

Report From the California Burn Registry— The Causes of Major Burns

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In its first four years of operation, the California Burn Registry recorded 3,332 cases of burns, of which 73.1% were in male and 26.9% were in female patients of all ages. The average total body surface area burned was $15.4 \pm 0.3\%$. Flame burns were the most common (31.4%). Other common sources included scalds (24.5%) and flammable liquids (12.9%). Several other causes were cited with less frequency. Burns taking place at home occurred more commonly than at all other locations combined. In all, 221 deaths (6.6%) were reported, most (66.1%) of which were due to flame burns.

(Bongard FS, Ostrow LB, Sacks ST, et al: Report from the California Burn Registry—The causes of major burns. West J Med 1985 May; 142:653-656)

Deaths and significant morbidity due to major burns have increased considerably over the past several years. More than 100,000 patients annually require admission to hospital for treatment of burn injuries, using approximately 2 million hospital bed-days.¹ About 6,000 civilians in the United States per year die as a result of thermal injury.² The combined cost incurred by these patients is in excess of \$1 billion.³ It has been estimated that at least \$50,000 is required to manage a patient with a 50% burn.⁴

In spite of improved therapeutic modalities for burn care, the most effective way to reduce burn morbidity and mortality lies in preventive efforts, which in turn depend on a knowledge of the diversity of the causes of burn injury. The California Burn Registry (CBR) was established by state law in 1977 to provide a central facility for collecting, tabulating and disseminating burn-related information in the state. Since the Registry's inception, the records of more than 3,000 patients have been accumulated. Evaluation of individual and collective case records has provided information regarding the epidemiology of burns and fire-related deaths. This report represents a statistical analysis of etiologic data obtained in the first four years of operation of the Registry.

Patients and Methods

Information was collected from 17 participating burn facilities throughout the state of California. Minimum requirements for patient entry into the Registry included evidence of second- or third-degree burn. Those with only first-degree burns were excluded.

Following a patient's admission to a burn unit, or upon initiation of outpatient therapy, a standard coding form was completed (Figure 1). An estimate of burn severity and relevant etiologic and demographic information, when available, were included. Forms were completed by either medical or health-related personnel. After the patient was discharged from a burn unit, or upon completion of outpatient care, the finished forms were sent to the California State Fire Marshal's office, where the sheets were tabulated and stored as coded data. (The California State Fire Marshal's office works with and provides extensive assistance to the Burn Registry.)

Values are expressed as mean \pm standard error of the mean. Comparisons were done using the unpaired Student's *t* test and contingency table analysis (χ^2) when appropriate. Statistical significance was assumed for $P < .05$.

Results

From the tabulated data, 3,332 cases were available for analysis. Due to variability in reporting techniques and errors in data entry, not all patients are included in each category.

Of the 3,332 reports, 3,290 contained properly coded information. Among these, 2,405 (73.1%) were of male patients and 885 (26.9%) were of female patients. The average total body surface area (TBSA) burn was $15.4\% \pm 0.3\%$. The average second-degree involvement was $12.4\% \pm 0.2\%$. Third-degree burns averaged $15.4\% \pm 0.1\%$. A total of 221 patients died (6.6%).

Data were examined in relation to the causative agent. Flame burns were most common, causing 31.4% of all inju-

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ABBREVIATIONS USED IN TEXT

CBR=California Burn Registry
TBSA=total body surface area

ries. Scalds other than from tap water accounted for 19% of the cases reported. Other significant causes included the following: flammable liquids (12.9%), combustible gas (5.8%), grease (5.6%), tap water scalds (5.5%), tar (4.0%), chemical (3.4%), electrical (3.3%) and all other causes, including contact burns (9.1%) (Figure 2).

The age dependence of each causative agent was examined by sex of the patient. Flame burns, those from flammable liquids and combustible gases and tar burns were most common in the 20- to 29-year age range for both sexes. Chemical burns occurred most frequently in men in the 20- to 29-year decile. There were no reported chemical burns in female patients. Electrical burns were evenly divided among male patients in their third and fourth decades; among female patients, the 20- to 29-year age group predominated. Grease burns were most common in men in the 20- to 30-year age

group. Grease burns were most commonly seen in female patients younger than 20 years. Scalds, whether due to tap water or other sources, were predominantly seen in those younger than 10 years, irrespective of gender.

The frequency with which burns occurred was examined with respect to geographic location. Overall, burns sustained at home occurred more commonly than all other locations combined. Within the home, burns took place with the greatest frequency in the kitchen (37.2%). This was followed by the bedroom (12.0%), garage (7.4%) and bathroom (7.0%). Burns at other and unidentified locations in the home accounted for the remainder of residential burns (36.4%).

The geographic location at which a burn occurred was considered with respect to causative agent. Open flame, flammable liquids, combustible gas, grease, tap water and other types of scalds occurred most frequently at home. Chemical, electrical and tar burns occurred most frequently at work.

Burns of the face or hands were frequent findings in this series. A total of 1,223 cases of face burns and 1,473 of hand burns were reported. Face or hand involvement was due most frequently to flame burns (42.5% and 39.7%, respectively).

HOSPITAL # 60		CALIFORNIA STATE FIRE MARSHAL		BURN CENTER REPORT (BCR)		STATE FIRE MARSHAL	
CASE NO. 4850							
A PATIENT INFORMATION		SEX	M	F	RACE	DATE OF BIRTH	MONTH DAY YEAR
RESIDENCE CITY				STATE		ZIP	
METHOD OF PAYMENT		MEDICAL	MEDICAL CARE	WORKMAN COMP	INSUR	OTHER	FD ID
B TERM OF CARE		DISCHARGED TO		HOME	HOSPITAL	OTHER	DECEASED
DATE OF INJURY		DATE OF ADMITTANCE		DATE OF DISCHARGE			
C SEVERITY OF BURN		PERCENTAGE OF BODY HAVING		SUSPECT CONDITION		SUICIDE ASSAULT CHILD ABUSE	
ASSOCIATED CONDITIONS		ETOH	SMOKER	DRUGS	PHYSICAL DISABILITY	BLIND	PSYCH HISTORY
AFFECTED BODY AREA		FACE	HANDS	OTHER	SMOKE INHALATION		YES NO
D CAUSE OF BURN		FLAME	FLAMMABLE LIQUID	COMBUSTIBLE GAS	TAP WATER SCALD	OTHER SCALD	GREASE/OIL
ELECTRICAL		CHEMICAL	TAR	CONTACT	OTHER		
E WHERE BURN HAPPENED		HOME	WORK	SCHOOL	HOSPITAL	OTHER	
INDOORS		KITCHEN	BEDROOM	GARAGE	BATH	OTHER	
OUTDOORS		VEHICLE	YARD	OPEN LAND	REC AREA	OTHER	
F IGNITION FACTORS		IGNITION SOURCE		CIGARETTE	MATCHES	OTHER	
CLOTHING IGNITED		SLEEPWEAR	DAYWEAR	F.R. TREATED	OTHER		
? HOW		DESCRIBE HOW BURN HAPPENED					

Figure 1.—Example of burn center report form.

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The other common agents producing face burns were flammable liquids (15.7%), scalds other than tap water (12.8%) and combustible gas (11.4%). Hand burns similarly were caused by flammable liquids (16.1%), combustible gas (9.7%) and scalds other than tap water (9.8%).

Of the 221 deaths (6.6%), the majority were from flame burns (66.1%). Burns from flammable liquids were next in frequency (15.7%), followed by tap water scalds (6.4%), burns by combustible gas (5.9%), other scalds (2.5%), tar (1.7%), electrical (1.3%) and grease burns (0.4%) (Figure 3).

Discussion

The epidemiology of burn morbidity and mortality has been addressed as integral portions of previous reports.^{2,5} The large number of patients in this study provides a useful data base for evaluating and contrasting causes of burns. Furthermore, in conjunction with other reports, this series is helpful in planning and establishing prevention efforts on local, state and national levels. This report includes patients of all ages and wide socioeconomic backgrounds. Because of the increasing trend toward outpatient burn care, this subpopulation has been included in our survey. The etiologic information contained in this report is intended for the use of those involved in the treatment and prevention of burn injury.

Data were accumulated from 17 participating burn facilities. Because all burns that occurred in California during our study period are not included and because those at risk were not strictly defined, population-based incidence data are not part of this report. Geographically, all reporting facilities except one were located in the southern two thirds of the state. Hence, reasonable homogeneity exists among environmental conditions. Obvious diversity is present, however, in housing styles, population density and socioeconomic levels. The temperate California climate lends itself to outdoor activities and provides greater exposure to hazards away from home.

Additionally, due to the relatively mild winter season, risks from items such as space heaters and other heating-related devices are probably underrepresented in this study, when compared with those reports emanating from harsher climates.

Consistent with the findings of several previous studies,⁶⁻⁸ burn injuries in male patients predominated over those in female patients. In this series, 73.1% of the patients were male, which is somewhat greater than the 52.4%⁶ and 62.3%⁸ reported in other large series, but is less than the 78.3% reported by Sanderson and associates.⁹ Hence, our sex distribution is within previously defined ranges.

In this study there was a mean TBSA burn of 15.4% \pm 0.3%. Most studies do not provide a mean TBSA burn but rather report a median burn range percentage. Feck and Baptiste⁷ found that more than 90% of their patients in New York had injuries of less than 20% TBSA. Blocker and associates⁶ reported that 51.6% of their burn patients had less than 20% TBSA burns, whereas Sanderson and colleagues⁹ found 37.6% of their patients to have less than a 20% TBSA burn. The CBR data reveal that 77.4% of the patients had burns of less than 20%, with a median burn of 9.5%. The decreased severity of burns in this study is most likely due to the inclusion of outpatient treated burns, which include less severely injured patients. Other series generally do not report second- and third-degree burns separately and, thus, our median of 9.6% for second-degree burns and 6.3% for third-degree burns is difficult to compare with previous work.

The 221 patients who died represent 6.6% of the population entered into the study. Others have reported from 1.1%⁸ to 12.8%⁶ mortality rates in in-hospital patients only. Although this study may selectively decrease the total mortality by including outpatients in the denominator, our result falls midway between previously reported mortality rates.

Flame burns typically prevail as the predominant source of mortality in thermal injury. In this series, as in others,

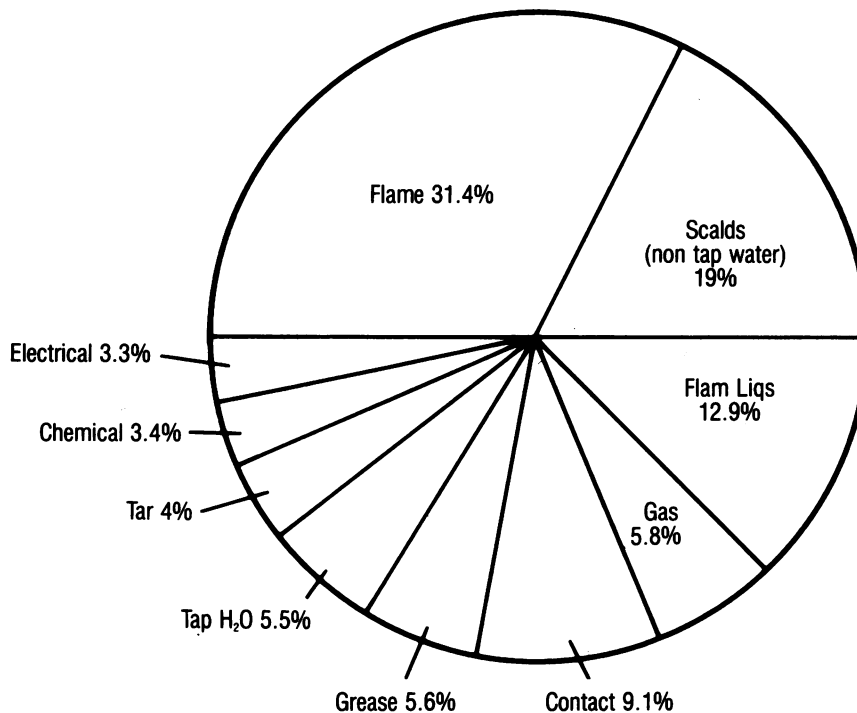


Figure 2.— Causes of burns in 3,332 cases.

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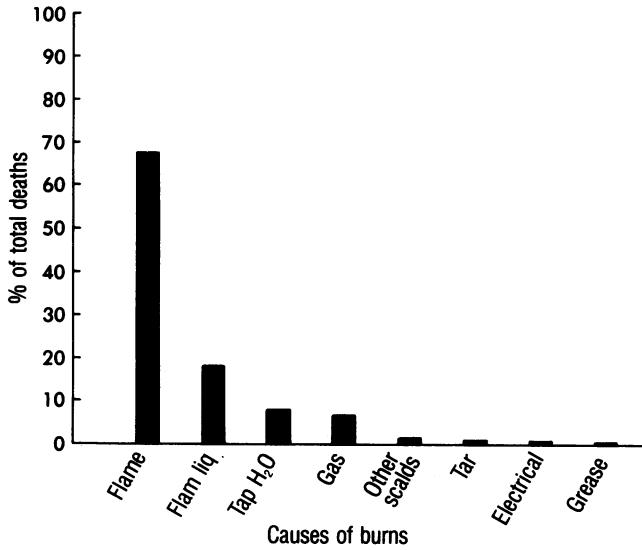


Figure 3.—Causes of death for 221 cases coded in California Burn Registry.

flames cause more deaths than other causes combined. Hamit,⁵ in a series of burn patients treated in a community hospital, found that flame burns accounted for only 42.3% of burn cases admitted, but were responsible for 81.5% of deaths. Moyer¹⁰ previously reported that flame burns were more lethal than burns from other causes. In the CBR, flames accounted for 31.4% of the injuries but 66.1% of the deaths. The specific death rate for flame burns was 15.3%, which was higher than that for any other cause (Table 1). In the 30 years since Moyer's report, flame injuries remain the most lethal of all burns.

Flame burns and combined scalds accounted for more than 50% of all burns treated, which is in agreement with previously reported series.^{6-8,11} In the present study, flame burns predominated, accounting for 31.4% of all injuries. Our finding is most likely due to the fact that the age group of 20 to 39 years had the most representation. Flame burns occur more frequently in this age group, whereas burns from scalds predominate in the first two decades of life,¹² which was the second most common burn occurrence and the second most common age group to suffer flame burns.

Among the most anatomically and psychologically incapacitating sequelae of burns are injuries of the hands and face. About a third of our patient population had involvement of either or both of these areas. Flame burns were the most commonly cited cause for these injuries. Hand or face burns or both were found in approximately two thirds of all deaths (L.B. Ostrow, MD, F.S. Bongard, MD, S.T. Sacks, PhD, unpublished data, April 1984). Although this is due in part to the fact that involvement of the hands and face often accompa-

TABLE 1.—Burn Cause-Specific Death Rate

Cause	Patient Population % of Total N=3,332	Cause-Specific Death Rate N=221
Flame	31.4	15.3%
Scalds other than tap water	19.0	1.0%
Flammable liquids	12.9	8.9%
Combustible gas	5.8	7.4%
Grease	5.6	.6%
Tap water scalds	5.5	8.3%
Tar	4.0	3.1%
Chemical	3.4	.0%
Electrical	3.3	2.7%
Contact and other	9.1	.0%

nies burns of greater severity, the increase in care required by these injuries complicates patient management. Nutritional, ventilatory and patient personal care are all significantly compromised by these burns.

In this study, the majority of burns occurred at home. This finding, in conjunction with the fact that most were caused by a flame or by a scalding agent, makes clear the need for passive preventive and active educational measures, with emphasis directed to the home. Smoke detectors, hot-water-temperature regulation devices, explosion-resistant fuel tanks on motor vehicles, the use of fire retardants in mattresses and furniture, residential sprinkler systems and fire-resistant cigarettes would all help to reduce burn morbidity and mortality. Only after a thorough understanding of the causes of burns is achieved can effective preventive measures, including environmental modifications and legislation, be implemented.

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