

# Increased Incidence of Heater-Related Burn Injury During a Power Crisis

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**Hypothesis:** Recent power shortages in California resulted in rolling blackouts and increased utility prices. Residents turned to alternative heating devices, such as space heaters, to decrease utility bills. Our hypothesis is that the incidence of heater-related injuries increased owing to the use of alternative heating methods during the power crisis.

**Design:** Retrospective case-series database and medical record review of all burn admissions for the 4 months of November through February for the period 1998-2002.

**Setting:** Regional pediatric and adult burn unit in northern California.

**Patients:** Patients admitted during the study interval with burn injury.

**Main Outcome Measures:** Parameters recorded included patient demographics, cause of burn, total body surface area burn, number of operative procedures, and hospital length of stay during each of the 4 months in the interval.

**Results:** A total of 512 patients were admitted during all 4-month intervals. During the power crisis there were significant increases in the number of hospital admissions (151 in 2000-2001 vs 117 in 1998-1999, 124 in 1999-2000, and 152 in 2001-2002) and heater-related burn admissions (36 in 2000-2001 vs 25 in 1998-1999, 26 in 1999-2000, and 29 in 2001-2002). The percentage total body surface area burn (mean  $\pm$  SEM, 24.0%  $\pm$  4.6% in 2000-2001 vs 16.5% in 1998-1999, 12.3% in 1999-2000, and 12.0% in 2001-2002), hospital length of stay (15.0 days in 2000-2001 vs 9.9 days in 1998-1999, 12.3 days in 1999-2000, and 7.0 days 2001-2002), and the number of operations (55 in 2000-2001 vs 7 in 1998-1999, 18 in 1999-2000, and 19 in 2001-2002) also increased during the crisis.

**Conclusions:** The number of heater-related burn admissions, as well as their magnitude, increased during the energy crisis, resulting in increased resource use and health care costs. The economic stresses of the power shortage had societal costs that extended far beyond the price of electricity.

*Arch Surg.* 2002;137:1106-1108

**T**HE POWER shortage in northern California from November 2000 through February 2001 resulted in a substantial increase in the price of natural gas and electricity throughout the state. As a result many residents, in an attempt to lower their utility bills, took a variety of measures to decrease these costs, ranging from lowering the temperature on the thermostat to the use of alternative heating sources such as space heaters, wood-burning stoves, and fireplaces. Improper or inadequate use, installation, or supervision of these devices can result in house fires or direct burn injury from the heating source.

Each year more than 100 000 persons are admitted to burn units with severe burns.<sup>1</sup> The incidence of burn injury, owing to a variety of reasons, has been decreasing over the last 20 years.<sup>2</sup> However, the number of admissions to the University of California Davis Regional Burn Center and Shriners Hospitals for Chil-

dren Northern California Burn Center increased markedly during the winter months of 2000-2001, coinciding with the peak of the energy crisis.

Although the financial and economic consequences of the energy shortage have been widely publicized, the potential increase in burn injury and its socioeconomic effect have not been explored. The purpose of this study is to determine if the incidence in heater-related injuries in northern California increased during the power crisis.

## PATIENTS, MATERIALS, AND METHODS

The study was approved by the University of California at Davis institutional review board. The University of California at Davis Regional Burn Center and Shriners Hospitals for Children Northern California Burn Center admit patients from northern California, the central valley, and the adjacent states. Analysis of the Trauma Registry of the American College of Surgeons burn database and retrospective patient

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### Demographic Data of Burn Admissions During Study Period\*

Interval	Total No. of Admissions	Total No. of Heater-Related Injury Admissions	Age, Mean (SEM), y	TBSA Burn, Mean (SEM), %	Hospital LOS, Mean (SEM), d	No. of OR
November 1998-February 1999	117	25	33.2 (4.6)	16.5 (4.5)	9.9 (2.3)	7
November 1999-February 2000	124	26	45.7 (5.5)†	12.3 (2.7)	12.3 (2.7)	18
November 2000-February 2001	151	36‡	32.4 (3.8)	24.0 (4.6)§	15.0 (3.5)§	55
November 2001-February 2002	152	29	42.0 (3.7)†	12.0 (2.9)	7.0 (1.5)	19

\*TBSA indicates total body surface area; LOS, length of stay; and OR, operations.

† $P < .006$  by  $t$  test compared with 1998-1999 totals.

‡ $P < .001$  by  $\chi^2$  test compared with November 1998 through February 1999, November 1999 through February 2000, and November 2001 through February 2002 totals.

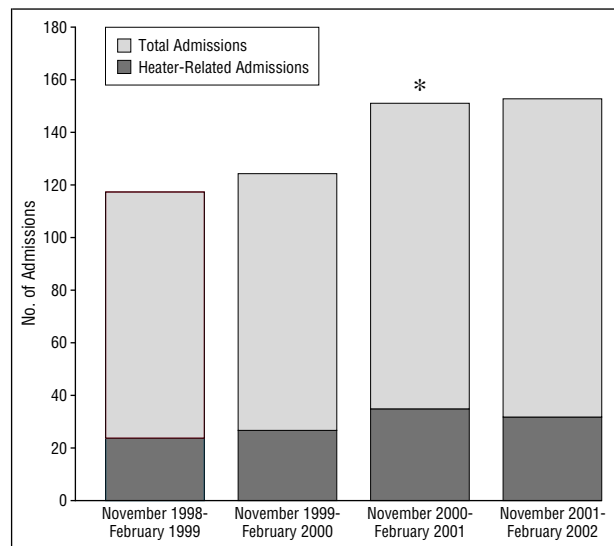
§ $P < .001$  by  $t$  test compared with November 1998 through February 1999, November 1999 through February 2000, and November 2001 through February 2002 totals.

medical record review was completed for all burn admissions in the 4 months from November through February in years 1998 through 2002. Medical records were reviewed for patient demographics, cause of burn, percentage total body surface area (TBSA) burn, survival, number of operative procedures required, and hospital length of stay (LOS). The mean monthly temperature for each of the study months was obtained from the Western Regional Climate Center.<sup>3</sup> Differences between the total number of burns, heater-related burns, and the number of heater-related burns by month during the power shortage months (November 2000-February 2001) were compared with each of the 2 periods immediately prior (November 1999-February 2000 and November 1998-February 1999) as well as to the ensuing year (November 2001-February 2002) using the  $\chi^2$  test. Mean hospital LOS and TBSA burn percentage differences between the power shortage months and each of the other 3 intervals were compared using the  $t$  test. Results are given as the mean (SEM).

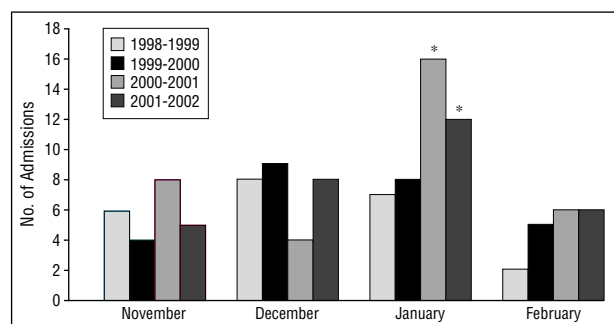
## RESULTS

A total of 512 patients were admitted in the 4 months from November through February in 1998-2002. There was a significant increase ( $P < .006$ ) in the incidence of heater-related burn injuries between the 2000-2001 period and each of the 2 previous years as well as in the subsequent year (**Table**, **Figure 1**, and **Figure 2**). There was a significant increase in the TBSA burn, with mean burn size greater than 20% in the 2000-2001 period vs the previous and subsequent years (**Figure 3**). The number of operations also increased markedly, with 7 operations performed in 1998-1999, 18 in 1999-2000, 55 in 2000-2001, and 19 in 2001-2002. The male-female ratio of patients with burn injury was 2.2 in 2001-2002, 2.4 in 2000-2001, 3.3 in 1999-2000, and 1.9 in 1998-1999. The most common causes of the burn are house fires, lighting a heater, and direct contact with a heater (**Figure 4**). To control for the potential effect of temperature on the incidence of heater burns, the mean California temperature for each of the study months was obtained from the Western Regional Climate Center.<sup>3</sup> The mean temperature in each of the study months did not differ significantly between any of the study intervals (**Figure 5**).

The greatest increase in heater-related burn injuries occurred in January 2001. Coincidentally, on January 1, 2001, Pacific Gas and Electric increased rates by 16.5%, and Southern California Edison raised rates by 9.9%. As the shortage became more severe, stage 3 alerts (declared when an operating reserve shortfall of 1.5% is unavoidable or when the operating reserve is forecast to be  $< 1.5\%$  after using all avail-

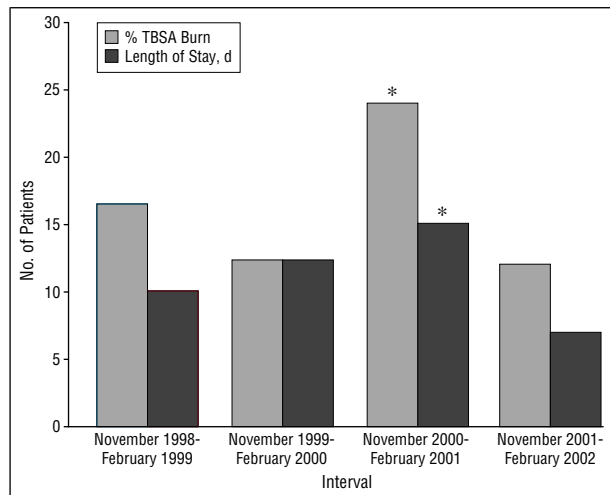


**Figure 1.** Total number of burn admissions and heater-related burn admissions during the winter months (November-February) for 1998-2002. The percentages of heater-related burns increased significantly during November 2000 through February 2001 compared with November 1998 through February 1999, and November 2001 through February 2002 ( $P < .05$ ,  $\chi^2$  test). Asterisk indicates significant differences.

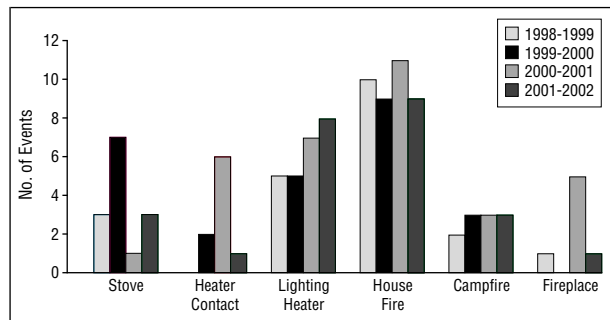


**Figure 2.** Distribution of heater-related burn injuries by month. A significant increase ( $P < .05$ ,  $\chi^2$  test) in burn injuries occurred in the period 2000-2001 compared with the 1998-1999, 1999-2000, and 2001-2002 periods. Asterisks indicate significant differences.

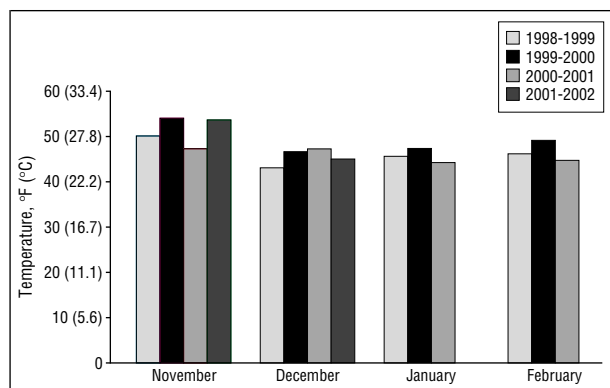
able resources) were instituted. On January 17 and 18, 2001, rolling blackouts were ordered statewide. A statewide stage 3 alert continued for 24 consecutive days. The rate of rotating blackouts increased from 1 in 2000 to 38 in the period from January to May 22, 2001. During this same interval, stages 1 and 2 notifications increased from 91 to 127.<sup>4-8</sup>



**Figure 3.** Mean percentage of total body surface area (TBSA) involvement and hospital length of stay increased significantly in the interval from November 2001 through February 2002 compared with November 1999 through February 1999, November 1999 through February 2000, and November 2001 through February 2002 ( $P < .05$ ,  $t$  test). Asterisks indicate significant differences.



**Figure 4.** Causes of heater-related burns included contact burns with stoves, house fires, fireplaces, and campfires.



**Figure 5.** Average ambient temperature in northern California during the interval from November through February 1998-2001.

## COMMENT

The fiscal impact of the California energy crisis has been the focal point of published reports. The financial effects of the shortage on California power companies, the state, and consumers have been well documented. California residents were encouraged to conserve electricity and gas during times of severe shortages, and the high

cost of electricity further reinforced this request. Measures taken to conserve energy ranged from decreasing the set point on the thermostat to using alternative devices such as space heaters, wood-burning stoves, and fireplaces. Cost restraints frequently lead people to use unsafe heating sources. These alternative heating sources have the potential to cause serious injury if not used properly. To our knowledge, to date the potential effect of the shortage on consumer health has not been addressed.

This article is the first to document an increase in consumer-related burns after the implementation of rolling blackouts and increased energy costs. The greatest increase in the incidence of heater-related burns occurred in January 2001, coinciding with the electricity rate increase and the institution of blackouts. The increased number and severity of burn injuries, as indicated by a significantly greater number of operative procedures performed during this period, had a detrimental effect on consumer physical and financial health. This will likely result in long-term morbidity for the affected consumers. Prevention of these injuries could result in lower financial and consumer health costs. Implementation of preventive strategies, such as installation of smoke detectors in homes, have been successful in decreasing the incidence of burn injury.<sup>9-11</sup> A similar strategy may well be of benefit in preventing heater-related burn injuries in the future. Although economic or societal events may increase the risk of this type of burn injury, education regarding appropriate behaviors in response to the power shortage may help to ameliorate these effects.

The full impact of the California energy crisis remains unclear. Although current studies have centered on the financial impact of the crisis, further investigation into the effects on consumer health needs to be undertaken.

*This study was presented as a poster at the Pacific Coast Surgical Association Meeting, Las Vegas, Nev, February 16, 2002.*

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