



Trauma/Critical Care

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Let the right one in: High admission rate for low-acuity pediatric burns[☆]

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ABSTRACT

Background: The purpose of this study was to characterize emergency pediatric burn care triage at a tertiary children's hospital to identify targets for quality improvement.

Methods: A retrospective review of patients <18 years with primary burn injuries who presented to a children's emergency department in 2016 was conducted. Demographic and injury characteristics were recorded. Low acuity was defined by size (<5% total body surface area burn), depth (not third degree), and no need for conscious sedation for debridement. Multiple logistic regression was used for analysis.

Results: A total of 309 pediatric burn patients were triaged in the emergency department. Patients were typically young (median 3.3 years), male (59%), Hispanic (47%), publically insured (77%), and transferred in (65%). Scalding was the most common mechanism (59%). Though most burns were small (median 2% total body surface area), not deep (<third degree: 91%), and debrided without sedation (70%), most patients were admitted (80%). On regression, larger total body surface area, child protective services involvement, and in-transfer, but not mechanism, location of injury, or time of day, were associated with observation admission (<24 hours) versus emergency department discharge.

Conclusion: Though burns were low acuity, most children were admitted. Social factors may play an important role in triage decisions but there may be an opportunity for improved resource utilization.

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Introduction

Burn injuries are common in the pediatric population with more than 125,000 emergency visits per year in the United States.¹ Most pediatric burns are small (<5%–10% total body surface area [TBSA]) and do not require admission or surgery.^{1–4} Available services for pediatric burns in the acute care setting vary widely, and patients are often transferred to pediatric burn centers for specialized care.⁴ The current burn model includes triage by commu-

nity hospitals with transfer to a pediatric burn center based on American Burn Association (ABA) criteria. These criteria include stipulations for size, depth, and type of burn but also the subjective proviso “hospitals without qualified personnel or equipment for the care of children.”⁵

Regionalized burn care has been criticized both for undertriage of severe burns and overtriage of minor burns.^{1,3,6} Identifying patients who require in-patient care or transfer to a burn center or who can be safely managed in an ambulatory setting is challenging in community hospitals where resources and comfort with burn management are variable. The purpose of this study was to characterize emergency pediatric burn care triage at a tertiary, academic children's hospital with a large referral population to identify targets for value and quality improvement.

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Methods

A retrospective review of pediatric patients (<18 years) with primary burn injuries who presented to a tertiary, academic children's emergency department (ED) in 2016 was conducted. As quality improvement, the review was deemed exempt by the Institutional Review Board. Children's Memorial Hermann Hospital (CMHH) is a tertiary, teaching pediatric hospital. CMHH serves as the primary pediatric trauma center for the metropolitan area with 18,000 pediatric emergency patients per year. A quaternary burn center, Shriners Hospitals for Children—Galveston, is located within 60 miles of Texas Medical Center and serves as the definitive care location for the most severe burns (>30% TBSA). CMHH receives transfers from a network of in-system hospitals and from nonaffiliated hospitals and freestanding EDs (non-network).

Triage patterns and demographic and injury characteristics

TBSA burned percentage, degree (first, second, third), and body location were recorded. Burn or surgical attending TBSA determination was used in the majority of patients as available. If attending determination was unavailable, surgical resident TBSA was used. Patients transferred to a quaternary burn specialty center for large burns (>30% TBSA) were excluded. *Complex body area* was defined as burns to the face, hands, feet, or genitalia or across a major joint. Complex areas are one of the American Burn Association (ABA) referral criteria for transferring a patient to burn center.⁵ Patients were classified as presenting during regular hours if their ED triage time was between 07:00 and 19:00 on a weekday. These are the hours in which the pediatric burn attendings are in-house. Weekends were Saturdays and Sundays at all hours. Child Protective Services (CPS) involvement was evaluated via social worker documentation and included all patients for whom CPS was contacted and engaged in the child's situation.

For the purposes of this study, low acuity was defined by size (<5% TBSA), depth (not third degree), and no need for conscious sedation for debridement. Conscious sedation was the use of intravenous ketamine, for the purpose of sedation, in addition to analgesics for debridement. A transfer was deemed appropriate if the patient met ABA referral criteria: partial-thickness burns >10% TBSA; partial-thickness burns to the face, head, neck, hand, foot, joint, and genitalia; full-thickness burns; electrical burns; chemical burns; inhalation injury; burns in patients with comorbid conditions; and burns with concomitant trauma.⁵

Descriptive statistics, χ^2 , Wilcoxon rank sum, and multiple logistic regression was used for analysis. Purposeful selection ($P \leq .20$) from univariate analysis was used to choose regression variables. All analyses were performed on STATA Version 14 (Stata Corporation, College Station, TX).

Results

In 2016, 309 pediatric burn patients were triaged in the CMHH ED and 4 patients required transfer to a higher level burn specialty center. Of the 305 patients who received definitive care at CMHH, the median age was 3.3 years and most were male (59%) (Table 1). Most patients were of Hispanic or other ethnicity (47%), publically insured (77%), transferred from other facilities (65%), and arrived by ambulance (75%). Of those who were transferred, one third came from in-system hospitals and two thirds came from nonaffiliated hospitals or freestanding EDs. Based on ABA referral criteria, most (84%) transfers were appropriate, and this was similar at both referral hospital types. Scalding burns (55%) were the most common injury type, followed by flame (18%) and contact burns (15%). Though most burns were small, with a median TBSA

of 2%, the majority involved a complex area (71%). Full thickness, third-degree burns (9%), and surgery (10%) were uncommon.

Admission was common (80%) despite most burns being low acuity (54%). In those admitted, duration of stay was brief (median 1.5 days, interquartile ratio [IQR] 0.8–3.0) with 35% admitted for less than 24 hours (observation status). Compared with patients discharged directly from the ED, observation admission patients were similar in age, weight, race or ethnicity, and insurance status. Observation admission patients were more likely to be male, arrive by ambulance, be transferred, have a larger TBSA burn, and require conscious sedation for debridement. Discharged patients were more apt to have low-acuity burns. Time and day of presentation were not different by disposition status.

Low-acuity patients were equally likely to be admitted, observed, or discharged directly from the ED (Fig. 1). Compared with patients discharged from the ED, low-acuity observation admission patients had a slightly higher TBSA, were more likely to have CPS involvement, and were more often transferred from an outside hospital (Table 2). On multiple logistic regression, these variables remained significant (Table 3). In this small sample, time of presentation, mechanism, and complex area involvement were not predictive of observation admission.

Discussion

Though most pediatric burns presenting to CMHH were low acuity, admission was common. Social factors and transfer status were stronger predictors of observation admission than burn size or mechanism in low-acuity patients. Deep, complex, and large burns undoubtedly warrant admission. However, there are modifiable factors, such as availability of social workers, burn dressing videos and kits, and local provider education, that may ameliorate unnecessary admissions.

Our results are similar to the 2011 study by Vercruyse et al³ at Grady Memorial Hospital Burn Center. They found that most children they treated had small to medium-sized burns (<10%), were often discharged within 24 hours, and rarely required surgery. Transfer patients were also more likely to be discharged in less than 1 day. Several studies have found that both adult and pediatric burn patients are not referred appropriately based on ABA criteria.^{6–8} The ABA criteria are thorough and liberal: If a provider or facility is not comfortable with patient management, the patient should be transferred. The centralized burn care system may have led to the increase in short stay (<2 days) admission reported in several studies and the ABA–National Burn Repository data.^{9,10} Vercruyse et al³ and Holmes et al⁸ both argue that regionalization of burn care needs to be reevaluated to provide cost-effective, efficient, patient-centered care.

Lack of expertise or comfort with providing burn care encompasses not only the medical component but also the social aspects of care. The ABA criterion that pediatric patients who “will require special social, emotional or rehabilitative interventions” may account for a significant proportion of CMHH's transfer patients and discrepancies between appropriate and inappropriate transfers.¹¹ Racial and ethnic minorities and indigent patients (low income or public payer status) make up a disproportionate number of burn patients in pediatric and adult populations.⁹ Though race and ethnicity and insurance status were not significant in our study's population, CPS involvement may be a surrogate measure of poor social support in this largely minority and publically insured cohort.

There are several strategies that may be employed at a local level to improve pediatric burn patient management. Outpatient management of thermal injuries in children has been found to be safe and cost effective.^{2,12,13} Though our institution is only able to provide one clinic morning a week for pediatric burns, increasing clinic times may provide a safe alternative to observation admis-

Table 1
Demographic and burn injury characteristics for pediatric burn patients.

	No. (%)			P
	All Patients (N = 305)	Admitted 243 (79.7)	Discharged from ED 62 (20.3)	
Age, y, median (IQR)	3.3 (1.4–7.5)	3.1 (1.4–6.9)	3.7 (1.3–9.6)	.45
Weight, kg, median (IQR)	15.1 (11.4–25.0)	15 (11.6–24.1)	17.9 (11.0–37.4)	.52
Male	180 (59.0)	148 (60.9)	32 (51.6)	.18
Race/ethnicity				.75
White	71 (23.3)	57 (23.5)	14 (22.6)	
Black	86 (28.2)	67 (27.6)	19 (30.7)	
Asian	4 (1.3)	4 (1.7)		
Hispanic/other	144 (47.2)	115 (47.3)	29 (46.8)	
Insurance status				.81
Private	57 (18.7)	44 (18.1)	13 (21.0)	
Public	235 (77.1)	188 (77.4)	47 (75.8)	
Self/other	13 (4.3)	11 (4.5)	2 (3.2)	
Method of arrival				<.01
Personal vehicle	70 (23.0)	35 (14.5)	35 (56.5)	
Ambulance	228 (75.0)	201 (83.1)	27 (43.6)	
Helicopter	5 (1.6)	5 (2.1)		
Other	1 (0.3)	1 (0.4)		
Location of initial presentation				<.01
CMHH	108 (35.4)	71 (29.2)	37 (59.7)	
In-network ED	65 (21.3)	58 (23.9)	7 (11.3)	
Non-network ED	132 (43.3)	114 (46.9)	18 (29.0)	
Transferred to CMHH ED	197 (64.6)	172 (70.8)	25 (40.3)	<.01
Meets ABA transfer criteria	166 (84.3)	147 (85.4)	19 (76.0)	.26
Time of presentation				.17
Regular hours (07:00–19:00)	103 (33.8)	54 (22.2)	19 (30.7)	
Weekend	98 (32.1)	79 (32.5)	19 (30.7)	.78
Mechanism				.05
Flame	55 (18.0)	445 (18.5)	10 (16.1)	
Scald	169 (55.4)	142 (58.4)	27 (43.6)	
Electrical	8 (2.6)	8 (3.3)		
Chemical	6 (2.0)	3 (1.2)	3 (4.8)	
Contact	46 (15.1)	31 (12.8)	15 (24.2)	
Secondary	1 (0.3)	1 (0.4)		
Other	8 (2.6)	5 (2.1)	3 (4.8)	
Unknown/not reported	12 (3.9)	8 (3.3)	4 (6.5)	
Location of injury				.03
Complex area location	216 (70.8)	179 (73.7)	37 (59.7)	
Face only	60 (19.7)	49 (20.2)	11 (17.7)	
Hands only	72 (23.6)	55 (22.6)	17 (27.4)	
Feet only	32 (10.5)	26 (10.7)	6 (9.7)	
Genitalia/perineum only	18 (5.9)	16 (6.6)	2 (3.2)	
Major joints only	6 (2.0)	6 (2.5)		
Face & hands	12 (3.9)	11 (4.5)	1 (1.6)	
Other combo	16 (5.3)	16 (6.6)		
Burn severity				<.01
Final TBSA, median (IQR)	2 (1–4)	3 (1–5)	1 (0–1)	<.01
Third degree	27 (8.9)	27 (11.1)	0 (0)	<.01
Low acuity	166 (54.4)	113 (46.5)	53 (85.5)	<.01
Required sedation for debridement	89 (29.2)	83 (34.2)	6 (9.7)	<.01
Required surgery	29 (9.5)	29 (11.9)		<.01
CPS involvement	60 (19.7)	56 (23.1)	4 (6.5)	<.01

sion. Providing clinic hours to local providers, particularly in our hospital network, would allow community physicians a level of comfort in avoiding transfer for specialist evaluation.

Video consultation and mentoring between referral and tertiary centers can also help with triage and care of minor burns.¹⁴ Burn injuries are uniquely suited to telemedicine because diagnosis of injury severity is primarily visual. Moreover, distance to verified burn centers continues to be of national concern.¹⁵ There is a paucity of research on outcomes for telemedicine for burn care; however, a systematic review by Wallace et al.¹⁶ concluded that it is feasible, comparable to in-person evaluation, and may improve clinical decision making. It can help avoid unnecessary transfer, inpatient bed days, and scar check visits and reduce costs significantly.¹⁷ Telemedicine may accomplish more than just a decrease in transfer rates. Expert consultation with either a pediatric burn specialist during regular hours or pediatric trained emer-

gency physician at night may assuage the concerns or requests by parents for specialist evaluation. Local providers would be educated with repeated encounters of consultation. Telemedicine could also provide photographic clinical documentation. There are several barriers to implementation of a burn telemedicine program, including legal concerns of photography/videography, interhospital agreements, and technical capacity. The technical and financial limitations of telemedicine may be obviated by the use of smart phones as has been described in South Africa.¹⁸ In South Carolina, Cina et al.¹⁹ recently reported shorter time to wound healing in pediatric burn patients using a smart phone burn application.

The social issues that lead to patient admission are complex. Several studies have found that approximately 10% of nonaccidental trauma (NAT) patients report burn injuries.^{20,21} Admission of patients in whom NAT is suspected is likely warranted in order for a thorough evaluation to be conducted and an investigation

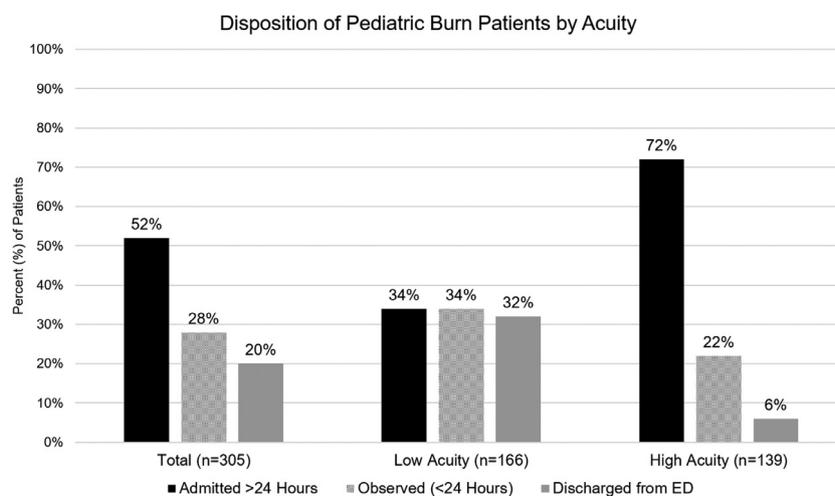


Figure 1. Triage disposition of pediatric burn patients by acuity of burn. Low-acuity burns were those that involved <5% total body surface area, were not third degree, and did not require conscious sedation for debridement. ED, emergency department.

Table 2

Demographic and burn injury characteristics for pediatric burn patients with low-acuity injury (<5% total body surface area burn, did not require conscious sedation for debridement, and no third degree involvement).

Low-acuity burn patients	No. (%)			P
	Discharged from ED (n = 53)	Admitted <24 h (n = 56)		
Age, y, median (IQR)	3.9 (1.5–9.6)	4.1 (1.5–8.9)		.70
Weight, kg, median (IQR)	19.2 (11.2–37.2)	19.1 (11.8–30.5)		.81
Male	28 (52.8)	37 (66.1)		.16
Race/ethnicity				.66
White	11 (20.8)	15 (26.8)		
Black	16 (30.2)	18 (32.1)		
Asian				
Hispanic/other	26 (49.1)	23 (41.1)		
Insurance status				.73
Private	12 (22.6)	13 (23.2)		
Public	39 (73.6)	39 (69.6)		
Self/Other	2 (3.8)	4 (7.1)		
Transferred to CMHH ED	20 (37.7)	37 (66.1)		<.01
Meets ABA transfer criteria	15 (75.0)	29 (78.4)		.42
Time of presentation				
Regular hours (07:00–19:00)	15 (28.3)	13 (23.2)		.54
Weekend	16 (30.2)	16 (28.6)		.85
Mechanism				.06
Flame	9 (17.0)	12 (21.4)		
Scald	21 (39.6)	31 (55.4)		
Electrical	0 (0)	3 (5.4)		
Chemical	3 (5.7)	1 (1.8)		
Contact	14 (26.4)	8 (14.3)		
Other	3 (5.7)			
Unknown/not reported	3 (5.7)	1 (1.8)		
Complex area involved	33 (62.3)	37 (66.1)		.68
Final TBSA, median (IQR)	1 (0–1)	2 (1–3)		<.01
CPS involved	2 (3.8)	10 (17.9)		.02

Table 3

Adjusted odds of observation admission in low-acuity burn patients.

	Odds Ratio (95% CI)
CPS involvement	21.9 (2.1–222.8)
Transferred	6.4 (2.0–20.4)
Final TBSA%	2.8 (1.7–4.8)
Female	0.9 (0.3–2.6)
Burn mechanism	
Flame	ref.
Scald	0.9 (0.3–3.3)
Chemical	0.2 (0.0–5.3)
Contact	0.9 (0.2–4.3)

CI, confidence interval.

by CPS to be performed if needed. The association between CPS involvement and admission may also be linked to transfer status. NAT has been correlated with transfer in pediatric trauma patients.²² Factors associated with nonaccidental burn injury, such as young age, specific burn patterns, or delay in care, should be recognized by providers and included in protocols for transfer and admission. There is a need not only for more social services support after hours but more research and better education among health care providers to identify warning signs for NAT. Even in an unintentional burn, low socioeconomic status families may benefit from additional support to avoid admission. Although some dressing supplies are easily procured at pharmacies, in our experience the cost may be prohibitive. Moreover, families may be uncomfortable with dressing changes. In our institution, we are developing preprepared packs of burn dressing supplies and educational material on dressing applications to assist in ED discharge. An online video of a dressing change has been developed by our pediatric burn surgeons and is now available for families. Remote evaluations via telemedicine could play a role in mitigating social factors that prevent ideal burn care. Because many of our patients are transferred, some from up to 2 hours away, video or photo consultations and outpatient visits may assist families who live far from the burn center in receiving appropriate care. Even patients who are transferred locally may not have the means to return home because of their car being at the initial facility, lack of funds, or late hours with limited public transportation. Taxi fare or other support to assist low-income families to return home is likely less expensive than one night in the hospital. However, this study provides clearer knowledge of our patient population and their needs. Because of this knowledge, we have a better understanding of the resource allocations needed to care for these patients and their families.

Pain management is a challenge in young burn patients. Pain and anxiety surrounding burn wound care can lead to psychologic distress and even post-traumatic stress disorder.²³ Conscious sedation in the ED and pain management protocols may decrease admissions or duration of stay. Educating caregivers on opioid and nonopioid pain management in addition to nonpharmacologic strategies is necessary if patients are to be discharged with home wound care. Pain and anxiety management should follow evidence-based guidelines, where they exist, and be tailored to individual needs.²⁴

There are limitations in this study beyond its retrospective nature. We evaluated appropriateness of transfer in terms of ABA referral criteria. We were unable to account for all criteria, specif-

ically social concerns and hospital resources, which our study found are significant components of patient disposition. We only reviewed patients who were triaged through our ED; therefore an unknown number of patients may have been dispositioned to follow-up with a pediatrician or in our burn clinic from outside hospitals. We did not have any direct admissions, because all burn patients, especially polytrauma patients, are evaluated in the ED. Though not presented here, we did collect data on patients who followed up in clinic. There were very few complications such that we could not assess the impact of observation admission versus ED discharge in low-acuity burns. Fortunately, these patients do extremely well, but the consequences of different disposition strategies need to be further elucidated.

In conclusion, the majority of pediatric burn patients were admitted to the hospital despite the low acuity of injury. Though complex areas of the body such as hands were often involved, evaluation by CPS, transfer from another facility, and burn size were associated with observation admission. Resources may be better uses for outpatient management of minor burns to improve the quality, value, and convenience of care.

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