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# The Epidemiology of Burn Injury in New York

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BURN INJURY has been increasingly recognized in recent years as a discrete surgical problem. According to one study, the number of burn treatment facilities in the United States more than doubled between 1969 and 1976 (1). This expansion took place despite the scarcity of data describing the frequency and severity of burn injuries in large populations.

Like diseases, injuries occur in definite geographic, demographic, and seasonal patterns (2,3). Systematic methods for identifying various prevention strategies have now been articulated (3,4), but population studies to provide specific foci for prevention are not widely available.

Most previous burn studies (5-9) have been of patients in a single specialized burn hospital or a group of hospitals, most of which are specialized for burns. They tend to overrepresent the more severely injured patients. These hospital-based studies are of most use in developing treatment techniques and establishing standards of care. However, having no well-defined geographic base, they can contribute little to determining the demand for beds or to describing the etiological factors that need to be known for prevention planning. For those purposes, a hospital-based study has to rely on estimates based on a nonrepresentative group.

The few representative studies of burns include the Pittsburgh burn study (10) and Clark and Lerner's

report of a 2-year survey of burn injuries in a 15-county area surrounding Syracuse, N.Y. (11).

Determination of the appropriate number of burn treatment facilities for a given population and the appropriate degree of specialization for such facilities requires data on the frequency and severity of the burn injuries. The planning of preventive measures requires an adequate understanding of the interrelationships between the host, the host's environment, and the harmful agent. The New York burn study provides these data for a whole population. Most previous studies have been derived from a nonrepresentative segment of the burn-injured population.

## Methods

All burn injuries for 2 consecutive years resulting in admission of the injured for at least 1 day to a hospital in upstate New York were included in the burn study. The 57 counties of upstate New York (that is, New York State exclusive of the 5 boroughs of New York City) had 223 hospitals and a population of 10.8 million. Records of burn patients discharged during the 2 calendar years 1974 and 1975 were collected in the hospitals by methods described earlier (12). The records were carefully screened to eliminate readmissions. Therefore incidence rates could be calculated from the final data set, since it consisted exclusively of 5,791 inpatients with new burns who had been hospitalized for the first time during the study period.

A finding of the 1974 survey was that the size of the burn wound, an important factor in determining severity, was not recorded in the hospital records of two-thirds of the burn patients. A narrative description of the burn wound was, however, nearly always available in the record. That description was used in the 1975

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survey to gain an approximation of the size of the injured area. Fieldworkers were trained to represent on a body chart the parts of the body injured as described narratively in each patient's record. Later, these charts were converted by a single trained clerk to numerical estimates of body surface area injured—the standard term used to describe burn wound size.

The distributions of estimated and recorded wound size were compared for those cases in which wound size was recorded in the hospital record. A strong and statistically significant positive correlation (Pearson  $r$  of 0.8983,  $P = 0.001$ ) was shown between estimated and recorded wound size. For those cases in which size was available in the record, the recorded mean percentage of body surface area injured was 16.9 as compared with a mean estimated size of 14.8.

The purpose of the percentage of body surface area estimation was to represent the wound size distribution of the entire group of patients. The strong correlation and the comparability of the means of estimated and recorded wound size provide confidence that the estimation method reasonably approximates the wound size distribution for the group as a whole.

The terms burn center and burn unit have no legal standing and carry no clear implications as to the capabilities of the facilities referred to or the quality of care they provide. Therefore, the hospitals in the 1975 survey were categorized by their annual burn patient census (table 1) rather than by arbitrary terms. Hospitals each treating 20 or fewer burn patients per year comprised 82 percent of the hospitals in upstate New York; they treated slightly more than half of the burn patients. Hospitals each treating 21 to 40 patients per year comprised 13 percent of the hospitals; they

treated about one-fourth of the burn patients. The 10 hospitals that each treated more than 40 burn patients per year (5 percent of the hospitals) also treated about one-fourth of the burn patients.

A slightly revised version of a list of physical environmental factors associated with burn injury causation that Barancik and Shapiro devised for their Pittsburgh burn study (10) was used to code the environmental agents contributing to the burn injuries. Estimates of the upstate New York population in 1974 and 1975 were provided by the New York State Department of Health, Office of Biostatistics (13). In addition to morbidity data derived from patients' records, death certificates were also examined in order to provide a fuller perspective of the total burn problem. In the 3-year period 1974–76, a total of 837 burn deaths (International Classification of Diseases, Adapted, code num-

Table 1. Categorization of hospitals by annual burn patient census, upstate New York, 1975

Item	Annual burn patient census			Total
	Hospitals treating 1–20 burn patients	Hospitals treating 21–40 burn patients	Hospitals treating more than 40 burn patients	
Number of hospitals . . . .	164	25	10	199
Percent of hospitals . . . .	82	13	5	100
Number of patients . . . .	1,536	697	694	2,927
Percent of patients . . . .	52	24	24	100

<sup>1</sup> 24 other hospitals provided no burn treatment.

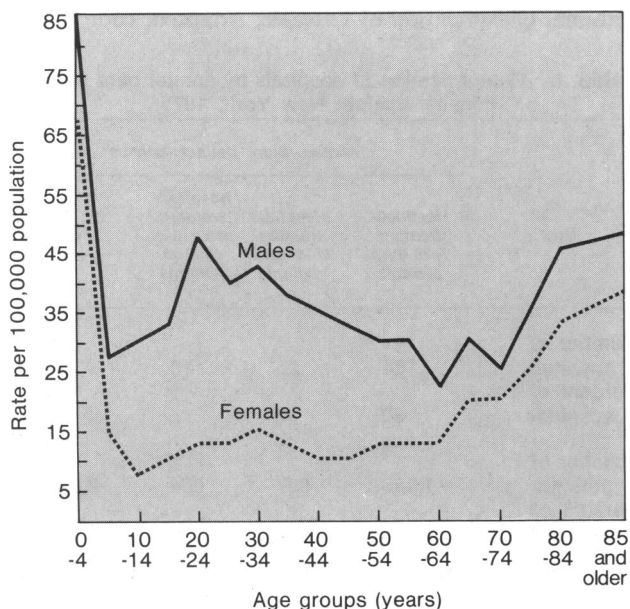
bers E890–E899) were recorded for the resident population of upstate New York.

## Results

**Age, sex, and race of injured.** Small children, the elderly of both sexes, and males, both youths and adults, were found to have a high incidence of burn injuries. There was an excess of males in every age group, and blacks were found to be at higher risk than whites. These results generally correspond with those of previous studies (10,14).

The incidence of burn injuries resulting in hospitalization was about 27 per 100,000 population per year in upstate New York (26.6 in 1974 and 27.0 in 1975). Age-specific and sex-specific incidence rates for 1974–75 are shown in figure 1. Children 0–4 years (1,147) constituted almost 20 percent of the total group hospitalized for burns; the incidence rate for this 5-year age group was about 74 per 100,000 population per year. Within this age group, the first 2 years of life were found to be a period of even higher incidence. More detailed analysis of this 2-year age group was thus indicated. From birth records, demographers of the New York State Department of Health approximated the numbers of persons in the population in the single-month age groups through 23 months, ignoring any mortality. Using these population estimates, we then calculated the burn injury rates for single months of age, using person-months of risk as the denominator. Incidence rates, shown in figure 2, increased with advancing age, reaching a peak at 14 months.

Figure 1. Annual age-specific incidence rates for persons hospitalized for burn injuries in upstate New York, by sex, 1974–75



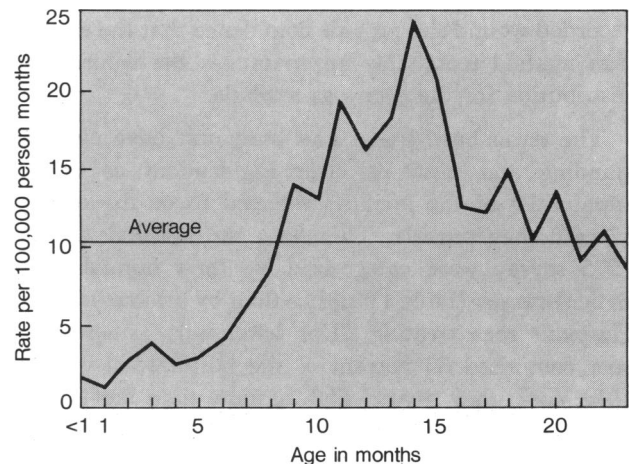
The incidence of burns resulting in hospitalization in the black population, 66 per 100,000 per year, was almost 3 times that in the white population, 23 per 100,000. The predominance of males over females, about 2 to 1, was the same among blacks and whites. Blacks hospitalized for burn injuries tended to be somewhat younger (mean age 24 years) than whites (mean age 30 years), a difference probably reflecting the different age distributions of the two populations.

**Place of occurrence of injury.** Within the State, considerable geographic variation in incidence rates was found (fig. 3). Among the State's health service areas, the rates ranged from 19 to 34 per 100,000 population. Rural and urban rates also differed. Counties outside Standard Metropolitan Statistical Areas had a rate 1½ times that of counties within SMSAs.

In 79 percent of the cases, the place of occurrence of the injury was known, and of these cases, 21 percent occurred in occupational settings. In the working age population (18–64 years) for whom place of occurrence of injury was known, 39 percent of the injuries occurred in occupational settings. Among men 18–64 years old, 49 percent of the burns occurred at work, while only 12 percent of the burns of females 18–64 years old occurred at work.

**Seasonality.** Figure 4 shows the percentage of all hospital admissions for burns in each calendar month, along with the monthly mortality as derived from death certificates. There was a decided increase in burn hospitalizations from June through August. The seasonal pattern for burn mortality was almost directly opposite that for burn hospitalization, mortality being highest in

Figure 2. Age-specific incidence per 100,000 person months for children under 1 month to 23 months old hospitalized for burn injuries in upstate New York, 1974–75



winter. This seasonality of burn mortality is probably associated with the occurrence of house fires.

The summer excess in burn hospitalization was most pronounced in the school age group (5–19 years). For the age groups 20–39, the seasonal excess was still apparent but less pronounced. For the age groups over

Figure 3. Annual incidence rates per 100,000 population of burn injuries resulting in hospitalization, by health service area, upstate New York, 1974–75

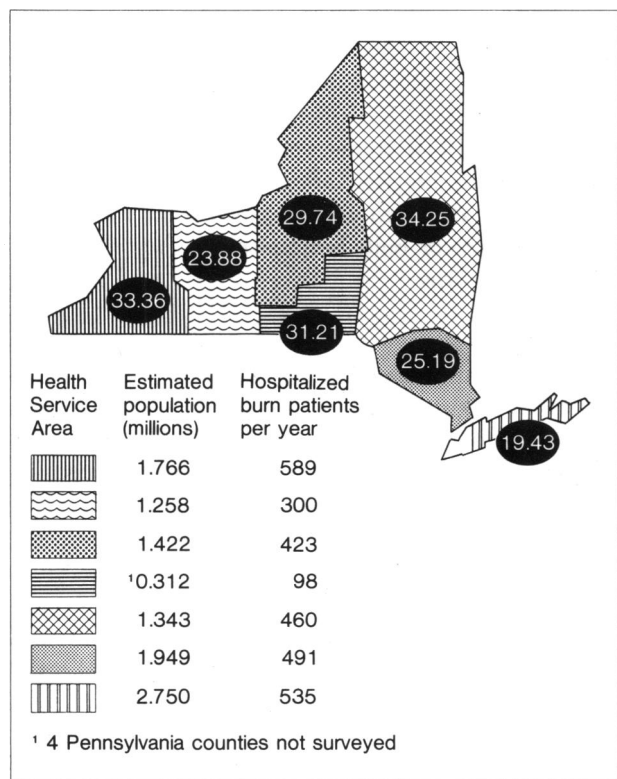
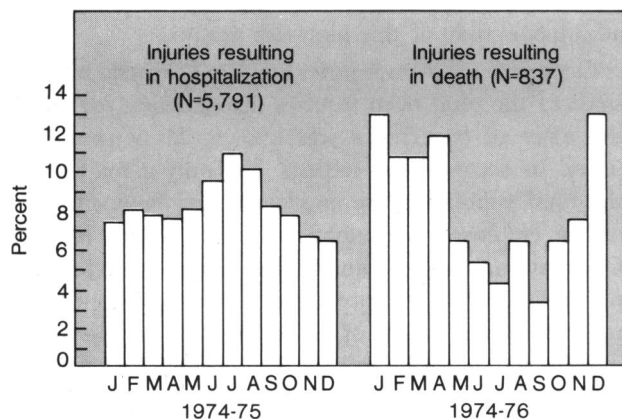


Figure 4. Percentage distribution of burn injuries resulting in hospitalization, 1974–75, and of burn injuries resulting in death, 1974–76, by month, upstate New York



NOTE: Percentage distribution is adjusted for number of days per month.  
SOURCE OF DATA: New York State Department of Health, Office of Biostatistics.

39 and 0–4 years, there was no apparent pattern of seasonal variation.

**Indicators of severity.** Table 2 shows the percentage of the body surface area injured, as derived by the estimation method. The mean size as estimated was 8.9 percent of the body surface. One half of the patients had injuries of 5 percent or less of the body surface. More than 90 percent had wounds of 20 percent or less of the body surface. Only about 4 percent had wounds greater than 30 percent of the body surface.

The mean period of hospitalization was 15 days. Table 3 shows that in hospitals each treating more than 40 burn patients annually, the mean length of stay was 5 to 7 days longer than in hospitals treating fewer than 40. The mean wound size was considerably greater in the patients in hospitals each treating more than 40 burn patients annually. The proportion of patients with large burns (here taken to be those larger than 20 percent of the body surface) was also greater in the most active hospitals. Among patients with full-depth burns, the mean size of the full-depth wounds was almost twice as large in the most active hospitals as in hospitals with 21–40 or 1–20 burn patients annually. Based on these indicators, the patients treated in hospitals with more burn treatment experience clearly seem to have been more severely injured. It should also be noted, however, that the less experienced hospitals retained a substantial number of patients with large burns, as well as a large majority (71 percent) of all the patients with some full-depth injury. Six to 8 percent of the patients treated in less experienced hospitals had wounds larger than 20 percent of their body surface area, and fully one-fourth had a full-depth injury.

### Etiology

The most frequent types of burn injuries that resulted in hospitalization were scalds (40 percent) and those caused by flames (37 percent), followed by contact burns (9 percent), chemical burns (7 percent), and electrical burns (4 percent). “Other” types accounted for 3 percent.

The age groups at highest risk of burns involving clothing were those 5–19 years and 60 years and over. In view of the Federal Government’s flammability standards for children’s sleepwear, it may be of interest to note that no sleepwear burns were identified in children 0–11 months old. The burn injuries that occurred in the first 2 years of life were predominantly scalds. Males 5–24 years, especially whites, were at particularly high risk of gasoline burns. Chemical burns occurred relatively more often in children and working-age adults. In children, the chemical burns tended to

**Table 2. Estimated percentage of body surface area injured in 2,927 hospitalized burn patients, upstate New York, 1975**

Estimated percent of body surface area	Number of patients	Percent of patients	Cumulative percent of patients
1- 5 .....	1,468	50.2	50.2
6-10 .....	700	23.8	74.0
11-15 .....	314	10.7	84.7
16-20 .....	179	6.1	90.8
21-25 .....	96	3.3	94.1
26-30 .....	43	1.5	95.6
31-35 .....	37	1.3	96.9
36-40 .....	24	0.8	97.7
40 or more ..	66	2.3	100.0

**Table 3. Indicators of severity of injuries of 2,927 patients admitted to a hospital for burn treatment, by annual burn patient census of hospitals, upstate New York, 1975**

Indicators of severity	Annual burn patient census			
	1-20 burn patients (N = 1,536)	21-40 burn patients (N = 697)	More than 40 burn patients (N = 694)	All hospitals (N = 2,927)
Mean days in hospital .....	12.6	15.2	20.0	15.0
Mean percent of body surface injured .	7.6	7.8	12.9	8.9
21 percent or more of body surface injured:				
Number of patients ...	89	55	222	266
Percent of patients ...	5.8	7.9	17.6	9.1
Some full-depth injury:				
Number of patients ...	389	176	226	791
Percent of patients ...	25.3	25.3	32.6	27.0
Mean size of full-depth injury (percent of body surface) .....	6.7	8.7	15.0	9.1

be internal; in adults, external. The chemical burns in adults happened with about equal frequency at home and at work. Males incurred 53 percent of all burns from cooking oil and grease. Conflagrations involved most age groups and both sexes, but adult males (20-

64) and elderly females (65 and over) showed an elevated risk of injury. (Much more detailed descriptions of the primary and secondary environmental hazards, additional analysis of risk groups, and strategies for prevention are contained in a 150-page report available from the Center for Disease Control (15) or from the authors.)

**Mortality.** According to death certificates identified by the burn codes ICDA E890-E899, the average yearly mortality rate for burns in upstate New York was 2.6 per 100,000 for the 3-year period 1974-76. Hot liquids, the leading hazard associated with hospitalization for burns, rarely was identified as a cause of death. Conversely, conflagrations were relatively infrequently associated with hospitalization but caused more than 70 percent of the burn deaths. Ignition of clothing was a major source of both hospitalizations for burns and deaths from burns.

### Discussion

In this population-based study, we were able to quantify the inpatient burn problem and its components by measurements made in a real population, rather than to present projections based on a nonrepresentative sample. We were also able to estimate the distribution of wound size of these hospitalized burn patients. The results have many implications both for the preparation of prevention programs and for determining the number and kind of treatment facilities needed.

The high rate of burns that resulted in hospitalization in the 0-4 year age group reflects the exceptionally high rates for children 9-19 months old. The decline thereafter from high to more moderate levels may correspond with the development of verbal ability or with conditioning about hot objects. Children 9-19 months old are especially susceptible to serious and chronic damage from burns. Thus, high priority should be given to preventive measures in their behalf and to additional study of this high-risk group.

Occupational burn injuries are also of special interest, since of the total burn injuries in our study for which the place of occurrence was known, 21 percent happened in occupational settings. Yet only a minority of the total population are employed, and only a portion of the employed are exposed to burn injury hazards. Occupational settings thus offer great potential for burn prevention. Passive approaches that do not depend upon the cooperation of those at risk may be implemented more readily in occupational settings. Analytic study of this component of the burn problem is indicated and is planned.

The high rate of burns in the black population, which

is probably due to socioeconomic factors, points up the need for giving this group high priority when prevention programs are planned.

Knowledge of the geographic variability in burn incidence has contributed to determinations of the number and type of treatment facilities needed in various parts of New York State and to the arrangement of cooperative agreements among such facilities. Since geographic variability is probably influenced by socioeconomic factors (14,16) and the extent of industrialization in an area, the low socioeconomic groups also should receive priority for prevention activities and be made the subject of additional study.

The seasonal variability in rates of hospitalization for burn injuries may have significant implications for facility planning, but these implications may be different for different types of burn facilities (that is, for intensive care burn units as compared with burn facilities designed for patients with injuries of more moderate severity). In the study described here, the incidence of fatal burn injuries declined in the summer, a seasonal pattern directly opposite to that for all burns resulting in hospitalization. If fatal burns are taken as a surrogate measure of the severest burns, there may be no substantial summer increase in those burn injuries requiring treatment in intensive care burn units.

Analysis of the seasonal factor also pointed up the school-age group as being at high risk of suffering burn injuries in summer and therefore as a high-priority group for preventive measures.

The consensus in burn medicine is that all patients burned seriously enough to require hospitalization should be treated in a hospital offering some degree of specialization for burns (17) and that the most severely injured of these should be treated in the most highly specialized facilities (18). Results of the upstate New York survey clearly show that this goal was not realized. Burn patients were found in all types and sizes of hospital—199 of the 223 hospitals in upstate New York. A majority were treated in a hospital that had only occasional experience with burn treatment (20 or fewer burn patients per year). Also, substantial numbers of patients with large burns and full-depth burns were found in hospitals with modest or little experience in the treatment of burns. An evaluation of the consequences of this patient distribution in respect to the quality of patient care should be a priority for future study.

The percentage of the body surface area injured is an important indicator of severity. In treatment planning, particularly in estimating fluid replacement requirements, knowledge of the wound size is essential. It was therefore surprising that this basic datum had

not been recorded in two-thirds of the patients' records, even though wound size may be observed in each patient. A need for more professional education is indicated. It is to be hoped that in the future wound size will be entered into the hospital records of all burn patients. This would contribute to better patient care and make reliance on estimations unnecessary.

Burn injuries that resulted in hospitalization occurred less frequently in upstate New York than would have been anticipated from previous studies. The National Center for Health Statistics (19) has estimated that in 1975 there were 35 hospitalizations for burns per 100,000 population in the Northeastern United States (including New York). Because this estimate was derived from hospital discharge summaries, readmitted patients were included in calculating the rate of occurrence. Clark and Lerner, in their study of the Syracuse, N.Y., area (11), also included readmissions in calculating a hospitalization rate of 33 per 100,000 population. A 1972 estimate based on data from the National Burn Information Exchange, a hospital-based study, projected a number of burn patients for New York State equivalent to a rate of 37.5 per 100,000 population (20). Those projections may be compared with the incidence rate found by direct measurement in our study: 27 per 100,000 population per year.

The estimated size of the burn wounds in our study was smaller than would have been anticipated from previous studies. For example, in a Florida study (9), patients having large wounds of 20 percent or more of the body constituted 22 percent of the series. That study included only one-third of the State's hospitals, which, moreover, had been selected judgmentally and therefore were not a representative sample (21). The Florida sample may have included a disproportionate number of the more severely injured patients. In our study, in which estimates were made of wound size for all of the burn patients, only 9 percent were found to have burns that large.

Feller and Crane (22) defined severe burns as those of 20 percent or more of the body or those in persons 60 years of age or older and estimated that 36 percent of hospitalized patients would have severe burns. That estimate is derived from the National Burn Information Exchange, a collection of hospitals most of which are specialized for burns and are not representative of all hospitals. In Clark and Lerner's study of the Syracuse area (11), 36 percent of those patients for whom wound size was recorded had severe burns by Feller and Crane's criteria. However, wound size is more likely to be recorded for the larger burns. In our study, only 22 percent of all hospitalized burn patients met Feller and Crane's criteria for severe burns.

The New York burn study, being based on the total population, provides direct measurement of the frequency and distribution of burn injuries in the State. These data were used to formulate plans for injury prevention (15) and methods for determining the number and kind of burn treatment facilities needed in each region of the State (23). These plans and methods are presently in use by State and area health planning agencies. Also, baseline data are now available for future evaluation of the effectiveness of these program plans.

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## SYNOPSIS

FECK, G. (New York State Department of Health), and BAPTISTE, MARK S.: *The epidemiology of burn injury in New York. Public Health Reports, Vol. 94, July–August 1979, pp. 312–318.*

A population-based study of all patients hospitalized for burns in a 2-year period was conducted in upstate New York. The objective was to provide data for setting burn injury prevention priorities and for

formulating treatment facility plans. The incidence rate of hospitalization for burns was 27 per 100,000 population per year. The mean estimated size of the burn wounds was 9 percent of the body surface, and fewer than 10 percent of the patients had large wounds (more than 20 percent of the body). Burn patients were admitted to hospitals of all capabilities, including 89 percent of 223 hospitals. Substantial numbers of pa-

tients with large and deep wounds were treated in hospitals with little burn treatment experience. High-risk groups were the young, blacks, and males. Burn injuries occurring at work were common. Burn injuries resulting in hospitalization occurred less frequently, and the wounds were smaller in size than would have been expected based on reports in the literature.