported amputations. Two patient

Table 1
Patient and Treatment Demographics.[*]

Category	Value (% of cohort)
Gender	
Male	22 (46%)
Female	26 (54%)
Mean age (SD)	22.2 (4.6)
Mean% TBSA (SD)	43.5% (20)
≤9	2 (4%)
10–19	4 (8%)
20–49	22 (46%)
≥50	20 (42%)
Mean Hospital Length of Stay in days (SD)	57 (29.6)[†]
Mean Number of Times Hospitalized (SD)	1.33 (0.52)
Patients Receiving Intubation	7 (15%)[‡]
Patients Receiving Fasciotomy	7 (15%)[‡]
Patients Receiving Debridement	14 (29%)[‡]
Patients Receiving STSG	40 (83%)
Patients Receiving ECMO	1 (2%)
Patients Receiving Amputation	2 (4%)
No. of Patient Deaths	2 (4%)

[*] All NHI expense records were cross-checked with CGMH's patient accounts. Only verified patients' accounts from the acute treatment period were included in this study.
[†] A total of 7 patients remained hospitalized beyond September 30th.
[‡] Billing data differed from clinical data in regards to patients requiring intubation, fasciotomy, and debridement. Actual demographics (clinical data) of patients receiving the following interventions are: Intubation = 29, Fasciotomy = 23, Debridement = 43.