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Inter-Facility Transfer of Pediatric Burn Patients from U.S. Emergency Departments

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Abstract

Purpose—To describe the epidemiology of pediatric burn patients seen in U.S. emergency departments (EDs) and to determine factors associated with inter-facility transfer.

Methods—We analyzed data from the 2012 Nationwide Emergency Department Sample. Current American Burn Association (ABA) Guidelines were used to identify children <18 who met criteria for referral to burn centers. Burn patient admission volume was used as a proxy for burn expertise. Logistic models were fitted to examine the odds of transfer from low volume hospitals.

Results—In 2012, there were an estimated 126,742 (95% CI: 116,104–137,380) pediatric burn ED visits in the U.S. Of the 69,003 (54.4%) meeting referral criteria, 83.2% were in low volume hospitals. Only 8.2% of patients meeting criteria were transferred from low volume hospitals. Of

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Conflicts of interest:

All authors have no conflicts of interest to declare.

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the 52,604 (95% CI: 48,433 – 56,775) not transferred, 98.3% were treated and released and 1.7% were admitted without transfer; 54.7% of burns involved hands.

Conclusions—Over 90% of pediatric burn ED patients meet ABA burn referral criteria but are not transferred from low volume hospitals. Perhaps a portion of the 92% of patients currently receiving definitive care in low volume hospitals are under-referred and would have improved clinical outcomes if transferred at the time of presentation.

Keywords

burn; pediatric; transfer; referral

Introduction

Every day in the United States, over 300 children aged 0 to 19 are seen in emergency departments with burn-related injuries.[1] Patients under the age of 18 comprise 26.8% of all burn injury admissions.[2] Ensuring that pediatric patients with significant burns receive care in hospitals with burn care expertise is important because lower mortality rates are associated with hospitals that have higher burn admission volumes. These facilities may also achieve better functional outcomes for patients.[3–9] Expertise is even more crucial when dealing with children, whose care needs are unique and distinct from adults.[7, 9, 10] Palmieri et al. found that even within verified and non-verified burn centers, pediatric experience as measured by annual pediatric burn patient admissions plays a role in patient mortality.[9] Other outcomes may be affected as well, since hospitals with low numbers of pediatric patients may lack pediatric specific social, emotional, and rehabilitative services.

The American College of Surgeons and American Burn Association (ABA) have a joint program to verify burn care facilities. As a result, hospitals fall into one of three categories: verified burn centers who have met the ABA's rigorous requirements for burn care resources; non-verified burn centers who are self-listed in the ABA directory but do not have ABA verification; and non-burn centers.[11] The ABA outlines certain characteristics of a burn injury that warrant referral to a facility equipped with burn care resources.[12] Most ABA referral criteria relate to the size, degree, and mechanism of the burn, but there is also a criterion specific to the pediatric population, recommending referral from hospitals without qualified personnel and equipment for the care of children. These criteria are not strict rules dictating automatic transfer to a burn center, but rather guidelines recommending burn-specific referral which can include outpatient referral and inter-facility transfer. Inter-facility transfer has been used in previous studies, as well as in the current study, to evaluate a component of referral.[3, 5, 13–15]

Previous studies have reported that pediatric hospitals treat 56% of hospitalized pediatric burn patients, and that children seen in pediatric hospitals are those with more severe burns. [13, 16] Zonies et al. utilized a national dataset to describe inpatients with significant burns that meet criteria for referral to a burn center.[14] They reported that for pediatric inpatients, 25% were cared for in verified burn centers, 30% were treated in non-verified burn centers, and 45% received care in non-burn centers.[14] One recent statewide study in North Carolina reported that 55% of children treated at non-burn centers meet criteria for transfer.

[15] Similarly, Carter et al. found that in a statewide sample of adult inpatients, 47% of burn injuries received acute inpatient care at non-burn centers, and almost half of these met referral criteria.[3] They also found that all burn-related deaths at non-burn centers had met criteria for transfer.[3]

Our study seeks to fill a gap in knowledge regarding pediatric patients with significant burns seen in emergency departments (EDs). Prior research examining transfer patterns and the treatment locations of burn patients have only studied hospitalized patients,[13, 14, 16] and other studies have been focused primarily on adults.[3, 14] Our study is drawn from a nationally representative sample of emergency departments. This study is the first to provide national estimates of the number of pediatric patients who meet ABA referral criteria and to examine factors associated with inter-facility transfer from US EDs.

Methods

Data Source

This study utilized the most current data available, the 2012 Nationwide Emergency Department Sample (NEDS) which is a part of the Healthcare Cost and Utilization Project (HCUP). The NEDS is the largest publicly available database containing de-identified discharge data for emergency department (ED) visits, with data from over 950 hospitals in 30 states. Each year, HCUP produces an approximately 20% stratified sample of U.S. hospital-based EDs, and it includes weighting variables to calculate national estimates. The 2012 NEDS contains approximately 30 million ED visits and an estimated 130 million discharges after weighting, with over 100 clinical and nonclinical variables per visit. The following hospital characteristics were used for sample stratification: U.S. Census region, trauma center designation, urban-rural location of the hospital, ownership, and teaching status.[17] More detailed information, such as the states included in the 2012 NEDS, is available on the HCUP website.[17]

Patient and burn characteristics

We identified children under the age of 18 with burn injuries using International Classification of Disease Ninth Revision, Clinical Modification (ICD-9) codes for burn injuries (ICD-9 codes 940–949). We included the following patient and burn injury characteristics: patient gender, age, median household income by zip code, patient disposition from the ED, expected primary payer, burn site, burn degree, and total body surface area (TBSA) burned. We also included burn mechanism using external cause of injury codes (E codes); each ED visit may have up to four E codes. Codes associated with intentional injuries/undetermined intent are reported separately.

American Burn Association (ABA) referral criteria

We created variables for American Burn Association (ABA) referral criteria describing those patients with burn injuries that should be referred to a burn center. These ABA referral criteria variables included: 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.[12] Comorbid conditions were defined using a variable available in the NEDS, the Chronic Condition indicator, which labels all available ICD-9 diagnosis codes as chronic or non-chronic.[18] We included all chronic conditions except those the NEDS categorizes as resulting from injuries. Concomitant trauma was defined as another trauma diagnosis and an Injury Severity Score (ISS) >9. In the NEDS, ISS is assigned using ICD-9-CM diagnosis codes by a publicly-available Stata program (ICDPIC). Burns are not included in the ICDPIC's ISS calculation. We did not create a variable for the ABA referral criterion specific to children, because our study looked exclusively at patients <18 years old. This criterion recommends referral from hospitals without qualified personnel and equipment for the care of children. Given the variables available in NEDS, we also did not attempt to create a referral criterion variable for patients who needed social, emotional, or rehabilitative services.

Hospital burn care resources

In this study, we used annual hospital burn patient admission volume as a proxy for burn center resources, including burn expertise to care for children. Our annual hospital burn patient admission volume variable includes both adult and pediatric burn admissions. In our study, low volume hospitals were defined as those with <50 burn admissions per year and high volume hospitals were those with ≥50 burn admissions. While the ABA Guidelines for the Operation of Burn Centers, in place at the time the data was collected, used ≥100 annual burn admissions for burn center verification, we are not attempting to identify verified centers but rather those hospitals with burn care experience (with or without verification). [12] Additionally, a recent review of the burn center verification guidelines, updated in February of 2015, allows centers to consider five new outpatients as one inpatient.[19] In our sample, there were only six hospitals with burn patient admission volumes in the range of 50–99.

Children's hospitals were identified by calculating the median age of patients admitted in each hospital. The median age of patients for some hospitals is less than ten, while for others it is over twenty, and no hospitals fall in between. For this reason we identified children's hospitals as hospitals with a median patient age <10 years. Hospitals were also categorized according to their urban-rural designation. We are making the assumption that transferred pediatric patients are being sent to hospitals with the necessary burn care resources; we cannot confirm this using the NEDS dataset. It is acknowledged that referral occurs in the context of the care available within each region.

Statistical Analysis

All analyses were performed using SAS 9.3 (SAS, Cary, NC) software. We used NEDS weighting variables to calculate national estimates with confidence intervals and weighted percentages for demographics, hospital characteristics, and burn injury characteristics of all pediatric burn-related ED visits. We produced incidence rates by age and gender for burn ED visits using US census data.

We report patient disposition by burn characteristics for both low and high volume hospitals. Patients who were admitted but then transferred were included as transfers. For those

patients meeting referral criteria, we then examined transfer rates by hospital burn patient admission volume.

Patients who met at least one referral criterion and were either admitted, or treated and released without transfer, by a low volume hospital were of interest and are shown in gray in Figure 1. We used multivariable logistic regression to determine which factors were associated with transfer among those patients meeting referral criteria and first seen in low volume hospitals. The variables of interest in our study were the ABA referral criteria and confounding variables included patient age, gender, urban-rural designation of patient residence, median household income by zip code, and expected primary payer. Those confounding variables were chosen because they can affect patient transfer between medical facilities. The primary purpose of the logistic regression analysis was to identify risk factors for transfer; therefore, we reported adjusted odds ratios and 95% confidence intervals for each independent variable in the model. We used SAS procedures for weighted sample data analysis.

Results

Characteristics of pediatric burn ED visits

There were a total of 28,363 pediatric burn-related ED visits identified in the 2012 NEDS sample, producing a weighted national estimate of 126,742 (95% CI: 116,104–137,380). Demographics and hospital characteristics are shown in Table 1. The majority of pediatric burn-related ED visits were seen in children age 4 and under. There was a peak in the population rates at age one, and rates in males were higher at this age (Figure 2). Those patients residing in zip codes with the lowest income were the largest proportion of patients, representing nearly 35% of burn ED patients. As household income by zip code increased, the proportions of pediatric burn patients residing in those zip codes decreased. Over half of the ED visits involved patients for whom public insurance was the expected primary payer. Nearly half of all pediatric burn patients resided in large metropolitan areas. Nearly 80% (95% CI: 72.38%–85.49%) of pediatric burn ED visits were in hospitals with under 20 annual burn patient admissions. Overall, 90.3% of patients were treated and released from the ED, 4.0% were admitted to that same hospital without transfer, and 5.6% were transferred.

Pediatric burn injury characteristics are shown in Table 2. The most common burn site involved the wrist(s) and hand(s), followed by lower limb(s). Over two-thirds of visits involved second degree burns. TBSA burned was unspecified in over half of patients; however, of those with unspecified TBSA burned, nearly 95% were treated and released and less than 5% were transferred (data not shown). Nearly 40% of all patients had a TBSA <10%. The most commonly coded mechanism for injury was hot object/substance: other/unspecified (44.6%) followed by hot liquids and vapors, including steam (28.6%). Fire and flames was reported in 11.3% of visits. In 2012, 69,003 ED patients (54.4%) had burns which met at least one referral criterion (95% CI: 53.1%–55.8%). A partial-thickness burn of the hand was the most frequently met criterion.

Patient disposition by burn characteristics

Table 3a shows patient disposition from the low volume hospitals by burn characteristics. Of those meeting at least one referral criterion in low volume hospitals, 90.1% were treated and released. Partial thickness burns >10% TBSA burned was the criterion with the greatest proportion transferred (50.1%), followed by partial thickness burns of the genitalia (39.8%). Only 5.2% of children with partial thickness burns of the hand were transferred from low volume hospitals, and 72.6% (4,562) of patients meeting more than one criterion were treated and released. Of the 6,648 transferred patients from low volume hospitals, 1,921 did not meet any referral criteria; of these, an estimated 1,201 had missing TBSA burned (data not shown). Table 3b shows patient disposition from high volume hospitals by burn characteristics. Of those meeting at least one referral criterion in high volume hospitals, 68.5% were treated and released. Admission rates for patients meeting referral criteria appear higher in the high volume hospitals. Direct statistical comparisons were not made between high and low volume hospital patient dispositions. High volume hospitals may be more likely to receive transfer patients. Patients seen in sample high volume hospitals may have been transferred from sample low volume hospitals.

Patients with significant burns (meeting referral criteria)

Table 4 shows the ED disposition of patients with burns meeting at least one referral criterion by annual hospital burn patient admission volume. An estimated 57,382 (95% CI: 52,801–61,962) were initially seen in low volume hospitals, with 78.9% first seen in hospitals with <20 burn admissions.

Despite meeting criteria for referral to a burn center, only 8.2% (95% CI: 7.3%–9.1%) of these patients were transferred from low volume hospitals, leaving an estimated 52,604 (95% CI: 48,433–56,775) patients who were not transferred. The rates of transfer from the high volume hospitals were similar for those hospitals with 50–99 burn admissions (3.1%) and those with 100 or more admissions (2.8%).

Patients with significant burns but not transferred

Among the patients with significant burns receiving their definitive care in low volume hospitals, an estimated 51,700 were treated and released and 905 were admitted without subsequent transfer by low volume hospitals (Figure 1). The most commonly met referral criterion in this group was partial-thickness burns of the hand, which was met by 54.7% (95% CI: 53.6%–55.9%) of patients with significant burns managed in low volume hospitals (data not shown). Of the estimated 28,798 patients with second degree hand burns in this group, 28,622 were treated and released and 175 were admitted. The next most commonly met criteria among those not transferred were burns of the feet or joints (19.2%, 95% CI: 18.3%–20.0%), followed by burns of the face/head and neck (14.0%, 95% CI: 13.3%–14.8%).

Factors associated with transfer

The results of logistic regression modeling transfer of pediatric burn ED patients meeting referral criteria from low volume hospitals are shown in Table 5. Patients with age <5 (AOR, 1.75; 95% CI: 1.29–2.36), partial-thickness burns with >10% TBSA (AOR, 12.61; 95% CI:

9.54–16.65), full-thickness burns (AOR, 6.43; 95% CI: 4.58–9.03), and burns of the face/head/neck (AOR, 3.41; 95% CI: 2.68–4.34) or genitalia (AOR, 10.55; 95% CI: 5.76–19.33) were more likely to be transferred. Patients from medium metropolitan areas (AOR, 0.62; 95% CI: 0.43–0.91) and those with chemical burns (AOR, 0.50; 95% CI: 0.34–0.74) were less likely to be transferred. Income by zip code and expected primary payer were not associated with transfer. Aside from being children, 28.7% of all transfers did not meet any additional referral criteria. These patients are not included in our logistic model. There is a criterion specific to the pediatric population, recommending referral from hospitals without qualified personnel and equipment for the care of children.

Discussion

In 2012, over half of pediatric burn patients met the ABA criteria for referral to a burn center, and over 78.9% of these children were first seen in hospitals with <20 burn admissions/year. Nevertheless, only 8.2% of patients meeting criteria were transferred from low volume hospitals presumably to hospitals with burn care expertise. Certain criteria were positively associated with transfer: age <5 years, burns >10% TBSA, full-thickness burns, and burns of the face/head/neck or genitalia. Insurance status and income were not associated with transfer. There has been little previous comparison research examining ABA burn referral criteria in children. Zonies et al. analyzed two years of burn patient admissions using HCUP national in-patient data.[14] Those admitted to verified centers were more likely to have head/neck burns, hand burns, or electrical burns, but their sample included both adults and children. These authors reported that patients under the age of five were more likely to be admitted to verified/non-verified burn centers, but no other pediatric-specific results were reported. Doud et al. studied pediatric burn in-patients from 2000 to 2007 using a statewide database and found that neither age nor gender was associated with treatment location; however, 78% of burn-specific procedures performed at non-verified burn centers were performed on patients meeting referral criteria.[15]

It is possible that some children treated without inter-facility transfer are receiving adequate burn care in the ED or with outpatient follow-up care, especially for minor burns. The guidelines, however, do not outline when this is appropriate, leaving the course of care and consultation with burn centers to the discretion of ED providers in low volume hospitals. A previous study has reported on the notable opportunity for error in this decision-making process.[20] One way to lessen this documented room for error involves clear guidance from the ABA and from burn centers to referring hospitals about these care continuum and consultation decisions.[21]

Another concern is that any recommended outpatient burn-specific care relies on caregivers to transport the child to a burn center. Other researchers have recommended a revision of the ABA guidelines in order to differentiate between significant burns requiring immediate transfer, from burns requiring burn center care but without an urgent need for transfer.[20] Others have suggested more detailed collection of outpatient and outcome data in the National Burn Registry to facilitate this research.[22] These authors provide an evaluation of the additional resources needed to collect outpatient data in their hospitals' burn registry.[22] Evaluating burn center outpatient populations in relation to the ABA referral guidelines may

add to our understanding of follow-up care patterns. In trying to address these concerns with burn center referral, the practice of telemedicine has recently been discussed as a potential area of investigation in improving burn care.[20, 23] Saffle et al. found that burn size estimates given by remote burn center physicians correlated closely with direct inspection without sacrificing provider or patient satisfaction.[23] The authors concluded that this practice of telemedicine may be able to improve utilization of burn care resources and provide cost-effective burn center expertise to many rural communities. Given the large numbers of pediatric patients with significant burns, greater use of telephone consultation and telemedicine is merited.

Limitations

The sampling and national estimation weighting in the NEDS database is a major strength of this research. However, perhaps the greatest limitation of this study is that TBSA burned was missing from nearly 58% of the burn-related visits; however, nearly 95% of these patients were treated and released and less than 5% were transferred. Of the 6,648 transferred patients from low volume hospitals, 1,921 did not meet any referral criteria; of these, an estimated 1,201 had missing TBSA burned. It is possible that referring hospitals do not always calculate TBSA burned and leave this to the receiving hospital. It is also worth noting that major discrepancies by hospital have been shown in pediatric burn size estimates. Goverman et al. (2015) found that 94% of children referred to a pediatric burn center had inaccurate burn size estimates from the referring hospital.[24] Because ICD-9 coding is intended for billing purposes, this may also explain the low reporting of TBSA burned. Transferring hospitals may not have pediatric specific care resources, and this may partially explain the transfer of children not meeting other burn referral criteria.

Another limitation is that burn center designation is not specified in the NEDS database. We used annual burn patient admission volume ≥ 50 as a conservative proxy for pediatric burn care expertise.[12] This does not guarantee that the hospitals that we classified as high volume are burn centers. Since we included both adult and pediatric burn admissions, hospitals classified as high volume may still not have sufficient pediatric burn care resources. Finally, the NEDS database does not provide information about patients referred for follow-up care at a burn center, so that some patients meeting ABA criteria may be referred to burn facilities without inter-facility transfer.

Conclusions

The current study found that a small proportion of burned children meeting ABA criteria are transferred from low volume hospitals. This finding raises concerns: the ABA referral criteria for pediatric burn patients may be too broad, and would possibly benefit from urgency specifications regarding care; perhaps a portion of the 92% of patients currently receiving definitive care in low volume hospitals are under-referred and would have improved clinical outcomes if transferred upon presentation. If outpatient referral is recommended for a substantial proportion of pediatric burn patients meeting ABA referral criteria, relying on caregivers may be problematic. Further research on the long-term care and outcomes of pediatric burn patients is needed to address these concerns.

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Highlights

- The epidemiology of U.S. pediatric burn-related ED visits in 2012 is presented.
- Over 50% met American Burn Association (ABA) referral guidelines.
- Factors associated with inter-facility transfer are described.
- Only 8.2% of children meeting criteria were transferred.

Figure 1. Pediatric burns in NEDS 2012

National estimates and weighted percentages are reported with sample n in parentheses.

Shaded boxes represent under-referred patients.

Abbreviations: NEDS, Nationwide Emergency Department Sample; ED, emergency department; ABA, American Burn Association

*Low volume hospitals are those with <50 annual pediatric burn patient admissions; high volume hospitals had ≥ 50

+Patients admitted but then transferred were included as transfers

Figure 2. Pediatric burn ED visits, incidence per 1000 population, by single year of age and sex, NEDS 2012

Abbreviations: NEDS, Nationwide Emergency Department Sample; ED, emergency department

Table 1

Demographic and hospital characteristics of pediatric burn related ED visits, NEDS 2012

	Sample N	National Estimates	% Weighted	95% CI
Total	28,363	126,742		
Gender				
Male	15,605	69,728	55.0	(54.4 – 55.6)
Female	12,756	57,007	45.0	(44.4 – 45.6)
Age (years)				
<1	2,088	9,271	7.3	(6.9 – 7.7)
1–4	13,119	58,664	46.3	(45.4 – 47.2)
5–9	5,513	24,415	19.3	(18.7 – 19.8)
10–14	4,242	19,097	15.1	(14.5 – 15.6)
15–17	3,401	15,295	12.1	(11.4 – 12.8)
Median Household Income (by Zip code)				
\$1 – \$38,999	9,838	43,374	34.7	(32.3 – 37.1)
\$39,000 – \$47,999	7,527	33,793	27.1	(25.5 – 28.6)
\$48,000 – \$62,999	6,178	28,346	22.7	(20.5 – 24.9)
\$63,000 or more	4,400	19,341	15.5	(13.7 – 17.3)
Expected primary payer				
Public	16,305	72,242	57.1	(55.2 – 59.0)
Private including HMO	8,426	38,407	30.4	(28.9 – 31.8)
Self-pay	2,272	10,060	8.0	(6.8 – 9.1)
Other	1,319	5,818	4.6	(3.7 – 5.5)
Patient residence urban-rural designation				
Large metropolitan	13,945	59,431	47.0	(43.2 – 50.7)
Medium metropolitan	6,101	28,637	22.6	(18.7 – 26.6)
Small metropolitan	2,628	12,259	9.7	(8.0 – 11.4)
Micropolitan	3,371	15,375	12.2	(11.0 – 13.3)
Not metropolitan or micropolitan	2,253	10,764	8.5	(7.6 – 9.4)
Hospital burn patient admission volume				
0	3,764	17,938	14.2	(12.0 – 16.3)
1–19	18,991	82,106	64.8	(58.7 – 70.8)
20–49	1,738	8,086	6.4	(2.2 – 10.6)
>=50	3,870	18,611	14.7	(8.4 – 21.0)
Children's hospital designation [^]				
Non-children's hospital	26,351	117,817	93.0	(88.1 – 97.8)

	Sample N	National Estimates	% Weighted	95% CI
Children's hospital	2,012	8,925	7.0	(2.2 – 11.9)
Disposition				
Treated and released	25,737	114,487	90.3	(89.0 – 91.6)
Admitted to same hospital without transfer	1,056	5,069	4.0	(2.5 – 5.5)
Transferred from ED/hospital	1,551	7,097	5.6	(4.8 – 6.4)
Died in the ED	*	13	0.0	(0.0 – 0.0)
Other	16	76	0.1	(0.0 – 0.1)

Abbreviations: ED, emergency department; NEDS, Nationwide Emergency Department Sample; CI, confidence interval

*
<10

^
Children's hospitals were identified using median admitted patient age <10

Table 2

Burn characteristics and referral criteria, NEDS 2012

	Sample N	National Estimates	% Weighted	95% CI
Burn site				
Burn confined to eye and adnexa	882	3,936	3.1	(2.8 – 3.4)
Burn of face head and neck	3,818	17,273	13.6	(12.9 – 14.3)
Burn of trunk	5,248	23,588	18.6	(17.7 – 19.5)
Burn of upper limb except wrist and hand	5,581	25,166	19.9	(19.2 – 20.5)
Burn of wrist(s) and hand(s)	10,880	48,908	38.6	(37.8 – 39.4)
Burn of lower limb(s)	7,299	32,601	25.7	(25.1 – 26.3)
Burn of internal organs	206	917	0.7	(0.6 – 0.8)
Burn unspecified site(s) ⁺	548	2,408	1.9	(1.4 – 2.4)
Burn degree				
Unspecified degree	4,010	17,429	13.8	(12.8 – 14.7)
First degree	4,130	18,342	14.5	(13.6 – 15.3)
Second degree	19,455	87,429	69.0	(67.8 – 70.1)
Third degree	768	3,542	2.8	(2.3 – 3.3)
Surface area involved				
Unspecified	16,694	73,423	57.9	(54.3 – 61.5)
<10%	10,793	49,305	38.9	(35.5 – 42.3)
10–19%	651	2,957	2.3	(2.1 – 2.6)
20–29%	124	591	0.5	(0.4 – 0.6)
30–39%	55	266	0.2	(0.1 – 0.3)
40–49%	15	62	0.0	(0.0 – 0.1)
>=50%	31	138	0.1	(0.1 – 0.2)
Mechanism				
No E-codes listed	1,209	5,596	4.4	(3.3 – 5.5)
Intentional injury/Undetermined intention	359	1,545	1.4	(1.2 – 1.5)
Unintentional injury mechanisms				
Fire and flames	2,813	12,771	11.3	(10.7 – 11.9)
Hot liquids and vapors, including steam	7,287	32,328	28.6	(27.2 – 29.9)
Hot (boiling) tap water	2,070	9,176	8.1	(7.3 – 8.9)
Hot object/substance: Other/Unspecified	11,363	50,520	44.6	(43.5 – 45.8)
Electrical	548	2,463	2.2	(1.9 – 2.4)
Chemical	970	4,347	3.8	(3.6 – 4.1)
Other E-codes	1,744	7,995	6.3	(5.8 – 6.8)
Referral criteria				
Did not meet any criterion	13,073	57,739	45.6	(46.1 – 48.7)

	Sample N	National Estimates	% Weighted	95% CI
Met at least one criterion	15,290	69,003	54.4	(51.3 – 53.9)
Partial-thickness and >10% TBSA	791	3,631	2.9	(2.5 – 3.2)
Partial-thickness of Face/Head and Neck	3,123	14,125	11.1	(10.4 – 11.9)
Partial-thickness of Hand	7,847	35,595	28.1	(27.3 – 28.9)
Partial-thickness of Feet or Joints	3,036	13,696	10.8	(10.2 – 11.4)
Partial-thickness of Genitalia	210	943	0.7	(0.6 – 0.9)
Full-thickness	768	3,542	2.8	(2.3 – 3.3)
Electrical	548	2,463	1.9	(1.7 – 2.2)
Chemical [^]	1,011	4,537	3.6	(3.3 – 3.8)
Inhalation injury	*	36	0.0	(0.0 – 0.1)
Comorbid Conditions	1,744	7,836	6.2	(5.6 – 6.8)
Concomitant Trauma	29	134	0.1	(0.1 – 0.1)

Abbreviations: NEDS, Nationwide Emergency Department Sample; CI, confidence interval; TBSA, Total Body Surface Area

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⁺ Includes patients with nonspecific burn site codes only

[^] Includes both unintentional and intentional/undetermined intention

Burn characteristics by disposition in low volume hospitals

Table 3a

Burn Characteristics	Treated & released	Weighted Row %	95% CI	Admitted without transfer	Weighted Row %	95% CI	Transferred from ED/hospital	Weighted Row %	95% CI
Total	100,269	92.7	(92.0 – 93.5)	1,129	1.0	(0.7 – 1.4)	6,648	6.1	(5.5 – 6.8)
Surface area involved									
Unspecified/Missing	63,742	94.5	(93.8 – 95.3)	448	0.7	(0.5 – 0.8)	3,221	4.8	(4.0 – 5.5)
<10%	35,208	92.9	(91.8 – 94.0)	531	1.4	(0.7 – 2.1)	2,123	5.6	(4.7 – 6.5)
10–19%	1,017	50.1	(44.2 – 56.0)	111	5.5	(2.1 – 8.9)	897	44.2	(38.5 – 49.8)
20%	302	40.4	(32.8 – 48.1)	38	5.1	(0.9 – 9.3)	407	54.5	(46.5 – 62.5)
Burn degree									
Unspecified degree	14,575	93.8	(92.9 – 94.8)	208	1.3	(0.9 – 1.7)	735	4.7	(3.8 – 5.6)
First degree	16,625	97.9	(97.3 – 98.6)	74	0.4	(0.2 – 0.7)	261	1.5	(1.0 – 2.1)
Second degree	67,725	92.1	(91.2 – 93.1)	757	1.0	(0.6 – 1.4)	4,975	6.8	(5.9 – 7.6)
Third degree	1,344	63.4	(58.7 – 68.2)	89	4.2	(2.0 – 6.5)	677	31.9	(27.4 – 36.4)
Did not meet any criterion	48,569	95.7	(95.1 – 96.3)	224	0.4	(0.3 – 0.6)	1,921	3.8	(3.2 – 4.4)
Met at least one criterion	51,700	90.1	(89.0 – 91.2)	905	1.6	(1.0 – 2.2)	4,727	8.2	(7.3 – 9.1)
Partial-thickness and >10% TBSA									
Partial-thickness of Face/Head & Neck	1,056	43.5	(38.0 – 49.0)	150	6.2	(2.6 – 9.7)	1,215	50.1	(44.7 – 55.5)
Partial-thickness of Hand	5,614	75.0	(72.3 – 77.7)	251	3.4	(1.5 – 5.2)	1,606	21.5	(19.1 – 23.8)
Partial-thickness of Feet or Joints	28,622	94.1	(93.1 – 95.2)	175	0.6	(0.2 – 1.0)	1,596	5.2	(4.3 – 6.2)
Partial-thickness of Genitalia	7,577	90.6	(88.8 – 92.3)	144	1.7	(0.6 – 2.8)	638	7.6	(6.1 – 9.2)
Full-thickness	298	51.4	(42.6 – 60.2)	47	8.1	(3.9 – 12.2)	231	39.8	(31.6 – 47.9)
Electrical	1,344	63.4	(58.7 – 68.2)	89	4.2	(2.0 – 6.5)	677	31.9	(27.4 – 36.4)
Chemical	2,053	95.5	(93.6 – 97.4)	*	0.2	(0.0 – 0.5)	93	4.3	(2.6 – 6.2)
Inhalation injury	3,737	93.1	(91.3 – 94.9)	84	2.1	(1.0 – 3.2)	184	4.6	(3.1 – 6.1)
Comorbid Conditions	*	22.8	(0.0 – 61.5)	10	43.5	(0.0 – 87.7)	*	33.7	(0.0 – 73.9)
Concomitant Trauma	5,407	88.5	(86.4 – 90.7)	324	5.3	(3.6 – 7.0)	364	6.0	(4.6 – 7.4)
	30	43.8	(17.9 – 69.8)	29	42.9	(16.0 – 69.9)	*	13.2	(0.0 – 30.5)

Burn Characteristics	Treated & released	Weighted Row %	95% CI	Admitted without transfer	Weighted Row %	95% CI	Transferred from ED/hospital	Weighted Row %	95% CI
Met more than one criterion	4,562	72.6	(69.5 – 75.8)	294	4.7	(2.6 – 6.8)	1,412	22.5	(19.8 – 25.1)
Hospital burn patient admission volume									
0	16,765	93.5	(92.3 – 94.6)	.	.	.	1,168	6.5	(5.4 – 7.6)
1–19	76,339	93.0	(92.2 – 93.7)	653	0.8	(0.6 – 1.0)	5,038	6.1	(5.4 – 6.9)
20–49	7,165	88.6	(83.0 – 94.2)	475	5.9	(3.9 – 7.9)	442	5.5	(0.6 – 10.3)

Abbreviations: ED, emergency department; TBSA, Total Body Surface Area; CI, confidence interval

* <10

Burn characteristics by disposition in high volume hospitals^a

Table 3b

Burn Characteristics	Treated & released	Weighted Row %	95% CI	Admitted without transfer	Weighted Row %	95% CI	Transferred from ED/hospital	Weighted Row %	95% CI
Total	14,218	76.4	(71.8 – 80.9)	3,940	21.2	(16.1 – 26.2)	449	2.4	(0.0 – 4.8)
Surface area involved									
Unspecified/Missing	5,525	92.5	(89.4 – 95.5)	299	5.0	(2.3 – 7.7)	152	2.5	(0.7 – 4.3)
<10%	8,406	73.7	(65.5 – 81.9)	2,798	24.5	(16.3 – 32.8)	191	1.7	(0.0 – 4.3)
10–19%	218	23.5	(14.7 – 32.3)	634	68.4	(53.5 – 83.3)	75	8.1	(0.0 – 18.3)
20%	69	22.3	(6.6 – 38.0)	210	67.8	(51.6 – 84.0)	31	9.9	(2.7 – 17.1)
Burn degree									
Unspecified degree	1,715	90.4	(87.5 – 93.2)	131	6.9	(4.4 – 9.5)	47	2.5	(0.4 – 4.6)
First degree	1,260	92.0	(88.0 – 96.1)	101	7.4	(3.5 – 11.2)	*	0.6	(0.0 – 1.7)
Second degree	10,866	78.0	(72.7 – 83.4)	2,760	19.8	(14.4 – 25.3)	296	2.1	(0.0 – 4.4)
Third degree	377	26.5	(16.5 – 36.5)	948	66.6	(51.4 – 81.8)	98	6.9	(0.0 – 14.8)
Did not meet any criterion									
Met at least one criterion	6,254	89.5	(85.7 – 93.3)	618	8.8	(5.1 – 12.6)	118	1.7	(0.0 – 3.5)
	7,964	68.5	(63.2 – 73.8)	3,322	28.6	(22.7 – 34.5)	330	2.8	(0.0 – 5.7)
Partial-thickness and >10% TBSA									
Partial-thickness of Face/Head & Neck	270	22.4	(13.6 – 31.2)	834	69.2	(54.9 – 83.5)	101	8.4	(0.0 – 17.2)
Partial-thickness of Hand	1,632	53.9	(48.3 – 59.4)	1,278	42.2	(35.8 – 48.7)	118	3.9	(0.1 – 7.7)
Partial-thickness of Feet or Joints	4,084	78.7	(74.0 – 83.5)	1,011	19.5	(14.0 – 24.9)	92	1.8	(0.0 – 4.1)
Partial-thickness of Genitalia	1,131	65.0	(55.1 – 75.0)	530	30.5	(20.6 – 40.4)	77	4.4	(0.1 – 8.7)
Full-thickness	128	35.5	(19.3 – 51.8)	214	59.2	(44.0 – 74.4)	19	5.3	(0.0 – 11.2)
Electrical	377	26.5	(16.5 – 36.5)	948	66.6	(51.4 – 81.8)	98	6.9	(0.0 – 14.8)
Chemical	266	84.9	(72.9 – 96.9)	47	15.1	(3.1 – 27.1)	.	.	.
Inhalation injury	418	80.0	(69.2 – 90.8)	105	20.0	(9.2 – 30.8)	.	.	.
Conorbid Conditions	*	31.0	(0.0 – 63.7)	*	69.0	(36.3 – 100.0)	.	.	.
Concomitant Trauma	645	37.4	(23.8 – 50.9)	1,019	59.0	(44.4 – 73.6)	59	3.4	(0.0 – 6.9)
	*	13.6	(0.0 – 29.9)	52	77.7	(56.0 – 99.5)	*	8.6	(0.0 – 25.4)

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Burn Characteristics	Treated & released	Weighted Row %	95% CI	Admitted without transfer	Weighted Row %	95% CI	Transferred from ED/hospital	Weighted Row %	95% CI
Met more than one criterion	891	33.6	(25.8 – 41.4)	1,617	61.1	(50.2 – 71.9)	141	5.3	(0.0 – 11.2)

Abbreviations: ED, emergency department; TBSA, Total Body Surface Area; CI, confidence interval

* <10

^ Patients seen in high volume hospitals may have been transferred from low volume hospitals.

Table 4

Disposition of significant* pediatric burns by hospital burn admission volume

National Estimates						
Annual hospital admission volume		Total	Treated and released	Admitted without transfer	Transferred from ED/hospital	% Transfer ⁺ 95% CI
Low volume						
No admissions	9,495	8,655	0	835	8.8 8.2 7.9 8.2	(7.3 – 10.3)
1–19 admissions	43,466	39,395	486	3,543		(7.2 – 9.1)
20–49 admissions	4,421	3,649	419	349		(1.8 – 14.0)
Total low volume	57,382	51,700	905	4,727		(7.3 – 9.1)
High volume						
50–99 admissions	2,300	1,819	409	71	3.1	(0.0 – 6.4)
>=100 admissions	9,322	6,144	2,913	260	2.8	(0.0 – 6.2)
Total high volume	11,621	7,964	3,322	330	2.8	(0.0 – 5.7)
Total	69,003	59,664	4,226	5,057		

Abbreviations: ED, emergency department; CI, confidence interval; ABA, American Burn Association

* significant: met at least one ABA referral criterion

[†] Patients admitted but then transferred were included as transfers

Table 5Logistic regression on transfers among severe pediatric burn ED visits, NEDS 2012^a

	# patients treated in low volume hospitals	# Transfer	% Weighted transfer	AOR ^d	95% CI ^c
Total	12,897	1,046	8.2		
Age (years)					
<1	989	106	10.9	2.07	(1.43 – 2.98)
1–4	6,376	572	9.1	1.70	(1.26 – 2.30)
5–9	2,222	166	7.5	1.16	(0.85 – 1.58)
10–14	1,739	115	7.1	1.21	(0.80 – 1.83)
15–17 (ref.)	1,571	87	5.5		
Gender					
Male (ref.)	7,571	649	8.7		
Female	5,324	397	7.7	0.86	(0.74 – 1.00)
Patient residence urban-rural designation					
Large metropolitan (ref.)	5,714	503	9.1		
Medium metropolitan	2,952	169	6.0	0.62	(0.43 – 0.91)
Small metropolitan	1,399	113	8.1	0.83	(0.51 – 1.35)
Metropolitan	1,733	151	8.6	0.88	(0.63 – 1.24)
Rural	1,078	108	9.8	1.01	(0.71 – 1.43)
Median household income (by Zip code)					
\$1 – \$38,999	4,229	374	8.9	1.13	(0.79 – 1.62)
\$39,000 – \$47,999	3,393	279	8.6	1.37	(0.96 – 1.97)
\$48,000 – \$62,999	3,003	240	8.2	1.18	(0.87 – 1.61)
\$63,000 or more (ref.)	2,092	143	6.7		
Expected primary payer					
Private including HMO (ref.)	7,173	587	8.2		

	# patients treated in low volume hospitals	# Transfer	% Weighted transfer	AOR ^d	95% CI ^c
Public	4,094	312	7.9	0.94	(0.75 – 1.18)
Self-pay	1,018	108	11.3	1.23	(0.90 – 1.70)
Other	585	35	5.4	0.69	(0.42 – 1.12)
Referral criteria^b					
Partial thickness and >10% TBSA	538	273	50.1	12.61	(9.54 – 16.65)
Partial thickness of Face/Head and Neck	2,043	364	18.2	3.41	(2.68 – 4.34)
Partial thickness of Hand	6,781	338	5.2	0.86	(0.68 – 1.09)
Partial thickness of Feet or Joints	2,505	219	8.9	1.32	(1.01 – 1.74)
Partial thickness of Genitalia	138	57	39.8	10.55	(5.76 – 19.33)
Full thickness	480	158	31.9	6.43	(4.58 – 9.03)
Electrical	483	23	4.3	0.82	(0.48 – 1.38)
Chemical	899	40	4.6	0.50	(0.34 – 0.74)
Comorbid Conditions	1393	83	6.0	0.95	(0.68 – 1.35)
Concomitant Trauma	15	*	13.2	1.00	(0.09 – 11.10)

Abbreviations: ED, emergency department; NEDS, Nationwide Emergency Department Sample; AOR, Adjusted Odds Ratio; CI, confidence interval; TBSA, Total Body Surface Area

^aRestricted to those burn patients satisfying at least one referral criteria and treated in low burn admission volume hospital EDs.

^bInhalation injury was not included in the logistic model due to small numbers.

^cSignificance at 0.05 two-sided.

^dFor referral criteria there is no specific reference group; each criterion was compared with those not meeting this specific criterion.

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