Estimates of the Incidence and Costs Of Fire-Related Injuries

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This report has not been reviewed or approved by the Commission and may not reflect the views of the Commission.

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EXECUTIVE SUMMARY

The U.S. Consumer Product Safety Commission (CPSC or Commission) contracted with the Pacific Institute for Research and Evaluation (PIRE) to undertake new estimates of the incidence and costs of medically treated injuries resulting from residential fires.

Using various national data sets, PIRE produced estimates of incidence at five levels: fatal, admitted to a burn center, admitted to another hospital, treated in a hospital emergency department (ED), and treated in a doctor's office or clinic. For each of these levels, incidence was estimated for five different diagnosis categories: burns only, inhalation injuries only, burns plus inhalation, trauma, and other (Inhalation injuries include anoxia; poisoning by toxic gases, fumes, and vapors; and burns of the nose, mouth, throat, and lungs). Estimates for fatalities are based on the 1999–2003 Multiple Cause of Death (MCOD) data from the National Vital Statistics System of the National Center for Health Statistics. Estimates for nonfatal injuries are derived from a variety of data sources from 1995 to 2003. Multiyear averages are used for most estimates, but some factors used for allocation of unknowns are based on a single year's data. For each combination of level and diagnosis category, three kinds of costs were estimated: medical cost, work loss, and lost quality of life.

We estimate that more than 60,000 injuries result from residential fires annually, including more than 3,000 deaths. Most (94%) of these injuries involve burns or inhalation injuries. While cases overall are divided roughly evenly between burns and inhalation, most deaths (58%) result from inhalation, as do a majority of non-admitted injuries; but most hospital admissions (62%) result from burns. A majority (57%) of hospital-admitted burns are treated in specialized burn centers. We estimate that residential fire injuries result in a total loss to society of $18.5 billion annually, of which fatalities account for 83 percent and inhalation injuries for 52 percent.

We estimate that 94 percent of these residential fire injury costs result from fires that are attended by the fire department. In addition to the civilian injuries counted above, we estimate that between 16,000 and 23,000 injuries are sustained by firefighters in residential fires, but a majority of these are too minor to require an ED visit.

Finally, we estimate that 77 percent to 79 percent of the nonfatal injuries resulting from residential fires receive treatment in an ED, and thus, are captured by the National Electronic Injury Surveillance System (NEISS), which provides national estimates of ED injuries based on a sample of hospitals with EDs. If we look at all burns, not just those resulting from residential fires, 69 percent to 72 percent are treated in an ED.

CHAPTER 1. INTRODUCTION

The mission of the CPSC is to protect the public against unreasonable risks of injury from consumer products through education, safety standards activities, regulation, and enforcement. For most projects concerning residential fires attended by the fire service, CPSC injury estimates have been calculated from National Fire Incident Reporting System (NFIRS) data provided by the U.S. Fire Administration (USFA) and from National Fire Protection Association (NFPA) survey results. Thus, in the past, residential fire injury estimates did not include injuries from residential fires unattended by the fire service. Additionally, injury estimates from fire service attended residential fires were reported only in terms of their disposition from the fire scene (*e.g*., treated at scene, or sent to hospital), rather than in terms of their medical treatment (*e.g*., treated in emergency room and released, or admitted to hospital as inpatient). Little detail was provided on injury severity. Costs for an injury sent to the hospital can differ by several orders of magnitude between a minor burn treated and released from a community hospital, and a severe burn and inhalation injury treated at a specialized burn center.

In the early 1990s, the CPSC sponsored a study with the National Public Services Research Institute (a component of the Pacific Institute for Research and Evaluation, PIRE), *Estimating the Costs to Society of Cigarette Fire Injuries*, which addressed some of these issues and developed incidence and cost estimates for the NFIRS/NFPA treatment categories for cigarette fire injuries, breaking the sent-to-hospital category in NFIRS/NFPA into treated-and-released and admitted-to-hospital. To break out cigarette-related injuries, the 1993 study developed information on various residential fire scenarios that allowed fine-tuning of the cost estimates according to ignition source or material first ignited.

Subsequently, CPSC rebuilt its injury cost model by diagnosis group (Miller et al., 1998) and the U.S. Center for Disease Control and Prevention estimated medical and work loss costs of injury by diagnosis group (Finkelstein et al., 2006). Both studies yielded improved cost information about burns that was never incorporated into the more detailed burn estimates from the 1993 study. This study expands on and updates the 1993 study. It integrates data from the 1998 and 2006 studies and adds some newer data.

This study incorporates data from sources that did not exist when the 1993 study began. Data quality and quantity both have risen. Notable additions are the Healthcare Cost and Utilization Project (HCUP) partnership's collection of state hospital and emergency department discharge census files, the Medical Expenditure Panel Survey (MEPS), the ambulatory care databases collected by the National Center for Health Statistics, Medstat's pooled Marketscan[@] health insurance clams data base, and the CPSC's NEISS follow-up survey of fire injuries, which ran from mid-2002 until the beginning of 2007.

This study offers improved measures of the incidence, severity, costs, and causality of burns, anoxia, and other residential fire-related injuries and, in some cases, of consumer product injuries in general. It integrates that information into the CPSC's injury cost and incidence model infrastructure. It supports better overall estimates of the societal costs of fires and targeted estimates of societal costs of injuries for individual products or projects.

Chapter 2 presents new estimates of the incidence of injuries resulting from residential fires. Chapter 3 provides estimates of medical costs and the value of work loss. Chapter 4 looks at data from the CPSC's Fire Survey, which follows up fire-related injuries in NEISS, to estimate what shares of injuries occur in fires that are attended by the fire department. Chapter 5 estimates pain and suffering costs and then draws on the three previous chapters to compute comprehensive costs of residential fire injuries by treatment level and fire department attendance. Chapter 6 draws on the Burn Foundation's database to devise product-specific cost-adjustment factors. And Chapter 7 estimates the number of hospital-admitted residential fire injuries that bypass the emergency department, and thus, are not captured by NEISS.

CHAPTER 2. INCIDENCE

Table 1 summarizes the main results of our estimates of the incidence of injuries resulting from residential fires, broken down by treatment level and diagnosis group.

Table 1. Estimated Annual Incidence of Residential Fire Injuries

Diagnosis Group	Fatal	Hospital-Admitted	Emergency Department	Doctor's Office/Clinic	Total
Burn only	590	5,927	12,185	7,829	26,531
Inhalation only	1,781	1,694	14,321	9,523	27,320
Burn + inhalation	602	1,509	806	NA	2,918
Trauma	18	255	1,939	1,260	3,472
Other	71	116	93	69	350
Total	3,062	9,502	29,345	18,682	60,590

Sources: Fatal: 1999–2003 MCOD; Hospital-admitted: 2003 HCUP-NIS; ED: 1995–2003 NEISS; Doctor/clinic: 1995–2003 NEISS times doctor/ED ratios estimated from NEISS-AIP, NAMCS, NHAMCS, and MEPS. Data from four Shriners hospitals on admitted injuries not reported through state discharge systems were used to adjust the estimates for admitted injuries. Details are provided in the next five pages. The sums of the rows and columns may not add to the totals due to rounding. NA= Not applicable. It is not feasible to estimate burn+ inhalation injuries separately in the doctor's office/clinic setting.

The five diagnosis categories are designed to be consistent with the sorts of injuries that occur in fires, comprehensive in scope, and tailored to the needs of this and future research projects on fire-related injuries. Our directions for this project suggested three categories: "burn injuries, anoxia injuries, [and] other civilian injuries."[1] We altered the second category from *anoxia injuries* to the slightly broader *inhalation injuries*, which also includes internal burns of the nose, mouth, and throat, as well as inhalation of poisonous gases, fumes, and vapors. This definition anticipates future research, which will focus on injuries that might be prevented or mitigated by the use of fire/escape masks.

In our various datasets, we searched all diagnosis fields for codes indicating *burn* and *inhalation* injuries. This resulted in four diagnosis categories: burn only, inhalation only, both, and neither. The category for cases with both burns and inhalation injuries was suggested by Tables 7 and 8 of the 1993 study.[2] However, the estimates of nonfatal, non-admitted incidence do not include estimates for burn-plus-inhalation incidence because they are based on the CPSC's NEISS, which provides only one diagnosis per case.[3] At most treatment levels, the fourth category, non-burn, non-inhalation injuries, was dominated by traumatic injuries, so we broke out *trauma* as a separate category. The miscellaneous cases remaining in *Other* included some cases that lacked traditional injury diagnoses, but where the patient's condition appears to have been caused by exposure to a residential fire.

[1] A fourth category, firefighter injuries, will be addressed elsewhere in this chapter.
[2] *Societal Costs of Cigarette Fires*, August 1993, pp. A-30, A-31.
[3] For emergency department incidence, we were later able to break out this estimate from inhalation, by relying on data from other sources.

Fatal incidence estimates were based on the 1999–2003 Multiple Cause-of-Death (MCOD) data. The MCOD data, which are collected by the National Center for Health Statistics from the death certificates filed with each state, encompass all deaths that occur in the United States in a given year. We dropped injuries that occurred at work or in locations other than home, residential institutions, or unspecified places. Cases were then selected on the basis of ICD-10 external-cause codes. The following codes correspond to unintentional injuries caused by exposure to smoke, fire, and flames:

X00	Exposure to uncontrolled fire in building or structure
X01	Exposure to uncontrolled fire, not in building or structure
X02	Exposure to controlled fire in building or structure
X03	Exposure to controlled fire, not in building or structure
X04	Exposure to ignition of highly flammable material
X05	Exposure to ignition or melting of nightwear
X06	Exposure to ignition or melting of other clothing and apparel
X08	Exposure to other specified smoke, fire, and flames
X09	Exposure to unspecified smoke, fire, and flames

In consultation with the CPSC, we determined that X00, X04, X05, X06, X08 always correspond to residential fire injuries, and sometimes X09. Because this project is focused on residential fire injuries, fires not in buildings (X01, X03) and controlled fires (X02, X03) were judged to be out of scope. We searched all external cause codes[4] and selected all cases with any of these codes. We then dropped cases with additional cause codes indicating that the fire was intentional or transport-related, as well as a few other cases where the death did not appear to be related to the fire or the fire appeared to be a miscode.

In order to compensate for the fact that many cases coded as X09 might not be in scope, we weighted them down based on the relative counts of in-scope and out-of-scope fire-related cases. Of 11,695 fire-related cases that included inhalation injuries, 11,475 (98.12%) were in scope. And of 2,962 other fire-related cases, 2,665 (89.97%) were found to be in scope. Therefore we applied weights of 0.9812 and 0.8997 to inhalation and other injuries, respectively, if they were selected on the basis of an X09 code.

For the 5-year period, we found 14,140 in-scope cases and 1,259 unspecified (X09) cases. After applying our weights to the latter cases, these 15,399 cases weighted down to 15,309. Dividing by 5, we arrived at an estimate of 3,062 deaths per year resulting from residential fire injuries. (By way of comparison, the NFPA estimated an average of 3,073 residential fire deaths per year during this same 5-year period.) Table 1 shows the breakdown by diagnosis group. Most of these deaths (77.8%) involved inhalation injuries.

Hospital-admitted incidence was estimated from the 2003 National Inpatient Sample of the Healthcare Cost and Utilization Project (HCUP-NIS).[5] We began by using the state-level primary payer variable to identify admissions where the primary expected payer was Workers' Compensation, in an attempt to exclude work-related injuries. Then we selected cases based on

[4] We searched all fields of the entity axis, as well as the underlying cause of death.

[5] 2003 National Inpatient Sample, Healthcare Cost and Utilization Project, Rockville, MD: Agency for Healthcare Research and Quality, Department of Health and Human Services.

ICD-9-CM external-cause-of-injury (E) codes. The codes listed in Appendix A correspond to unintentional injuries caused by fire and flames. In consultation with the CPSC, using criteria similar to those for the MCOD, we determined that E892, E893.2, E895, E896, E897, and E898.1 were out of scope for this project because these admissions were not caused by residential fires. We dropped a few cases where there did not appear to be any injury, or the injuries were not caused by a fire, or the fire was intentional or transport related.

The unspecified fire code, E899, like X09 in the mortality data, presented a problem because there was no way to judge whether the fires were in scope or not. Therefore, we weighted these cases downward, based on the relative counts of known in-scope and out-of-scope cases, as with the mortality data. The youngest and oldest patients showed different in-scope distributions, so we computed the weights by age, as well as diagnosis.

Table 2. Weights Applied to Cases Whose In-Scope Status Was "Unspecified"

Age	Inhalation Injuries	Other Injuries
0-2	0.9545	0.3023
3-69	0.8834	0.6750
70+	0.8525	0.6104

We found 1,706 in-scope cases and 365 unspecified (E899) cases. Applying the weights from Table 2 reduces the latter 365 cases to 244. And applying the HCUP-NIS discharge weights to all cases results in our national estimate of 9,385 hospital admissions resulting from residential fire injuries. A majority of these hospitalizations (78.0%) involved burns. This count should be regarded as conservative. Hospitals with burn centers, which treat disproportionate numbers of burns, are underrepresented among the hospitals of the HCUP-NIS sample.

In the next section of this chapter, we report our estimate of the number of injuries treated in three Shriners hospitals that do not report their admission data to their respective states. (Because Shriners hospitals are charitable institutions that do not bill their patients, they are exempt from state reporting requirements.) We estimate that these hospitals admitted 117 acute-burn patients who were injured in residential fires, of whom four also suffered inhalation injuries. We added these to our NIS-based estimate, for a total of 9,502 hospital-admitted cases. Table 1 shows the breakdown by diagnosis.

Emergency department incidence estimates came from the 1995–2003 NEISS data. We first dropped cases in which the patient was subsequently admitted to a hospital (DISP=2 or 4). Then we further restricted the data to injuries whose location was home, mobile/manufactured home, or not recorded (LOC=1, 6, or 0); and to cases coded as fire involved (FMV=1, 2, or 3). Our NEISS data had been prescreened to exclude fatalities (DISP=8) and work-related injuries (TYPE=1). We also dropped one duplicate record and a few cases where no injury was treated.[6]

Because the NEISS data lack external-cause codes, there was no easy way to distinguish residential fires from other fires. Therefore, we scrutinized the comment fields, which usually

[6] This often occurs when concerned parents bring young children to the ED after a fire and they are found to be unharmed.

contain a brief description of the incident. For the largest category, thermal burns, we developed an automated search routine to classify cases as in or out of the residential-fire subset. Unfortunately, while the comment field in NEISS often provides much useful information that is not available in other medical datasets, it is not structured to facilitate automated searches. The lack of standardization in terminology and formatting, along with frequent abbreviations and misspellings, reduced the effectiveness of the automated search, which was able to classify only about half the cases. We scrutinized the rest, looking for indications of where the fire occurred and whether it was in scope. Many fires were clearly outdoors, while some indoor incidents resulted from controlled fires, such as fireplaces and gas stoves. Other fires, such as those involving furniture, were clearly in scope.

In the end, however, many cases gave no clue as to the circumstance or the location of the fire. With these, we used a weighting scheme like that for the "unknown" cases in the mortality and hospital data. We differentiated the weights by fire department attendance (FMV=1, 2, or 3), computing the weights from the cases whose in-scope status we were able to classify:

1 – Fire department attended	0.8328
2 – Fire department did not attend	0.4479
3 – Fire department attendance not recorded	0.5654

We divided all of the NEISS survey weights by 9 so that weighted estimates based on the 9 years of data would be annual averages, and then we multiplied the annualized weights of the "unknown" cases by the weights above.

We found 6,641 in-scope cases and 556 whose in-scope status was indeterminate. After applying the survey weights, we arrived at an estimate of 29,345 injuries per year related to residential fires. Table 1 shows the breakdown by diagnosis group. Just over half of these injuries (51.6%) involved inhalation-related diagnoses.

Because NEISS codes only one diagnosis per case, we had to take an extra step to estimate the incidence of ED-treated injuries with both burn and inhalation diagnoses. In analyzing the Fire Survey data (see Chapter 5), we found that 13 of 119 cases coded in NEISS as inhalation injuries actually had both burn and inhalation diagnoses. None of the cases that NEISS had coded as burns, however, was found to have an inhalation diagnosis. It appears that NEISS, in selecting which diagnosis to code, always gives priority to anoxia over other injuries. (Perhaps anoxia is judged the more severe diagnosis because it is associated with a majority of fatalities.) Thus, any patient who suffered both burns and anoxia would be coded as anoxia. The Fire Survey, which provides additional detail on NEISS fire injuries, revealed the burn diagnoses. In the HCUP State Emergency Department Databases (HCUP-SEDD),[7] we found that 2.952 percent of all cases with either a burn or an inhalation diagnosis had diagnoses of both types. We applied this percentage to our NEISS-based estimates:

$$0.02952 \times (12{,}185.1 + 15{,}127.7) = 806.3$$

We then reduced the 15,127.7 inhalation injuries by 806.3, leaving 14,321.4 inhalation-only injuries.

[7] 2003 State Emergency Department Databases, Healthcare Cost and Utilization Project, Rockville, MD: Agency for Healthcare Research and Quality, Department of Health and Human Services.

Doctor's office/clinic incidence was estimated from the NEISS-based ED incidence by applying ratios of doctor's office/clinic incidence to ED incidence. This is the same approach that is used in the Injury Cost Model. We estimated the ratios based on data from the NEISS All Injury Program (NEISS-AIP), National Ambulatory Medical Care Survey (NAMCS), National Hospital Ambulatory Medical Care Survey (NHAMCS), and Medical Expenditure Panel Survey (MEPS). We computed ratios by age group and sex, both for all injuries and for residential fire injuries as defined for this project. The NAMCS sample was too thin to provide stable estimates by age group and sex for residential fire injuries by itself. Therefore, we started with the all-injury ratios by age group and sex and factored them down by the ratio of the overall residential fire ratio (0.6150) to the overall all-injury ratio (0.7225). We then applied the factored-down ratios to NEISS counts by age group and sex. The computations are shown in Table 3. We estimate there are 18,682 fire-related injuries per year treated in doctor's offices and clinics.

Table 3. Computation of Doctor/Clinic Incidence Estimates

Age &	All-Injury	Fire	NEISS				Doctor/Clinic Estimate*			
Sex	Ratio	Ratio	Burn	Inhalation	Trauma	Other	Burn	Inhalation	Trauma	Other
Male										
00-04	0.5130	0.4366	243.7	1,099.8	20.9	0.0	106.4	480.2	9.1	0.0
05-14	0.5874	0.4999	741.0	1,033.9	57.6	0.0	370.4	516.9	28.8	0.0
15-24	0.4056	0.3453	1,413.8	1,129.0	210.4	7.5	488.1	389.8	72.6	2.6
25-44	0.6412	0.5458	2,695.2	2,029.8	548.8	21.7	1,471.1	1,107.9	299.6	11.9
45-64	0.9354	0.7962	1,209.9	1,000.9	188.0	7.5	963.3	796.9	149.6	6.0
65-74	1.5327	1.3045	297.0	152.1	40.4	7.4	387.5	198.4	52.7	9.7
75+	1.1026	0.9384	180.2	286.6	17.7	0.0	169.2	269.0	16.6	0.0
Female										
00-04	0.3294	0.2803	173.0	1,116.9	7.7	0.0	48.5	313.1	2.2	0.0
05-14	0.8175	0.6959	518.1	958.2	103.0	10.0	360.5	666.7	71.7	6.9
15-24	0.5922	0.5041	1,169.2	1,344.4	135.9	0.0	589.4	677.6	68.5	0.0
25-44	0.8186	0.6968	2,090.8	2,674.4	376.8	22.7	1,456.8	1,863.4	262.5	15.8
45-64	1.1483	0.9774	968.1	1,285.1	147.5	5.5	946.2	1,256.0	144.2	5.3
65-74	1.2467	1.0611	234.9	484.2	42.6	8.6	249.2	513.8	45.2	9.1
75+	1.0454	0.8898	250.1	532.4	41.6	2.0	222.5	473.7	37.0	1.7
Total	0.7225	0.6150	12,185.1	15,127.7	1,938.9	92.9	7,829.1	9,523.5	1,260.3	69.1

*Computed as Fire Ratio times NEISS count.

The final column of Table 1 sums the four preceding columns. All together, we estimate that residential fires cause more than 60,000 injuries per year. Burns and/or inhalation injuries are diagnosed in 93.7 percent of the victims of residential-fire injuries.

Admissions to Shriners Hospitals for Children

In this section, we estimate the numbers of patients injured in residential fires who are admitted to a Shriners hospital whose admissions are not captured in state hospital discharge data.

The Shriners run four hospitals (in Boston, Cincinnati, Galveston, and Sacramento) that provide free burn care to children. Because they do not charge for their services and do not interact with the medical payments system, three of the four are exempt from their respective states' reporting requirements. Therefore, their patients are not included in state hospital discharge data. Only the Shriners Hospital for Children – Northern California, in Sacramento, reports to its state hospital discharge data system. Therefore, there was concern that the injuries treated in the other three hospitals would not be counted in our incidence estimates.

In order to learn more about burn admissions at Shriners hospitals, we asked Peter Brigham, past president of the Burn Foundation, to speak to his Shriners contacts. He spoke with a health information systems (HIS) person at the Shriners Burn Institute in Boston. He said the Shriners hospitals do not have their own emergency departments (EDs). Rather, each of them is located adjacent to a full-service university hospital with an ED, which will do what EDs normally do in the way of stabilizing patients, including sometimes admitting them overnight. The patient is then transferred through a tunnel or other protected passageway to the Shriners hospital.

Therefore, we can be sure that nearly all patients treated in Shriners hospitals will have received ED treatment elsewhere and will be recorded in state data systems. What Mr. Brigham's contact could not estimate, and what would probably require a special study of Shriners medical records, is how many Shriners patients were admitted, at least overnight, to their original hospital before being transferred to a Shriners hospital. Therefore, an unknown portion of Shriners patients will have already been recorded as admitted at another hospital.

Shriners hospitals generally function as a mix of a regional hospital for the usual mix of patients from nearby, most of whom will not have been previously admitted, and a special referral hospital for the very severely burned from a broader area of the country, who are more likely to have been previously admitted. Thus ED patients will not be undercounted, but hospital admissions will be undercounted to an unknown degree.

Based on an American Burn Association (ABA) survey of burn admissions in 2003, Mr. Brigham estimates that the four Shriners hospitals, between them, admit about 1,000 acute burn patients annually. The four hospitals reported as follows:

Boston	197
Cincinnati	311
Galveston	1,752
Sacramento	211

Suspecting that the Galveston figure was an error, Mr. Brigham contacted a clinical nurse specialist at the hospital, who estimated that the hospital had about 300 acute admissions.

In our own analysis of the 2003 California inpatient data, we found only 162 acute burn admissions at Shriners – Northern California. It appears that we might be using stricter criteria in defining what constitutes an acute injury. Of these 162 patients, 23 had no listed state of residence. Mr. Brigham's conversation with an HIS person from that hospital suggests that these patients were burned in Mexico and flown to the Shriners hospital. Therefore, it appears that about 23.2 percent of the 211 patients from the ABA survey do not meet our acute-burn criteria, and another 10.9 percent were injured outside the United States. Examining the E codes of acute-injury patients admitted to this same hospital in 1997–98, we found that only 23.8 percent of acute-injury patients with a listed state of residence and a non-missing E code were injured in residential fires. (Scalds were the most numerous type of burn.)

Using the patterns we found in Sacramento, we estimated how many cases from the other three Shriners hospitals might be missing from our incidence counts. Of the estimated 1,000 acute burn patients treated in Shriners hospitals in 2003, roughly 800 were treated in the three hospitals that do not report their data. First, we reduced this count by 23.2 percent to account for our tighter definition of "acute injury," eliminating 186 cases. Mr. Brigham reported that Galveston imported at least as many foreign patients as Sacramento, which implies that 33 of its burn patients were probably injured outside the United States. This leaves an estimated 581 cases of acute burns that took place in the United States. Next, we assume that 23.8 percent of these were injured in residential fires, or 138 cases. Finally, if 15 percent of these were previously admitted overnight before coming to the Shriners hospital, we can estimate that only 117 Shriners patients who were injured in residential fires are missing from hospital inpatient data. Based on patterns in the Sacramento data, we further estimate that 4 of these patients suffered inhalation injuries, in addition to burns.

While this will have little impact on the total incidence estimate, it could affect our picture of the demographics of residential fire injury. Since the Shriners hospitals specialize in treating children, their omission will skew the age distribution of residential fire injuries upwards. The additional 117 cases add only 1 percent to our estimate of the total incidence of hospital-admitted residential-fire injuries, but they add 7 percent to the incidence of such injuries to children less than 18 years old.

Looking at all burns, rather than just those in residential fires, and assuming that the other Shriners hospitals have the same small share of non-burn cases, we estimate 455 Shrine burn patients are not captured by hospital inpatient data. This would add 1 percent to the total incidence of hospital-admitted burns and 5 percent to incidence to children under 18.

Admissions to Burn Centers

The column of hospital-admitted estimates in Table 1 includes burn centers—hospitals that specialize in treating burn victims. Here, we break out the share of hospitalized burns that are admitted to burn centers. With the assistance of Peter Brigham, retired president of the Burn Foundation, we assembled a list of 126 hospitals that could be classified as burn centers in 2003. Using this list, we flagged the burn centers in the HCUP State Inpatient Databases (HCUP-SID).[8] We selected cases using the same criteria we developed for the HCUP-NIS and ran incidence counts by diagnosis group. We then applied these burn-center shares from the SID to the NIS-based case counts shown in Table 1.[9]

[8] 2003 State Inpatient Databases, Healthcare Cost and Utilization Project (HCUP), Rockville, MD: Agency for Healthcare Research and Quality (AHRQ), Department of Health and Human Services.

[9] The SID was superior to the NIS as a source of burn-center shares because it included more hospitals and many more burn centers. The NIS, on the other hand, is stratified to be representative at the national level and therefore, is a better source of national-level total incidence estimates.

An adjustment was made to account for three Shriners hospitals that treat burned children but that do not report to their respective states, and therefore, are not included in the HCUP data. The previous section described the estimation of these 117 cases, and the hospitalized incidence section, above, described their addition to the HCUP-NIS. These same 117 estimated cases were also added to the HCUP-SID burn center estimates, increasing the total from 3,663 to 3,780.

Table 4 shows the computations. The burn center percentages, shown in the center column, were computed from the SID-based counts of the preceding three columns. They were then applied to the NIS-based estimates of total hospital admissions in the next column (copied from Table 1) in order to decompose them into separate counts for burn centers and other hospitals.

Table 4. Residential Fire Injuries Treated in Burn Centers in 2003 HCUP Inpatient Data

	HCUP-SID*			Burn	HCUP-NIS		
Diagnosis Group	Burn Centers	Other Hospitals	Total Admissions	Center Percentage	Total Admissions	Burn Centers	Other Hospitals
Burns only	2,914.9	1,404.1	4,319.0	67.49%	5,927.0	4,000	1,927
Inhalation only	264.7	875.4	1,140.1	23.22%	1,694.3	393	1,301
Both	550.1	351.4	901.5	61.02%	1,509.3	921	588
Trauma + Other†	50.7	206.2	256.9	19.74%	371.1	67	304
Total	3,780.4	2,837.1	6,617.5	57.13%	9,502.7	5,381	4,121

*Except Hawaii, New Hampshire, and Wisconsin, which did not identify hospitals, and Pennsylvania, which withheld its data. The SID burn center column and the NIS total admissions column include an additional 117 cases to represent 3 Shriners hospitals not included in state hospital discharge data.

†Trauma and Other are combined here to comply with AHRQ's rule against reporting small cell counts. They were computed separately and then added together.

We estimate that burn centers account for 67.5 percent of burn-only admissions and 57.1 percent of all admissions resulting from residential fires.

Firefighter Injuries

We obtained data on numbers of nonfatal injuries sustained by firefighters from two different sources. First, an analyst from the National Institute for Occupational Safety and Health (NIOSH) performed some runs on the NEISS occupational supplement (NEISS-Work), which provides information on persons treated in EDs for nonfatal work-related injuries and illnesses. Second, we located statistics published by the NFPA and the United States Fire Administration (USFA). Table 5 summarizes the results of both.

Table 5. Firefighter Injuries, 2000-2001

	Total (NFPA)	ED-Treated (NEISS-Work)	Implied ED Share
Total	166,800	74,500	44.66%
Fire ground	84,460	25,900	30.67%
Residential	52,407	3,500	6.68%

A *fire ground injury* is any injury that results from activity at the scene of an uncontrolled fire from the moment of arrival until departure from the scene. Fire ground injuries account for about half of all injuries sustained by firefighters. We are particularly interested in the subset of fire ground injuries associated with fires in residential structures, such as houses and apartments. The NFPA estimates cover all firefighter injuries, while the NEISS-based estimates cover only those that resulted in ED visits.

At our request, Audrey Reichard of NIOSH performed the analysis of the 2000–2001 NEISS-Work data.[10] She used the *occupation* and *business* variables to differentiate between firefighters and EMS workers. She then selected and classified cases using criteria similar to those we used with the NEISS data. She found it difficult to identify cases related to residential fires because the location was usually not recorded (LOC=0), and the text fields are less likely to give clues about the circumstances of the fire than those in the NEISS consumer product data. Therefore, she created two datasets, the first narrowly defined and the second more broad. The figure in Table 5 came from the narrow dataset. Despite the fact that the broader dataset had four times as many cases, its coefficients of variation were far beyond what NIOSH will report. The 95 percent confidence interval on the estimate of 3,500 residential fire injuries was ±2,000. After comparing this estimate with the NFPA estimates, we asked Ms. Reichard to run total firefighter injuries and all fire ground injuries (where FMV=1, 2, or 3) for comparison. These are shown in Table 5.

NFPA publishes annual reports on U.S. firefighter injuries,[11] and also publishes statistical tables on-line.[12] The estimates of total and fire ground injuries shown come directly from NFPA. According to a USFA report,[13] in 1999, 85 percent of on-scene firefighter injuries occurred at or in structures, and residential structures comprised 73 percent of all structure-fire injuries. Multiplying these factors times the NFPA estimate of 84,460 fire ground injuries in 2000–2001 produces an estimate of 52,407 firefighter injuries in residential structure fires.

As we narrow the scope from all injuries to fire ground injuries to residential fire injuries, the NEISS-Work estimates shrink faster than the NFPA estimates. Could it be that fire ground injuries are less likely to result in ED treatment and residential fire injuries less likely still? With respect to total versus fire ground injuries, this is possible. Based on injury severities from the 1998 National Fire Incident Reporting System (NFIRS) published in the appendix of a Rand report,[14] we found that fire ground injuries are less likely than other injuries to be of greater than minimal severity[15] (36.5% versus 44.6%). Still, the 25,900 figure is known to be low. In checking the comment fields, Ms. Reichard found additional fire ground injuries that were not coded as such in the FMV variable and therefore, were not included in the 25,900. So this figure must be regarded as conservative. The much smaller NEISS-Work estimate for residential fire

[10] The NEISS-Work data are not released to outside researchers because of privacy concerns.
[11] The most recent was "U.S. Firefighter Injuries – 2005," Michael J. Karter, Jr., and Joseph L. Molis, November 2006.
[12] See http://www.nfpa.org/categoryList.asp?categoryID=955&URL=Research%20&%.
[13] "Firefighter Injuries in Structures," USFA Topical Fire Research Series 2:2, August 2001 (rev. March 2002).
[14] *Emergency Responder Injuries and Fatalities: An Analysis of Surveillance Data*, Ari N. Houser, Brian A. Jackson, James T. Bartis, and D.J. Peterson, TR-100-NIOSH, March 2004.
[15] That is, greater than 1 on a scale of 1 to 6. The report does not explain the severity scores, but they fit the pattern of maximum AIS scores.

injuries, however, is implausible. Comparison with the NFPA/USFA estimate of residential fire injuries confirms that the NEISS-Work case selection problems are too great to overlook.

It seems reasonable to assume that residential fire injuries are no more or less likely to result in ED treatment than other fire ground injuries. If we make this assumption, we can use the USFA factors to estimate the incidence of ED-treated residential fire injuries from the NEISS-Work estimate of all fire ground injuries: $25{,}900 \times 0.85 \times 0.73 = 16{,}071$. This must be regarded as a lower bound. An upper bound might be based on the NFPA figure for total fire ground injuries, multiplied by the ED share for all fire injuries and the previous factors:
$84{,}460 \times 0.4466 \times 0.85 \times 0.73 = 23{,}405$. This implies that 55 percent to 70 percent of injuries suffered by firefighters in residential fires in 2000–2001 were *not* treated in the ED; that is, they were treated in doctor’s offices or clinics, treated informally, or not treated at all.

CHAPTER 3. COSTS

In this chapter, we estimate the overall medical and work-loss costs of burn and anoxia injuries resulting from residential fires. We report our estimates of costs-per-case for various treatment levels and diagnoses. Then, we multiply these unit costs times the incidence estimates from Chapter 2 to arrive at aggregate U.S. costs of residential fire injuries.

Fatal. We drew costs for fatalities from our 1999–2003 Multiple Cause of Death (MCOD) file. Medical costs were computed separately for five different places of death identified in the MCOD data:

- On-scene/at home.
- Dead on arrival at the hospital (DOA).
- At the ED.
- At the hospital after admission.
- At a nursing home.

The medical costs incurred, depending on place of death, might include coroner/medical examiner, medical transport, emergency department, in-patient hospital, and nursing home costs. Table 6 summarizes the costs included for each place of death.

Productivity losses for fatal injuries follow the approach of Rice et al. (1989). For a victim of a given age and sex, we summed the sex-specific probability of surviving to each subsequent year of age (Arias, 2002) times sex-specific expected earnings for someone in that 10-year age bracket, as reported in Haddix et al. (2002). Earnings (*i.e.*, salary plus the value of fringe benefits) at future ages were adjusted upward to account for a historical 1 percent productivity growth rate (Haddix et al., 2002) and then discounted to present value using a 3 percent discount rate. Parallel calculations were used to value lost household work. Estimates of the value of household work are also included in Haddix et al. (2002). Historically, productivity growth in household production has been negligible, so we did not adjust for it. In all cases, we assume that the probability of surviving past the age of 102 is zero.

Lifetime earnings for someone of age a and sex b ($Earn_{a,b}$) is computed as

$$Earn_{a,b} = \sum_{k=a}^{102} [P_{a,b}(k) \times Y_{k,b}] \times [(1+g)/(1+d)]^{k-a}$$

where:

$P_{a,b}(k)$ = the probability that someone of age a and sex b will live until age k,

$Y_{k,b}$ = the average value of annual wages (plus fringe benefits) or annual household production at age k for someone of sex b,

g = the productivity growth rate (1% for wages, 0% for household production), and

d = the discount rate (3%).

Expected future earnings were discounted to present value using a 3 percent discount rate, which is the rate recommended for reference case comparisons worldwide by the U.S. Panel on Cost-Effectiveness in Health and Medicine (Gold et al., 1996).

Cost estimates in 2000 dollars calculated according to these methods were already attached to the MCOD file from which we selected residential fire injuries in Chapter 2. Using the same cases selected for that purpose, we computed average costs per case for the five diagnosis categories. These cost estimates appear in Table 7.[16] The aggregate costs are based on our fatal incidence estimates from Chapter 2, which totaled 3,062.

Table 7. Costs of Residential Fire Deaths (*2000 Dollars*)

	Unit Costs		Aggregate Costs	
Diagnosis Group	Medical	Work Loss	Medical	Work Loss
Burns	$44,613	$499,784	$26,327,945	$294,942,335
Inhalation	$6,235	$811,592	$11,101,489	$1,445,071,254
Burn+Inhalation	$18,504	$719,068	$11,139,116	$432,864,741
Trauma	$26,033	$683,210	$464,953	$12,202,137
Other	$22,962	$415,404	$1,638,575	$29,643,263
Average/Total	$16,549	$723,328	$50,672,078	$2,214,723,730

Hospital-admitted. A hospital-admitted injury victim may incur several different types of medical costs. In addition to the facility and non-facility costs of the admission itself, the patient may incur costs for emergency transport, follow-up treatment, readmissions, rehabilitation, nursing home stays, and, for particularly serious injuries, long-term care. We derived our estimates of facility costs from hospital charges, as recorded in the 2003 Healthcare Cost and Utilization Project – Nationwide Inpatient Sample (HCUP-NIS), multiplied times hospital-specific cost-to-charge ratios provided with the data by the Agency for Healthcare Research and Quality (AHRQ). We supplemented this with Medstat's MarketScan® database[17] for non-facility fees, the Prospective Payment System (PPS)[18] for rehabilitation expenses, the 1996–1999 Medical Expenditure Panel Survey (MEPS) for medium-term follow-up costs, and the 1979–1988 Detailed Claims Information (DCI) from worker's compensation claims for long-term follow-up costs. An overview of our approach is presented in Table 8.

One additional component of medical cost was required for the CPSC—the expenses incurred by payers in processing medical claims. Based on the *primary expected payer* variable in the 2003 HCUP-NIS, we assigned claims-processing percentages as per Table 10 of the revised ICM report (Miller et al., 2000) and factored up medical costs accordingly.

For nonfatal injuries, productivity loss is the sum of the expected values of wage and household work lost due to: (1) short-term disability in the acute recovery phase, and (2) permanent or long-term disability for the subset of injuries that cause lasting impairments that restrict work choices or preclude return to work. In estimating these costs, we followed the approach of Lawrence et al. (2000).

[16] Incidence estimates are shown in Tables 1 and 4 rounded to the nearest unit. Unit costs shown in all tables in this chapter are rounded to the nearest dollar. All aggregate costs shown in this chapter are computed from *unrounded* numbers, and cannot be replicated from the rounded incidence and unit costs that appear in the tables.

[17] For more information on this database, see www.medstat.com/1products/marketscan.asp.

[18] For more information on the PPS, see www.cms.hhs.gov/providers/hopps/.

To estimate short-term work-loss costs, we combined the probability that an injury would result in lost workdays from the 1987–1996 National Health Interview Survey (NHIS) with the mean work days lost in cases with work loss, as reported by the Bureau of Labor Statistics (BLS). We used a Weibull regression model to estimate the total duration of work loss for cases where the victim had still not returned to work at the end of the BLS reporting period. We multiplied the probability of work loss times the duration of work loss, by diagnosis group. Averaged across all injuries with work loss, the total estimated temporary work loss was 24.5 days per injury. MEPS revealed that work loss is roughly 5 times longer for hospitalized injuries. Using this ratio, we computed work-loss durations for injuries separately for admitted and non-admitted cases. Averaged across all injuries (including those with no work loss), our estimated temporary work loss was 11.1 days per injury.

To place a monetary value on temporary wage work loss, we multiplied the estimated days of work lost times the average wage and fringe benefit costs per day of work, given the victim's age and sex, from the Current Population Survey.[19]

We estimated household workdays lost as 90 percent of wage workdays lost, based on findings from an unpublished nationally representative survey on household work losses following injury (S. Marquis, the Rand Corporation, personal communication, 1992). Using this ratio and the value of household work reported in Haddix et al. (2002), we then imputed a value to household work lost. These estimates value lost household production using replacement cost—how much one would have to pay a professional to do the same work.

To compute productivity loss due to permanent or long-term disability, we considered permanent total disability and permanent partial disability separately. For permanent total disability, we multiplied the present value of age- and sex-specific lifetime earnings and household production, as reported in Haddix et al. (2002), times the probability of permanent disability for each type of injury. For permanent partial disability, we multiplied the earnings estimate times the probability of permanent partial disability times an additional factor identifying the percentage of disability resulting from that type of injury. We then summed the results to compute the expected productivity loss associated with permanent disability. The probabilities of permanent total and partial disability and the percent disabled by body part and nature of injury were computed from pooled multistate Workers' Compensation data from the 1979–1988 and 1992–1996 Detailed Claims Information database of the National Council on Compensation Insurance.[20] Averaged across all injuries, our estimated percentage of lifetime productivity potential lost due to permanent injury-related disability was 0.26 percent per injury.

These medical and productivity costs previously had been merged onto the 2003 HCUP-NIS dataset from which we selected hospital-admitted residential fire injuries for Chapter 2. We used the same subset of cases for estimating costs. We identified burn centers in the HCUP-NIS, as described in Chapter 2, and estimated costs separately for burn centers and other hospitals. We then applied our estimates of admissions to burn centers (totaling 5,381) and other hospitals (totaling 4,121) from Chapter 2 to compute aggregate costs from unit costs. Tables 9 and 10 show these costs.

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[19] For more information about the Current Population Survey, see www.bls.census.gov/cps/cpsmain.htm.
[20] For more information about NCCI, see www.ncci.com/NCCI/index.aspx.

Table 9. Costs of Residential Fire Injuries Admitted to Burn Centers (*2000 Dollars*)

	Unit Costs		Aggregate Costs	
Diagnosis Group	Medical	Work Loss	Medical	Work Loss
Burns	$26,210	$35,364	$104,842,337	$141,461,976
Inhalation	$39,592	$17,352	$15,573,053	$6,825,471
Burn+Inhalation	$72,671	$33,339	$66,929,172	$30,704,818
Trauma	$26,813	$62,896	$1,519,395	$3,564,067
Other	$6,050	$122,151	$60,101	$1,213,464
Average/Total	$35,634	$33,973	$188,924,058	$183,769,796

Table 10. Costs of Residential Fire Injuries Admitted to Other Hospitals (*2000 Dollars*)

	Unit Costs		Aggregate Costs	
Diagnosis Group	Medical	Work Loss	Medical	Work Loss
Burns	$14,227	$32,584	$27,413,967	$62,785,224
Inhalation	$8,310	$6,099	$10,810,866	$7,934,930
Burn+Inhalation	$22,994	$24,475	$13,527,719	$14,398,769
Trauma	$26,813	$62,896	$5,315,302	$12,468,182
Other	$6,050	$122,151	$642,899	$12,980,458
Average/Total	$14,981	$27,337	$57,710,754	$110,567,563

Injuries treated in burn centers tended to be more costly than those treated in other hospitals. This is because the most severe burns, which require longer hospital stays and more intensive treatment, are nearly always transferred to burn centers.

Emergency department. AHRQ provided us with facility-specific cost/charge ratios for EDs in eight states (Connecticut, Georgia, Maryland, Minnesota, Nebraska, South Carolina, Tennessee, and Utah). We multiplied these ratios times the hospital charges in HCUP's State Emergency Department Databases (HCUP-SEDD) to estimate the facility cost, just as we did with the HCUP-NIS data for hospital-admitted costs.

Because these costs were at state price levels for a non-representative sample of states, we converted the costs to national price levels by dividing by state price indexes based on the ACCRA Cost of Living Indexes. ACCRA publishes indexes for large metropolitan areas and the nonmetropolitan remainders of states. We weighted the regional indexes within each state by population to obtain a state-level index. For New York, for example, we started by computing separate indexes for New York City and the balance of the state, then combined them using population weights.

These initial facility costs were factored up by MEPS-based ratios to account for follow-up visits and medication. As with hospital costs, we assumed that half of patients received emergency transport. Finally, we factored up total costs to account for claims processing costs, as described above for hospital-admitted costs.

For productivity losses, we used existing costs from the Injury Cost Model (ICM). We simply merged the ICM costs onto the residential fire cases we had selected earlier for Chapter 2 and computed the weighted mean by diagnosis group. Since NEISS includes only one diagnosis per case, we could not compute a separate estimate for cases with both burn and inhalation diagnoses. Therefore, we applied the same work-loss cost as for burn-only injuries.

These costs appear in the unit costs columns of Table 12. We estimated aggregate costs using our NEISS-based estimates of ED-treated incidence from Chapter 2, which totaled 29,345. Since NEISS, which has only one diagnosis per case, did not provide a basis for estimating the incidence of cases involving both burn and inhalation diagnoses, we looked at incidence from the HCUP-SEDD. We found that 2.9522 percent of cases involving burn or inhalation diagnoses involved both. Applying this to the NEISS-based incidence estimates yielded an estimate of 806 burn-and-inhalation cases. In our analysis of data from the Fire Survey, which follows up fire-related injury victims whose ED visits are recorded in NEISS, we found that all patients with both burn and inhalation diagnoses had originally been listed as inhalation cases in NEISS. Therefore, we reduced the inhalation incidence by 806 and left the burn incidence unchanged.

Table 12. Costs of Residential Fire Injuries Treated in Emergency Departments (*2000 Dollars*)

	Unit Costs		Aggregate Costs	
	Medical	Work Loss	Medical	Work Loss
Burns	$722	$1,751	$8,802,571	$21,331,793
Inhalation	$459	$523	$6,570,348	$7,487,069
Burn+Inhale	$1,433	$1,751	$1,155,374	$1,411,594
Trauma	$956	$1,815	$1,853,422	$3,519,862
Other	$548	$1,706	$50,872	$158,503
Average	$628	$1,145	$18,432,587	$33,908,821

Doctor's office/clinic. We used the 1996–1999 MEPS data to quantify direct medical costs for injuries treated in non-hospital settings. MEPS participants with injury-related expenditures but without an inpatient admission or ED visit were divided into two categories by primary treatment location, according to this hierarchy: (1) any office-based use but no ED use; and (2) any outpatient treatment but no ED or office-based use. Even after pooling 4 years of data, the MEPS sample of non-admitted injuries remained small for some injury diagnoses. Therefore, we pooled injuries into diagnosis groups. We arrived at 52 for office-based visits and 7 for outpatient clinic cases.

Having classified each patient into one of these 59 location/diagnosis-group categories, we added up all medical costs for each patient (including costs incurred at other treatment locations lower in the hierarchy), and then calculated the average total medical cost across all patients in each location/diagnosis category. We then applied these direct cost estimates to the incidence estimates in the corresponding location/diagnosis categories to quantify total injury costs for non-admitted injuries. This procedure avoids double-counting costs for individuals seen in multiple locations. Finally, we multiplied these medical costs by 6.045 percent to account for claims administration costs. This was the average claims administration percentage of all visits to medical providers and hospital outpatient departments, excluding those paid for by worker's compensation.

Using incidence figures and unit costs by Barell Matrix cell,[21] we split off burns and systemic injuries (to represent inhalation injuries) from the rest, which represented trauma. We simply applied the overall average cost to our small "other" category. The incidence figures used to weight the costs came from the National Ambulatory Medical Care Survey (NAMCS) for treatment by office-based physicians and the National Hospital Ambulatory Medical Care Survey (NHAMCS) for hospital outpatient treatment. We computed average costs per case for each of these four diagnosis groups and combined the office-based and outpatient costs using the NAMCS and NHAMCS incidence figures as weights.

We factored up the total costs to account for claims processing costs, as described under hospital-admitted medical costs. Since we did not have payer data at the case level, we used 1999 MEPS aggregate data on sources of payment for visits to medical providers and hospital outpatient departments, excluding worker's comp. The resulting payer mix was 53.0 percent private insurance, 17.6 percent Medicare, 15.8 percent self/family, and 5.9 percent Medicaid. The average claims processing percentage was 6.045 percent.

For productivity losses, the methods are similar to those described above for ED cases. We used the same subset of NEISS cases with the same work-loss costs merged on, but we used different weights. We multiplied the normal NEISS weights times the ICM's ratios of doctor/clinic cases to ED cases. The resulting costs were close to the corresponding ED costs.

We computed aggregate costs from unit costs using our estimates of doctor/clinic incidence from Chapter 2, which totaled to 18,682. Note that for injuries treated in doctor/clinic settings there is no separate diagnosis category for cases with both burn and inhalation diagnoses. Unit and aggregate costs appear in Table 13.

Table 13. Costs of Residential Fire Injuries Treated in Doctor's Offices and Clinics (*2000 Dollars*)

Diagnosis Group	Unit Costs		Aggregate Costs	
	Medical	Work Loss	Medical	Work Loss
Burns	$250	$1,715	$1,955,464	$13,426,523
Inhalation	$353	$521	$3,363,081	$4,958,971
Trauma	$741	$2,150	$934,339	$2,709,253
Other	$336	$1,661	$23,211	$114,742
Average	$336	$978	$6,276,095	$21,209,489

Overall costs. Adding up all the costs of fatal, hospital-admitted, ED-treated, and doctor/clinic cases, we arrive at estimates of total annual costs of injuries resulting from residential fires. We estimate medical costs of $322 million and work loss of $2.564 billion.

[21] The Barell Matrix classifies ICD-9-CM injury diagnoses into a two-dimensional framework of body region and nature of injury. See www.cdc.gov/nchs/about/otheract/Ice/barellmatrix.htm.

Table 6. Summary of Data and Methods for Estimating Medical Costs of Fatal Injuries

Location of Death	**Cost categories**	**Description, Unit Cost (*2000 Dollars*)**	**Source of Data**
On scene/at home	Coroner/Medical Examiner (C/ME)	$530 (C/ME)	Edwards et al., 1981 (C/ME)
Dead on arrival at hospital	C/ME + Transport (T)	$530 (C/ME) + $212 (T)	1999 Medicare 5% Sample (T)
In emergency department (ED)	C/ME + T + ED Treatment (EDT)	$530 (C/ME) + $212 (T) + Avg. costs for fatalities in ED by external cause and age groupings (EDT)	1997 3-state (NE,NH,SC) ED discharge data (EDT)
In hospital after admission	C/ME + T + Fatal Inpatient Total (FIT)	$530 (C/ME) + $212 (T) + Avg. treatment cost for fatalities in hospital by body region and nature of injury (FIT)	2000 HCUP-NIS for hospital facilities costs, 1996–97 MarketScan® data for non-facility costs (FIT)
In nursing home	C/ME + T + Non-Fatal Inpatient Total (NIT) + Avg. cost for fatalities in nursing homes (NH)	$530 (C/ME) + $212 (T) + Avg. treatment cost for non-fatal inpatient injuries by diagnosis (NIT) + $5,545 (NH)	2000 HCUP-NIS for inpatient facilities costs (NIT), 1996–97 MarketScan® data for non-facility costs (NIT), 1999 National Nursing Home Survey (NH)

Table 8. Summary of Data and Methods for Estimating Medical Costs of Hospital-Admitted Non-Fatal Injuries

Cost category	**Description, Unit Cost (*2000 Dollars*)**	**Source/Notes**
Inpatient Stay - Facilities Component	Inpatient facility charges times facility-specific (or hospital stratum average) cost-to-charge ratios	2003 HCUP-NIS and cost-to-charge ratios from AHRQ
Inpatient Stay - Non-Facilities Component	Estimated via ratio of total costs to facilities costs by body region and nature of injury	1996–97 MarketScan® data
Hospital Readmission	Probability of readmission times average readmission costs by 3-digit ICD-9 diagnosis	Probability from 1997-98 MD, NJ, and VT hospital discharge data, costs from 2003 HCUP-NIS/MarketScan®
Hospital Rehabilitation	Estimated for 14 diagnosis groups and 6 mechanisms	Costs estimated using Prospective Payment System reimbursements, as per Miller et al. (2004)
Nursing Home (NH)	Costs added to HCUP/NIS patients discharged directly to NH. Costs estimated for hip-related fractures by age group and for all other injuries	1999 National Nursing Home Survey
Short- to Medium-Term Costs (Non-Inpatient)	Estimated as the ratio of inpatient to total costs in months 1-18 (on average) by select diagnosis groupings	1996–99 MEPS
Long-Term Costs - 18 Months to 7 Years	Estimated using ratios of total costs to 18-month costs by diagnosis/age group. Captures costs up to 7 years post injury	1979–88 Detailed Claim Information (DCI) data from Worker's Comp claims; adjustment factor for youth from Miller et. al. (2000)
Long-Term Costs – Beyond 7 Years	SCI: Ratio of lifetime costs to 7-year costs estimated from survey data TBI: 7+ year costs estimated at 75% of SCI costs	1986 survey data reported in Berkowitz et al. (1990)
Transport	50% of admissions assumed to have transport costs of $212	Mean cost estimated using 1999 Medicare ambulance claims with an injury E code
Claims Processing	Percentage of total cost (0%–13%), depending on primary expected payer	Miller et al. (2000)

Table 11. Summary of Data and Methods for Estimating Medical Costs of Non-Fatal, Non-Admitted Injuries Treated in Emergency Departments

Cost category	**Description, Unit Cost (*2000 Dollars*)**	**Source/Notes**
ED Visit	ED facility charges times facility-specific (or hospital stratum average) cost-to-charge ratios times national/state price adjustors	2003 HCUP-SEDD (8 states), cost-to-charge ratios from AHRQ, and national/state price adjustors from ACCRA
Follow-Up Visits and Medication	Estimated as the ratio of ED visit to total costs by select diagnosis groupings	1996-1999 MEPS
Transport	50% of admissions assumed to have transport costs of $212	Mean cost estimated using 1999 Medicare ambulance claims with an injury E code
Claims Processing	Percentage of total cost (0%–13%), depending on primary expected payer	Miller et al. (2000)

CHAPTER 4. ANALYSIS OF FIRE SURVEY DATA

In this chapter we analyze the Fire Survey data in order to look at fire department attendance and the general severity of residential fire injuries.

From mid-2002 until the beginning of 2007, CPSC administered a follow-up survey to collect additional information from NEISS patients who were injured in fire incidents.[22] The patient or other member of the patient's household most knowledgeable of the incident was asked 66 questions about the origin and results of the fire, including questions on attendance by the fire department (FD), the type of injuries sustained, and the medical treatment received. The survey added extra dimensions to NEISS, such as causation (heat source and what caught fire first), treatment location, types of treatment (*e.g.*, skin grafts), and whether time was lost from school or work. If the FD attended the fire, its report was also obtained when possible. Since the Fire Survey data came from NEISS patients, they can be linked back to the corresponding NEISS data at the case level.

David Miller of the CPSC provided us with Fire Survey data for 395 patients who were treated in the EDs of NEISS hospitals between July 2002 and June 2003. We were able to link most of these Fire Survey records to the corresponding NEISS records. We selected 267 residential fire cases from the Fire Survey data. We kept only cases that were structure fires (Q30, STRUCT=1) and where the structure was residential (Q31, STRUCUSE=1, 2, or 3). We dropped cases where the injury description said "NO INJURY" (Q48). We dropped six additional cases, including three where there was apparently no injury, one where a curious neighbor suffered trauma while trying to get a better view of the fire, one hotel fire, and one intentional fire.

Weights for non-response must be used along with the regular NEISS weights when working with the Fire Survey data in order to account for the fact that some NEISS patients either could not be reached or chose not to participate. Since we were working with just a subset of the Fire Survey data (395 of 628 cases), the weights that David Miller used with the full dataset would not have weighted up to the full population. Therefore, we created a new set of non-response weights based on the residential fire subsets of NEISS and the Fire Survey data. Following David Miller's pattern, we stratified the sample by hospital stratum (small, medium, large, very large, children's) and FMV code (1, 2, 3), indicating whether the FD attended. For each of the 15 strata, we divided the Fire Survey weighted case count by the NEISS weighted case count for the same 12-month period. The resulting non-response weights appear in Table 14.

[22] "Estimates of Fire Injuries Treated in Hospital Emergency Departments July 2002–June 2003," David Miller, January 2005.

Table 14. Non-Response Weights for Residential Fire-Related Injuries from Fire Survey Subset

	FMV		
Stratum	1	2	3
S	4.4132	2.3461	3.8790
M	4.2111	2.8980	2.4146
L	3.2948	4.3560	3.4646
V	5.1855	4.0576	3.6272
C	6.6667	2.7363	3.8806

Using both NEISS weights and the estimated non-response weights, the 267 raw residential fire cases weighted up to 32,722.8 weighted cases, of which 4,808.9 (14.7%) were admitted and 27,913.9 (85.3%) were non-admitted. Of the 4,808.9 admitted cases, 2,858.2 (59.4%) were admitted to hospitals with burn centers and 1,950.7 (40.6%) to other hospitals. (The corresponding raw case counts were 30 from burn centers, 15 from other hospitals, and 222 from EDs.)

Fire department attendance. In the NEISS data, the variable FMV identifies fire department (FD) attendance. Unfortunately, in a majority of cases (56.4% in 1995–2003), FD attendance is not recorded (FMV=3). Therefore, the NEISS data by themselves are not useful as a source of information on FD attendance.

In the Fire Survey data, we standardized the values of the FD attendance variable (Q6, FDATTND), changing *Y* and *N* to *1* and *2*. We compared FDATTND to the FMV variable from NEISS. While FDATTND was missing less frequently than FMV, for some cases, we used FMV to supplement FDATTND. In one case where both were missing, we decided the FD probably did not attend based on other recorded data (*e.g.*, zero property damage).

First, we tried running FD attendance separately for admissions to burn centers and admissions to other hospitals. But there were only 45 raw admitted cases, and the difference in their FD attendance rates was relatively small (73% versus. 69% without weights, 74% versus. 66% with weights). Therefore, we treated all the admitted cases as a single group.

Of the non-admitted cases, 16,085.5 (57.6%) resulted from fires attended by the FD. Of the admitted cases, 3,304.0 (68.7%) were attended by the FD. Table 15 shows the breakdown by diagnosis group.

Table 15. Fire Department Attendance Percentages by Admission Status and Diagnosis

Diagnosis group	Hospital-admitted	ED only	Total
Burns only	52.8%	26.3%	31.1%
Inhalation only	100.0%	91.8%	92.4%
Both	100.0%	92.1%	95.1%
Trauma	100.0%	58.9%	63.6%
Total	68.7%	57.6%	59.3%

The most obvious pattern is that non-FD cases usually involve burns only. This pattern can be explained pretty easily. These cases often involve small fires, where the patient is injured putting out the fire before it spreads. Fires that are extinguished promptly do not typically result in FD attendance or non-burn injuries.

If we make the very conservative assumption that no FD-attended injuries are treated initially in a doctor's office or clinic, then the Fire Survey suggests that FD-attended residential fires resulted in 19,389 non-fatal, medically treated injuries in 1 year. By way of comparison, NFPA estimates that residential structure fires attended by the FD caused an average of 15,505 non-fatal civilian injuries per year in 1999–2003. The Fire Survey estimate is 25 percent higher than the NFPA estimate.

Length of stay. Considering only admitted cases with known length of stay (LOS) where the stay was completed before the survey was administered, the average LOS of 39 cases was 7.1 days. Including the truncated cases, which tended to involve longer (though incomplete) stays, the average LOS of 43 cases was 8.2 days. By comparison, the average LOS for residential fire cases in the HCUP-NIS was 9.25 days. If we were to somehow repair the truncated hospital stays in the Fire Survey, the average LOS probably would still not exceed that of the HCUP-NIS. Thus, the Fire Survey data are generally consistent with the HCUP-NIS in LOS. Given the small sample size and difficulties in analyzing the data, the Fire Survey can add little to our LOS estimate based on the HCUP-NIS.

Hospitalization rate. Based on the 267 residential fire injuries, of which 45 were admitted, we find that 14.7% of weighted cases were admitted to the hospital. In the NEISS consumer product data, only 9.3% of patients were admitted. Perhaps hospital-admitted patients were more likely to have a telephone number on file at the NEISS hospital, and thus were more likely to be reached by those who administered the follow-up survey. Alternatively, perhaps patients who were more severely burned were more willing to respond to the survey.

Additional treatment. All of the 4,809 (weighted) hospital-admitted patients received additional treatment. The percentages receiving various sorts of treatment were:

66.3% - Routine follow-up care
19.9% - Plastic/reconstructive surgery
1.3% - Other surgery
16.3% - Pressure garments
26.6% - Physical therapy
27.3% - Other treatment

The numbers total to more than 100% because some received more than one type of care. All of these patients received follow-up treatment at a hospital (78.2% at the NEISS hospital, 25.3% at another hospital), and 10.5% were also treated by a private physician.

Of the 27,914 ED-only patients, 36.2% received follow-up treatment:

33.1% - Routine follow-up care
0.6% - Plastic/reconstructive surgery
1.6% - Pressure garments

1.8% - Physical therapy
6.0% - Other treatment

This care was administered at various locations: 11.6% of patients received care at the NEISS hospital, 2.9% at another hospital, 1.2% at a walk-in clinic, 19.0% from a private physician, 1.2% at home, and 0.5% "other."

Lost work/school days. Of the hospital-admitted patients, 54.4% lost work days and 7.8% lost school days. The average work loss was 17.5 days, and the average school loss was 13.7 days. Of the ED-only patients, 25.4% lost work days and 9.5% lost school days. The average work loss was 4.94 days, and the average school loss was 5.55 days.

Injuries not attended by the FD. Finally, we looked into the number of NEISS cases that would be missed by the National Fire Incident Reporting System (NFIRS). Since NFIRS collects data from FDs, it misses non-fatal injuries that are not attended by the FD, as well as injuries that are not immediately obvious at the time of the incident. There is no reliable way to get at the latter cases, i.e., late effects. But we can estimate the number of injuries resulting from fires that are not FD attended: 1,505 hospital-admitted injuries (32.3% of admitted injuries) and 11,828 ED-only injuries (42.4% of ED injuries) in NEISS were not FD attended and would therefore be missed by NFIRS. (These percentages are the complements of the FD attendance percentages reported in earlier in this chapter.)

CHAPTER 5. COMPREHENSIVE COSTS OF RESIDENTIAL FIRE INJURIES

In this chapter we develop comprehensive costs for all residential fire injuries by medical disposition, fire service involvement, and diagnosis classification. For the most part, this chapter simply brings together estimates of incidence from Chapter 2, costs from Chapter 3, and fire department attendance from Chapter 4. The one new thing that is required for this chapter is an estimate of the costs of lost quality of life, which was not included in Chapter 3.

For fatalities, CPSC policy dictates that the value of a statistical life (VSL) is $5 million dollars. Conceptually, VSL includes both productivity and quality of life. Therefore, lost quality of life is calculated as $5 million minus the value of lost work. The resulting estimates of lost quality of life appear in the *Fatal* column of Table 1.

For hospital-admitted burns and inhalation injuries, we used the pain and suffering regression model laid out in Appendix A, Table 19, of Ray, Zamula, et al. (1993). Using our selection of residential fire injuries from the 2003 HCUP-NIS for Chapter 2, we applied the estimated regression model at the case level. We applied the estimated regression coefficients to hospital data on the patient's age, sex, medical costs, percent of body burned, presence of third-degree burns, amputations of limbs or fingers, and anoxia. We ignored all variables related to on-the-job injuries, since we had excluded all such cases. For all other variables, where the hospital record provided no information, we simply imposed the mean value of the variable, as recorded in Table 19 of Ray, Zamula, et al. We deflated medical costs to November 1992 dollars. We then computed the mean pain and suffering costs, separately for burn centers and other hospitals, and inflated them to 2000 dollars. The resulting costs appear in the *Burn Center* and *Other Hospital* columns of Table 16 for burns, inhalation, and burns plus inhalation.

For ED-treated burns, we followed a similar procedure using our selection of residential fire injuries from the 1995-2003 NEISS data. NEISS did not provide as much information as the hospital records in HCUP-NIS, so we only applied the regression coefficients to the patient's age, sex, medical costs, percent of body burned, and anoxia. We assumed the mean values for all other variables except those related to employment, which we ignored. For percent of body burned, if the NEISS diagnosis was 84 (25-50% of body) we assigned 35%, and if the NEISS diagnosis was 85 (more than 50% of body) we assigned 70%. Again, we deflated medical costs to November 1992 dollars, computed the mean pain and suffering costs, and inflated these to 2000 dollars. The resulting costs appear in the *Emergency Department* column of Table 16 for burns, inhalation, and burns plus inhalation.

For hospital-admitted and ED-treated trauma and other injuries, we simply used the pain and suffering costs presently used in the Injury Cost Model. We merged these costs onto our selection of residential fire injuries in the 1995-2003 NEISS data, excluded burn and inhalation injuries, and computed the mean pain and suffering costs.

Finally, for injuries treated in a doctor's office or clinic, we scaled down the mean ED pain and suffering costs using the ratio of doctor/clinic medical costs to ED medical costs. For example, lost quality of life for burn survivors treated in a doctor's office or clinic was computed as

$$\$25{,}036 \times (\$250 / \$722) = \$8{,}656$$

using numbers from the *Emergency Department* and *Doctor's Office/Clinic* columns of Table 16.

All other costs in Table 16 are identical to the costs reported in Chapter 3.

In Table 17, we compare these unit cost estimates with those we computed 15 years ago in preparing Ray, Zamula, et al. (1993). Before comparing the numbers, we must enumerate the ways in which the new estimates differ from the old:

- While the published 1993 costs covered only cigarette-related fires, the 1993 costs shown here cover all fires. They are, therefore, not entirely comparable with our new costs, which cover only residential fires.
- The old costs for hospital-admitted injuries include a fourth type of cost – legal costs.
- The old costs used the category *anoxia*, while our new costs used *inhalation*. (The latter is a broader category, which includes burns to the nose, mouth, throat, and lungs and poisoning by toxic gases, fumes, and vapors.)
- The old costs for injuries other than burns and anoxia did not separate ED-treated injuries from other non-admitted injuries.

We inflated the old costs to 2000 dollars and collapsed the new costs into the old treatment categories, insofar as possible. For hospital-admitted injuries other than anoxia, the new pain and suffering estimates are much lower. For doctor's office and clinic cases, meanwhile, the new pain and suffering costs are much higher. Otherwise, the new cost estimates are comparable to the old.

All incidence figures in Table 18 are identical to those reported in Chapter 2.

Table 19 shows the total annual aggregate costs of residential fire injuries, computed by multiplying the unit costs from Table 16 times the incidence estimates from Table 18. We estimate that residential fire injuries result in annual costs of $18.5 billion.

Table 20 begins with the total costs by diagnosis and medical disposition from Table 19 and separates them into costs from fires attended by the fire department (FD) and those not attended by the FD. For injuries treated in hospitals (both burn centers and others) and EDs, we applied our estimates of FD attendance from Chapter 4. We assumed that all fatalities are FD attended. (All fire-related deaths are investigated by the FD, even if the fire was not originally attended.) And for injuries that are treated only in a doctor's office or clinic we assumed that none are FD attended. We estimate that 94% of residential fire injury costs result from fires that are attended by the FD.

Table 16. Unit Costs of Residential Fire Injuries (*2000 Dollars*)

All Cases	Fatal	Burn Center	Other Hospital	Emergency Department	Doctor's Office/Clinic
Medical	16,549	35,634	14,981	628	336
Work Loss	723,328	33,973	27,337	1,145	978
Quality of Life	4,276,672	215,902	124,637	21,095	11,470
Total	5,016,549	285,508	166,955	22,868	12,784
Burns					
Medical	44,613	26,210	14,227	722	250
Work Loss	499,784	35,364	32,584	1,751	1,715
Quality of Life	4,500,216	170,298	119,919	25,036	8,656
Total	5,044,613	231,873	166,730	27,509	10,621
Inhalation					
Medical	6,235	39,592	8,310	459	353
Work Loss	811,592	17,352	6,099	523	521
Quality of Life	4,188,408	292,641	117,697	17,809	13,708
Total	5,006,235	349,585	132,107	18,790	14,582
Burn + Inhalation					
Medical	18,504	72,671	22,994	1,433	NA
Work Loss	719,068	33,339	24,475	1,751	NA
Quality of Life	4,280,932	377,903	164,049	47,022	NA
Total	5,018,504	483,913	211,517	50,206	
Trauma					
Medical	26,033	26,813	26,813	956	741
Work Loss	683,210	62,896	62,896	1,815	2,150
Quality of Life	4,316,790	106,843	106,843	10,523	8,161
Total	5,026,033	196,552	196,552	13,294	11,052
Other					
Medical	22,962	6,050	6,050	548	336
Work Loss	415,404	122,151	122,151	1,706	1,661
Quality of Life	4,584,596	74,285	74,285	6,547	11,470
Total	5,022,962	202,485	202,485	8,801	13,467

Note: Sums of components may not add to totals because of rounding.

Table 17. Comparison of Non-Fatal Unit Cost Estimates with 1993 Cost Estimates (*2000 Dollars*)

	All Fires – 1993 Estimates			Residential Fires – 2008 Estimates		
Burns	Hospital-Admitted	Emergency Department	Doctor's Office/Clinic	Hospital-Admitted	Emergency Department	Doctor's Office/Clinic
Medical	61,902	1,153	171	28,605	766	250
Productivity	54,954	4,030	556	33,532	1,751	1,715
Pain & suffering	850,430	15,374	2,159	182,462	26,400	8,656
Legal	17,285					
Total	984,571	20,557	2,886	244,598	28,917	10,621
Anoxia	Hospital-Admitted	Emergency Department	Doctor's Office/Clinic	Hospital	Emergency Department	Doctor's Office/Clinic
Medical	7,470	1,159	177	15,567	459	353
Productivity	20,289	4,030	556	8,710	523	521
Pain & suffering	144,419	13,590	2,159	158,283	17,809	13,708
Legal	3,545					
Total	175,723	18,779	2,892	182,560	18,791	14,582
Other	Hospital-Admitted	Non-Admitted		Hospital-Admitted	Non-Admitted	
Medical	21,534	923		20,321	851	
Productivity	41,006	1,541		81,423	1,934	
Pain & suffering	301,975	14,288		96,663	9,547	
Legal	6,676					
Total	371,191	16,751		198,407	12,333	

Note: Sums of components may not add to totals because of rounding.

Table 18. Annual Incidence of Residential Fire Injuries

Diagnosis Group	Fatal	Burn Center	Other Hospital	Emergency Department	Doctor's Office/Clinic	Total
Burns	590	4,000	1,927	12,185	7,829	26,531
Inhalation	1,781	393	1,301	14,321	9,523	27,320
Burn + Inhalation	602	921	588	806	NA	2,918
Trauma	18	57	198	1,939	1,260	3,472
Other	71	10	106	93	69	350
Total	3,062	5,381	4,121	29,345	18,682	60,590

Note: Sums of rows, and columns may not add to totals because of rounding.

Table 19. Annual Aggregate Costs of Residential Fire Injuries (*2000 Dollars, Thousands*)

All Cases	Fatal	Burn Center	Other Hospital	Emergency Department	Doctor's Office/Clinic	Total
Medical	50,672	188,924	57,711	18,433	6,276	322,016
Work Loss	2,214,724	183,770	110,568	33,909	21,209	2,564,179
Quality of Life	13,094,676	1,151,155	509,776	619,030	209,391	15,584,029
Total	15,360,072	1,523,849	678,055	671,371	236,877	18,470,224
Burns						
Medical	26,328	104,842	27,414	8,803	1,955	169,342
Work Loss	294,942	141,462	62,785	21,332	13,427	533,948
Quality of Life	2,655,758	681,213	231,070	305,062	67,769	3,940,871
Total	2,977,028	927,517	321,270	335,196	83,151	4,644,161
Inhalation						
Medical	11,101	15,573	10,811	6,570	3,363	47,419
Work Loss	1,445,071	6,825	7,935	7,487	4,959	1,472,278
Quality of Life	7,457,629	115,108	153,119	255,043	130,546	8,111,445
Total	8,913,801	137,507	171,865	269,100	138,868	9,631,141
Burn+Inhalation						
Medical	11,139	66,929	13,528	1,155	NA	92,751
Work Loss	432,865	30,705	14,399	1,412	NA	479,380
Quality of Life	2,577,035	348,042	96,513	37,915	NA	3,059,505
Total	3,021,039	445,676	124,439	40,482		3,631,637
Trauma						
Medical	465	1,519	5,315	1,853	934	10,087
Work Loss	12,202	3,564	12,468	3,520	2,709	34,464
Quality of Life	77,098	6,054	21,180	20,402	10,285	135,019
Total	89,765	11,138	38,963	25,775	13,928	179,570
Other						
Medical	1,639	60	643	51	23	2,416
Work Loss	29,643	1,213	12,980	159	115	44,110
Quality of Life	327,157	738	7,894	608	792	337,189
Total	358,439	2,012	21,517	817	930	383,715

Note: Sums of components, rows, and columns may not add to totals because of rounding.

Table 20. Annual Comprehensive Costs of Residential Fire Injuries (*2000 Dollars, Thousands*)

All Cases	Fatal	Burn Center	Other Hospital	Emergency Department	Doctor's Office/Clinic	Total
FD Attended	15,360,072	1,085,712	526,295	388,264	0	17,360,343
No FD	0	438,136	151,760	283,108	236,877	1,109,881
Total	15,360,072	1,523,849	678,055	671,371	236,877	18,470,224
Burns						
FD Attended	2,977,028	489,380	169,510	88,158	0	3,724,076
No FD	0	438,136	151,760	247,038	83,151	920,085
Total	2,977,028	927,517	321,270	335,196	83,151	4,644,161
Inhalation						
FD Attended	8,913,801	137,507	171,865	247,161	0	9,470,334
No FD	0	0	0	21,940	138,868	160,807
Total	8,913,801	137,507	171,865	269,100	138,868	9,631,141
Burn+Inhale						
FD Attended	3,021,039	445,676	124,439	37,276	NA	3,628,431
No FD	0	0	0	3,206	NA	3,206
Total	3,021,039	445,676	124,439	40,482		3,631,637
Trauma						
FD Attended	89,765	11,138	38,963	15,187	0	155,053
No FD	0	0	0	10,588	13,928	24,517
Total	89,765	11,138	38,963	25,775	13,928	179,570
Other						
FD Attended	358,439	2,012	21,517	482	0	382,449
No FD	0	0	0	336	930	1,266
Total	358,439	2,012	21,517	817	930	383,715

Note: Sums of rows, and columns may not add to totals because of rounding.

CHAPTER 6. HOSPITALIZATION COST ADJUSTMENT FACTORS FOR SELECTED FIRE IGNITION SOURCES

In this chapter we analyze the Burn Foundation's proprietary data on admissions to six burn centers in eastern Pennsylvania and New Jersey.[23] By the time we obtained these data, we had already estimated the medical costs of injuries treated at burn centers based on data from HCUP (see Chapter 3). Therefore, our analysis of the Burn Foundation data focused on our other goal for these data, the development of adjustment factors on length of stay (LOS) by product category. The burn centers collected data on the heat source that caused the fire, but not on the object first ignited. Therefore our analysis was limited to products of the former type.

Methods

The Burn Foundation's proprietary data were collected from burn centers serving eastern Pennsylvania during the period 1987-2004. Initially, five burn centers provided data to the Burn Foundation. Starting in 1994, one of them stopped participating in the data collection effort. Another center began providing data in 1999. In total, 13,862 records of hospitalized burn patients were compiled.

We found that in a number of cases the value of LOS was either negative or greater than one year. For comparison, we re-computed LOS based on the burn date and the admission date. We concluded that most of these outliers had resulted from entering dates incorrectly when computing LOS. We were able to correct most of these dates either by substituting our calculated LOS or by adding or subtracting 365 days.

For this study, only survivors of burns resulting from unintentional fires in a non-institutional residence were selected. We also excluded outdoor fires (*i.e*., fires in yards, sheds but not fires in attached garages, which are considered part of the residence) and burns that occurred at work. To avoid double counting, we excluded readmissions. Using these selection criteria, we selected 2,116 cases with non-missing values for all relevant variables.

We ran regression analyses for each group of fire ignition sources to assess whether the overall mean LOS and the mean LOS associated with the ignition source differed significantly. The regression models controlled for the year of the burn (testing if LOS changed over the years), the patient's sex and age group (0-4, 5-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65+), percentage of body surface area (BSA) burned, trauma involvement, and contribution of clothing to the burn. Percentage of BSA with full thickness burns and involvement of inhalation were considered as control variables, but these fields had too many missing values (93% and 43%, respectively).

Given the overdispersion of LOS (mean=22.5, standard deviation=29.7), we considered two types of regression models with transformed variables: negative binomial and log-normal. The latter was eventually chosen because it provided a better fit. The regression analysis was

[23] Nathan Speare Regional Burn Treatment Center (Crozer-Chester Medical Center), Lehigh Valley Hospital Burn Center, St. Agnes Medical Center, St. Barnabas Medical Center (1987–1993), Pediatric Burn Center (St. Christopher's Hospital for Children), and Temple Burn Center (Temple University Hospital, 1999–2004).

conducted in SAS version 8.2. To detect potential collinearity among independent variables, we used the variance inflation factor (VIF) option in the SAS regression procedure.

The regression coefficients can be used to calculate cost adjustment factors by source of ignition, by assuming that differences in LOS are a good proxy for differences in hospitalization cost. Given that the dependent variable is the natural logarithm of LOS, we exponentiated each ignition source coefficient (EXP[coefficient]) to calculate source-specific multipliers for mean hospitalization cost.

Results

Mean LOS for unintentional, non-institutional residential fire burn survivors in the Burn Foundation data was 22.5 days (min=1, max=280). Survivors of fires caused by electric appliances or tobacco products had the largest mean LOS, whereas survivors of fires caused by barbecues or gas engines had the lowest (Table 21). When controlling for the year of the burn, the patient's age group and sex, percentage of BSA burned, trauma involvement, and contribution of clothing to the burn (Tables 22A-22J), only burns related to fires caused by tobacco, electric appliances, gas engines, or barbecues had a statistically significant difference in mean LOS from the remaining burns (p-value<0.05). In all regressions, the year-of-burn coefficient was highly significant and with a negative sign (indicating that LOS has shortened over the years) and the variance inflation factor was well under 8 (indicating an absence of collinearity problems).

Table 23 presents the hospitalization cost adjustment factors for the fire ignition sources included in the regression analyses. These factors can be used to adjust average hospitalization cost for fire burns, reflecting differences in underlying LOS by ignition source. For example, if the mean hospitalization cost for unintentional, non-institutional residential fire burn survivors is $12,000, the mean cost for a survivor of a tobacco-initiated fire burn would be estimated as $14,040 (12,000×1.17). Adjusting with factors whose underlying coefficients are statistically significant at less than the 90 percent level of confidence, however, is questionable.

Table 21. Mean LOS for Selected Ignition Sources

Ignition Source	Cases	Mean LOS
Tobacco Products	311	27.3
Matches	194	21.2
Lighters	121	18.3
Electric Appliances	281	32.4
Stoves/Ovens	421	22.2
Barbecues	97	12.3
Gas Engines	145	14.8
Heaters/Furnaces	143	24.4
Propane	45	18.6
Candle/Oil Lamps/Lanterns	89	20.4
Other	269	17.4
All	2,116	22.5

Table 22A. Log-Normal Regression Results for Tobacco Products

Variable	Coefficient	Standard Error	Pr > |t|	Variance Inflation Factor
intercept	41.26	7.87	<.0001	0.0
tobacco	0.16	0.06	0.0064	1.1
year	-0.02	0.00	<.0001	1.1
female	0.21	0.04	<.0001	1.0
age0_4	-0.41	0.11	0.0001	1.3
age5_14	-0.60	0.08	<.0001	1.8
age15_24	-0.81	0.08	<.0001	1.8
age25_34	-0.67	0.08	<.0001	2.0
age35_44	-0.52	0.07	<.0001	1.9
age45_54	-0.33	0.08	<.0001	1.7
age55_64	-0.18	0.09	0.0407	1.5
logBSA	0.59	0.02	<.0001	1.2
traumainvl	0.20	0.11	0.0666	1.0
clothesinvl	0.33	0.04	<.0001	1.2

N=2,116; Adjusted R-squared=0.42; F-statistic=118

Table 22B. Log-Normal Regression Results for Matches

Variable	Coefficient	Standard Error	Pr > |t|	Variance Inflation Factor
intercept	40.32	7.90	<.0001	0.0
matches	0.01	0.07	0.8617	1.1
year	-0.02	0.00	<.0001	1.1
female	0.21	0.04	<.0001	1.0
age0_4	-0.45	0.11	<.0001	1.3
age5_14	-0.64	0.08	<.0001	1.8
age15_24	-0.83	0.08	<.0001	1.8
age25_34	-0.70	0.08	<.0001	1.9
age35_44	-0.53	0.07	<.0001	1.9
age45_54	-0.34	0.08	<.0001	1.7
age55_64	-0.17	0.09	0.0435	1.5
logBSA	0.59	0.02	<.0001	1.2
traumainvl	0.19	0.11	0.0710	1.0
clothesinvl	0.33	0.04	<.0001	1.2

N=2,116; Adjusted R-squared=0.42; F-statistic=117

Table 22C. Log-Normal Regression Results for Lighters

Variable	Coefficient	Standard Error	Pr > |t|	Variance Inflation Factor
intercept	40.79	7.89	<.0001	0.0
lighter	0.07	0.09	0.4146	1.1
year	-0.02	0.00	<.0001	1.1
female	0.21	0.04	<.0001	1.0
age0_4	-0.46	0.11	<.0001	1.3
age5_14	-0.65	0.08	<.0001	1.8
age15_24	-0.84	0.08	<.0001	1.8
age25_34	-0.70	0.08	<.0001	1.9
age35_44	-0.53	0.07	<.0001	1.9
age45_54	-0.34	0.08	<.0001	1.7
age55_64	-0.17	0.09	0.0431	1.5
logBSA	0.59	0.02	<.0001	1.2
traumainvl	0.19	0.11	0.0721	1.0
clothesinvl	0.33	0.04	<.0001	1.2

N=2,116; Adjusted R-squared=0.42; F-statistic=117

Table 22D. Log-Normal Regression Results for Electric Appliances

Variable	Coefficient	Standard Error	Pr > |t|	Variance Inflation Factor
intercept	31.08	8.28	0.0002	0.0
electappl	0.23	0.06	0.0003	1.2
year	-0.01	0.00	0.0003	1.3
female	0.21	0.04	<.0001	1.0
age0_4	-0.44	0.11	<.0001	1.3
age5_14	-0.62	0.08	<.0001	1.8
age15_24	-0.82	0.08	<.0001	1.8
age25_34	-0.68	0.08	<.0001	1.9
age35_44	-0.52	0.07	<.0001	1.9
age45_54	-0.34	0.08	<.0001	1.7
age55_64	-0.16	0.09	0.0572	1.5
logBSA	0.58	0.02	<.0001	1.2
traumainvl	0.14	0.11	0.2033	1.0
clothesinvl	0.36	0.04	<.0001	1.2

N=2,116; Adjusted R-squared=0.42; F-statistic=119

Table 22E. Log-Normal Regression Results for Stoves/Ovens

Variable	Coefficient	Standard Error	Pr > |t|	Variance Inflation Factor
intercept	39.77	7.90	<.0001	0.0
stove/oven	-0.05	0.05	0.3143	1.1
year	-0.02	0.00	<.0001	1.1
female	0.22	0.04	<.0001	1.1
age0_4	-0.45	0.11	<.0001	1.3
age5_14	-0.64	0.08	<.0001	1.8
age15_24	-0.83	0.08	<.0001	1.8
age25_34	-0.70	0.08	<.0001	1.9
age35_44	-0.53	0.07	<.0001	1.9
age45_54	-0.34	0.08	<.0001	1.7
age55_64	-0.18	0.09	0.0391	1.5
logBSA	0.59	0.02	<.0001	1.2
traumainvl	0.19	0.11	0.0776	1.0
clothesinvl	0.34	0.04	<.0001	1.2

N=2,116; Adjusted R-squared=0.42; F-statistic=117

Table 22F. Log-Normal Regression Results for Barbecues

Variable	Coefficient	Standard Error	Pr > |t|	Variance Inflation Factor
intercept	39.31	7.86	<.0001	0.0
barbecue	-0.34	0.10	0.0005	1.0
year	-0.02	0.00	<.0001	1.1
female	0.20	0.04	<.0001	1.0
age0_4	-0.43	0.11	<.0001	1.3
age5_14	-0.62	0.08	<.0001	1.8
age15_24	-0.82	0.08	<.0001	1.8
age25_34	-0.67	0.08	<.0001	2.0
age35_44	-0.51	0.07	<.0001	1.9
age45_54	-0.33	0.08	<.0001	1.7
age55_64	-0.16	0.09	0.0585	1.5
logBSA	0.59	0.02	<.0001	1.2
traumainvl	0.18	0.11	0.0923	1.0
clothesinvl	0.33	0.04	<.0001	1.2

N=2,116; Adjusted R-squared=0.42; F-statistic=119

Table 22G. Log-Normal Regression Results for Gas Engines

Variable	Coefficient	Standard Error	Pr > |t|	Variance Inflation Factor
intercept	40.39	7.87	<.0001	0.0
gasengine	-0.20	0.08	0.0131	1.1
year	-0.02	0.00	<.0001	1.1
female	0.19	0.04	<.0001	1.1
age0_4	-0.46	0.11	<.0001	1.3
age5_14	-0.65	0.08	<.0001	1.8
age15_24	-0.83	0.08	<.0001	1.8
age25_34	-0.69	0.08	<.0001	1.9
age35_44	-0.52	0.07	<.0001	1.9
age45_54	-0.34	0.08	<.0001	1.7
age55_64	-0.17	0.09	0.0447	1.5
logBSA	0.59	0.02	<.0001	1.2
traumainvl	0.18	0.11	0.0916	1.0
clothesinvl	0.34	0.04	<.0001	1.2

N=2,116; Adjusted R-squared=0.42; F-statistic=118

Table 22H. Log-Normal Regression Results for Heater/Furnace

Variable	Coefficient	Standard Error	Pr > |t|	Variance Inflation Factor
intercept	40.28	7.88	<.0001	0.0
heaterfurnac	-0.08	0.08	0.3079	1.0
year	-0.02	0.00	<.0001	1.1
female	0.21	0.04	<.0001	1.0
age0_4	-0.44	0.11	<.0001	1.3
age5_14	-0.64	0.08	<.0001	1.8
age15_24	-0.83	0.08	<.0001	1.8
age25_34	-0.69	0.08	<.0001	1.9
age35_44	-0.52	0.07	<.0001	1.9
age45_54	-0.34	0.08	<.0001	1.7
age55_64	-0.17	0.09	0.0468	1.5
logBSA	0.59	0.02	<.0001	1.2
traumainvl	0.19	0.11	0.0782	1.0
clothesinvl	0.33	0.04	<.0001	1.2

N=2,116; Adjusted R-squared=0.42; F-statistic=117

Table 22I. Log-Normal Regression Results for Propane

Variable	Coefficient	Standard Error	Pr > |t|	Variance Inflation Factor
intercept	39.94	7.88	<.0001	0.0
propane	-0.26	0.14	0.0669	1.0
year	-0.02	0.00	<.0001	1.1
female	0.21	0.04	<.0001	1.0
age0_4	-0.45	0.11	<.0001	1.3
age5_14	-0.64	0.08	<.0001	1.8
age15_24	-0.83	0.08	<.0001	1.8
age25_34	-0.69	0.08	<.0001	1.9
age35_44	-0.53	0.07	<.0001	1.9
age45_54	-0.34	0.08	<.0001	1.7
age55_64	-0.17	0.09	0.0445	1.5
logBSA	0.59	0.02	<.0001	1.3
traumainvl	0.20	0.11	0.0621	1.0
clothesinvl	0.33	0.04	<.0001	1.2

N=2,116; Adjusted R-squared=0.42; F-statistic=117

Table 22J. Log-Normal Regression Results for Candles/Oil Lamps/Lanterns

Variable	Coefficient	Standard Error	Pr > |t|	Variance Inflation Factor
intercept	41.20	7.94	<.0001	0.0
candlelamp	0.08	0.10	0.4591	1.0
year	-0.02	0.00	<.0001	1.2
female	0.21	0.04	<.0001	1.0
age0_4	-0.45	0.11	<.0001	1.3
age5_14	-0.64	0.08	<.0001	1.8
age15_24	-0.83	0.08	<.0001	1.8
age25_34	-0.70	0.08	<.0001	1.9
age35_44	-0.53	0.07	<.0001	1.9
age45_54	-0.34	0.08	<.0001	1.7
age55_64	-0.17	0.09	0.0438	1.5
logBSA	0.59	0.02	<.0001	1.2
traumainvl	0.19	0.11	0.0732	1.0
clothesinvl	0.33	0.04	<.0001	1.2

N=2,116; Adjusted R-squared=0.42; F-statistic=117

Table 23. Hospitalization Cost Adjustment Factors for Selected Fire Ignition Sources

Ignition Source	Regression Coefficient	Hospitalization Cost Adjustment Factor
Tobacco Products	0.16*	1.17
Matches	0.01	1.01
Lighters	0.07	1.07
Electric Appliances	0.23*	1.26
Stoves/Ovens	-0.05	0.95
Barbecues	-0.34*	0.71
Gas Engines	-0.20*	0.82
Heaters/Furnaces	-0.08	0.92
Propane	-0.26^	0.77
Candles/Oil Lamps/Lanterns	0.08	1.08

* Statistically significant at 99% confidence level.
^ Statistically significant at 90% confidence level.
Adjusting with coefficients that are not significant at the 90% confidence level is questionable.

CHAPTER 7. Proportion of Fire-Related Hospital Admissions Bypassing the Emergency Room

In this chapter, we estimate the proportions of injuries resulting from residential fires that are admitted to a hospital without first passing through an emergency department (ED).

The National Electronic Injury Surveillance System (NEISS) collects data on injury patients treated at selected hospital emergency departments (EDs) in the United States. While it provides valuable data on the large subset of injuries whose victims are treated in the ED, it misses the minority of hospitalized injury patients who are admitted to the hospital without first passing through the ED. Overall, roughly 80 percent of hospital-admitted injury victims are admitted through the ED, but the percentage varies widely by diagnosis. Burn victims, in particular, are often admitted to a hospital without first being treated in an ED. The Injury Cost Model currently assumes that, for every three burn patients admitted to the hospital through the ED (and thus captured by NEISS), two additional burn patients are admitted without first passing through the ED (Miller, Lawrence, et al., 2000, p. 32).

Data. Most hospital discharge datasets include a variable, *admission source*, which identifies how the patient entered the hospital. The standard UB-92 values for admission source,[24] which are used in most states, are:

1	Physician referral
2	Clinic referral
3	HMO referral
4	Transfer from a hospital
5	Transfer from a skilled nursing facility
6	Transfer from another health facility
7	Emergency room
8	Court/law enforcement
A	Transfer from a rural primary care hospital

A value of 7 identifies admissions via the ED. Thus, it is a simple matter to determine what share of patients was admitted to a hospital through its ED. There is, however, a complication: some of the patients who are transferred from another hospital (values 4 and A) will have been treated in that hospital's ED, and these will need to be accounted for.

We used the 2003 HCUP-NIS, a multistate weighted sample of hospital discharges in which we had already identified residential fire injuries for Chapter 2 of this report. Before proceeding, we compared the HCUP-NIS count of patients admitted through the ED with that from NEISS. The *disposition* variable in NEISS datasets can take these values:

1	Treated (or examined without treatment) and released
2	Treated and transferred to another hospital
4	Treated and admitted for hospitalization (within same facility)
5	Held for observation
6	Left without being seen/left against medical advice

[24] These admission sources apply only to non-newborns.

8 Fatality
9 Not recorded

Values of 2 and 4 identify ED patients who were subsequently admitted to the hospital.

Using the selections of injury cases related to residential fires previously developed for Task 1, we looked at admissions via the ED in both NEISS and HCUP-NIS. In NEISS, we found that 5,509.4 of 33,542.6 ED-treated injuries (16.4%) resulted in a hospital admission.[25] In the HCUP-NIS we found that 6,439.8 of 9,384.6 hospitalized patients (68.6%) were admitted through the ED.[26] We found that an additional 919.0 were transferred from another hospital,[27] and we estimate that 699.1 of these (76.1%) were treated in the original hospital's ED.[28] Comparing these two estimates, we find the HCUP-based estimate (7,138.9) is 29.6 percent higher than the NEISS-based estimate (5,509.4) of admissions via the ED. Considering that both datasets are weighted samples and that they take different approaches with different objectives, these estimates are reasonably close. Therefore, we judged that we could proceed with estimates based on the HCUP-NIS, confident that they would not be incompatible with NEISS.

The HCUP datasets are compiled from state-level hospital discharge data. Because some states depart from UB-92 standards in coding the admission source, HCUP data include a recoded uniform admission source variable with five possible values:

1. Emergency department
2. Another hospital
3. Another health facility including long term care
4. Court/law enforcement
5. Routine, birth, and other

For states that code admission source by the UB-92 standard, the value 1 here is mapped from 7 in UB-92, and the value 2 is mapped from 4 and A.

Estimating the shares of residential fire injury patients admitted via the ED. We began by running the incidence of hospital-admitted, nonfatal, residential fire injuries by admission source (ED, transfer from other hospital, non-ED) against variables that we hypothesized might be correlated with admission source. We found that differences by age and sex were small, but primary injury diagnosis group (burn, other), and hospital type (burn center, other) were strongly correlated with admission source. Burn patients were less likely to be admitted via the ED (63.5% versus. 79.5%), and patients admitted to burn centers were three times as likely to be transferred from another hospital (16.0% versus. 5.1%). Therefore, we broke down the admission counts by admission source, diagnosis, and hospital type. These counts are displayed in Table 24. Note that each cell of the table contains four numbers. For each combination of diagnosis and hospital type, the cell contains counts for the three different admission statuses and the sum of the three. (Table 24 is color-coded by diagnosis for ease of reading, and Tables 25–30 are similarly color-coded to assist the reader in moving from Table 24 through the other tables.)

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[25] The 95% confidence interval is 4,776–6,326.
[26] The 95% confidence interval is 6,252–6,626.
[27] The 95% confidence interval is 802–1,043.
[28] We assume the 919.0 transfers are as likely to be admitted through the ED as the 9,384.6–919.0 = 8,465.6 non-transfers. The percentage of admissions via the ED is computed as 6,439.8 / 8465.6 = 76.1%.

Table 24. Residential Fire Injuries: Hospital Admissions by Admission Source, Primary Injury Diagnosis, and Hospital Type, 2003 HCUP-NIS

Primary Injury Diagnosis	Admission Source	Hospital Type		Total
		Burn Centers	Other Hospitals	
Burn	Via ED	2,223.5	1,941.3	4,164.8
	Other Hosp	533.1	200.9	734.1
	Non-ED	757.7	836.2	1,593.9
	Total	3,514.3	2,978.5	6,492.8
Other	Via ED	732.0	1,660.0	2,391.9
	Other Hosp	114.0	70.9	184.9
	Non-ED	108.5	323.6	432.0
	Total	954.4	2,054.4	3,008.9
Total	Via ED	2,955.5	3,601.3	6,556.8
	Other Hosp	647.1	271.9	919.0
	Non-ED	866.2	1,159.7	2,025.9
	Total	4,468.7	5,032.9	9,501.6

To the HCUP-NIS total for burn admissions to burn centers via the ED, we added our estimate of 117 admissions to Shriners hospitals that are not captured by state hospital discharge data (see Chapter 2).

For each of the four cells, plus the column and row totals, we computed the percentage of patients admitted via the ED. For the first cell, burn diagnosis by burn center, the computation is as follows: First, the 2,223.5 estimated patients admitted through the hospitals' own EDs account for 2,223.5 / 3,514.3 = 63.3% of admissions. Next, we must split the 533.1 estimated patients who were transferred from other hospitals into ED and non-ED. We assume the breakdown is identical to that of the non-transfers: 2,223.5 / (2,223.5 + 757.7) = 74.6%.[29] We apply this percentage to the 533.1 estimated patients admitted by transfer from another hospital, which yields 397.6. Dividing this by the total, 397.6 / 3,514.3 = 11.3%. We add this percentage representing transfers to the percentage from the hospitals' own EDs: 63.3% + 11.3% = 74.6%. Similar computations for the other cells result in the percentages in Table 25.

Table 25. Residential Fire Injuries: Percent Admitted Via ED

	Burn Centers	Other Hospitals	Total
Burn	74.6%	69.9%	72.3%
Other	87.1%	83.7%	84.7%
Total	77.3%	75.6%	76.4%

The HCUP-NIS is not fully representative of burn centers. Just 46.4 percent of the residential fire injuries in the 2003 HCUP-NIS were admitted to burn centers. In the larger 2003 HCUP-SID, which we take to be more representative of the proportion of burn centers in the hospital population, the figure was 55.4 percent. Therefore, we weighted the percentages shown in the

[29] We will examine the impact of this assumption via sensitivity analysis.

row totals of Table 25 according to the HCUP-SID proportions. Table 26 shows the hospital-type breakdown that we used. Burn admissions to burn centers again include the 117 estimated Shriners admissions.

Table 26. Residential Fire Injuries: Breakdown by Hospital Type, 2003 HCUP-SID

	Burn Centers	Other Hospitals	Total	Burn Center Percentage
Burn	3,146.4	1,514.9	4,661.3	67.5%
Other	634.0	1,322.3	1,956.2	32.4%
Total	3,780.4	2,837.1	6,617.5	57.1%

Applying these burn center percentages as weights to the totals in Table 25 produces Table 27. Only the right-hand column, which shows the row totals, changes from Table 25. The burn-center percentage from Table 26, 67.5 percent, is used to weight the burn-center percentage from Table 25, 74.6 percent; and 1 minus the burn-center percentage from Table 26, 32.5 percent, is used to weight the other-hospital percentage from Table 25. The computation is straightforward:

$$(67.5\% \times 74.6\%) + (32.5\% \times 69.9\%) = 73.1\%$$

The row totals for other diagnoses and the total, as shown in Table 27, are computed in the same way.

Table 27. Residential Fire Injuries: Percent Admitted Via ED, with Adjusted Totals

	Burn Centers	Other Hospitals	Total
Burn	74.6%	69.9%	73.1%
Other	87.1%	83.7%	84.8%
Total	77.3%	75.6%	76.5%

Finally, these row totals are used to produce estimates of the ratios of non-ED admissions to ED admissions. These are shown in Table 28.

Table 28. Residential Fire Injuries: Computation of Ratios of Non-ED/ED Admissions

	% Admitted Via ED	% Admitted Non-ED	Ratio Non-ED/ED
Burn	73.1%	26.9%	0.3687
Other	84.8%	15.2%	0.1794
Total	76.5%	23.5%	0.3067

For every 10,000 residential fire injuries admitted to the hospital via the ED, we estimate that another 3,067 are admitted without first passing through an ED. Or, to put it differently, we estimate that 23.5 percent of hospital admissions for residential fire injuries are not captured by NEISS.

Sensitivity analysis. We earlier assumed that patients who transferred from other hospitals were just as likely to have entered the original hospital via the ED as non-transfer patients. However, it is likely that patients who were transferred from another hospital were injured more seriously than non-transfers and entered the hospital under emergency circumstances, which would suggest a higher probability of admission via the ED. In order to test the impact of our assumption, therefore, we produced alternative estimates under the assumption that *all* transferred patients were treated in the ED. Tables 29–30 replicate Tables 27–28 under this assumption.

Table 29. Residential Fire Injuries: Alternative Percent Admitted Via ED, with Adjusted Totals

	Burn Centers	Other Hospitals	Total
Burn	78.4%	71.9%	76.3%
Other	88.6%	84.3%	85.7%
Total	80.6%	77.0%	79.1%

Table 30. Residential Fire Injuries: Computation of Alternative Ratios of Non-ED/ED Admissions

	% Admitted Via ED	% Admitted Non-ED	Ratio Non-ED/ED
Burn	76.3%	23.7%	0.3102
Other	85.7%	14.3%	0.1672
Total	79.1%	20.9%	0.2644

Under this alternative assumption, the percentage of residential fire admissions not captured by NEISS would fall from 23.5 percent to 20.9 percent.

Estimating the shares of burn patients admitted via the ED. We repeated the above exercise for all burn patients, regardless of the cause of their burns. We selected all injury patients with a primary injury diagnosis in the range 940–949. The computations were simpler because there was only one diagnosis group – burns. Just as we added 117 estimated admissions to account for uncaptured Shriners admissions, here we add 455 for the same purpose. Otherwise, Tables 31–34 repeat the computations of Tables 24–27 for the burn population.

Table 31. Burn Injuries: Hospital Admissions by Admission Source and Hospital Type, 2003 HCUP-NIS

	Burn Centers	**Other Hospitals**	**Total**
Via ED	11,097.9	13,801.3	24,899.2
Other Hosp	2,258.4	1,110.4	3,368.8
Non-ED	4,218.0	7,351.8	11,569.7
Total	17,574.4	22,263.4	39,837.8

Table 32. Burns Injuries: Percent Admitted Via ED

	Burn Centers	Other Hospitals	Total
Burn	72.5%	65.2%	68.3%

Table 33. Burn Injuries: Breakdown of Hospital Type, 2003 HCUP-SID

	Burn Centers	Other Hospitals	Total	Burn Center Percentage
Burn	15,358	12,198	27,556.0	55.7%

Table 34. Burn Injuries: Percent Admitted Via ED, with Adjusted Total

	Burn Centers	Other Hospitals	Total
Burn	72.5%	65.2%	69.3%

We estimate that 69.3 percent of burn admissions came through an ED. We can perform a similar computation for non-burn injuries without the complication of the breakdown by hospital type. In the 2003 HCUP-NIS, there were 2,418,676.0 non-burn injury admissions, of which 1,838,975.0 (76.0%) were admitted via the hospitals' own EDs, 73,279.3 (3.0%) were transfers from other hospitals, and 506,421.7 (20.9%) came neither through the ED nor from other hospitals. Following our established algorithm, these counts imply that 78.4 percent of non-burn injury admissions came through the ED. Using these percentages we can estimate the ratio of non-ED admissions to ED admissions, as in Table 28 above. Table 35 shows this computation.

Table 35. Burn Injuries: Computation of Ratio of Non-ED / ED Admissions

	% Admitted Via ED	% Admitted Non-ED	Ratio Non-ED / ED
Burn	69.3%	30.7%	0.4437
Other	78.4%	21.6%	0.2754

The ratios 0.4437 and 0.2754 compare to ratios of 0.6667 and 0.1308, respectively, currently in use in the Injury Cost Model.

As with residential fire injuries, we can perform sensitivity analysis to test the impact of the assumption that transfer patients were no more likely to have entered the hospital via the ED than non-transfer patients. If we assume that all transfer patients were treated in the ED before admission, then Tables 36–37 replace Tables 34–35.

Table 36. Burn Injuries: Alternative Percent Admitted Via ED, with Adjusted Total

	Burn Centers	Other Hospitals	Total
Burn	76.0%	67.0%	71.9%

Table 37. Burn Injuries: Computation of Alternative Ratio of Non-ED/ED Admissions

	% Admitted Via ED	% Admitted Non-ED	Ratio Non-ED/ED
Burn	71.9%	28.1%	0.3901
Other	79.1%	20.9%	0.2648

Under this alternative assumption, our estimate of the percentages of burn and other admissions not captured by NEISS would fall from 30.7 percent and 21.6 percent, respectively, to 28.1 percent and 20.9 percent.

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Appendix A. Codes for *Accidents Caused by Fire and Flames* in ICD-9-CM

E890 Conflagration in private dwelling

- E890.0 Explosion caused by conflagration
- E890.1 Fumes from combustion of PVC and similar material in conflagration
- E890.2 Other smoke and fumes from conflagration
- E890.3 Burning caused by conflagration
- E890.8 Other accident resulting from conflagration
- E890.9 Unspecified accident resulting from conflagration in private dwelling

E891 Conflagration in other and unspecified building or structure

- E891.0 Explosion caused by conflagration
- E891.1 Fumes from combustion of PVC and similar material in conflagration
- E891.2 Other smoke and fumes from conflagration
- E891.3 Burning caused by conflagration
- E891.8 Other accident resulting from conflagration
- E891.9 Unspec accident resulting from conflagration of other/unspec building or structure

E892 Conflagration not in building or structure

E893 Accident caused by ignition of clothing

- E893.0 From controlled fire in private dwelling
- E893.1 From controlled fire in other building or structure
- E893.2 From controlled fire not in building or structure
- E893.8 From other specified sources
- E893.9 Unspecified source

E894 Ignition of highly inflammable material

E895 Accident caused by controlled fire in private dwelling

E896 Accident caused by controlled fire in other and unspecified building or structure

E897 Accident caused by controlled fire not in building or structure

E898 Accident caused by other specified fire and flames

- E898.0 Burning bedclothes
- E898.1 Other

E899 Accident caused by unspecified fire