Admitted injury victims could incur component costs C_1, C_2, and C_5. Non-admitted injury victims could incur all cost components except C_2. That is:

$EM_h = v_{1,h} \times C_1 + v_2 \times C_2 + v_5 \times C_5$ (if hospital-admitted)
$EM_n = v_{1,n} \times C_1 + v_3 \times C_3 + v_4 \times C_4 + v_5 \times C_5$ (if non-admitted)

where the v multipliers are:

$v_{1,h} = e \times d_h$ (if hospital-admitted)
$v_{1,n} = e \times d_n$ (if non-admitted)
$v_2 = e \times (1 - d_h)$
$v_3 = e \times (p - d_n)$
$v_4 = e \times (1 - p)$
$v_5 = (1 - e)$

The probability of permanent disability (d_h) for an admitted injury is the sum of the probabilities of partial ($d_{p,h}$) and total ($d_{t,h}$) disabilities, which were defined in the long-term work loss section of this chapter. Similarly, the probability of permanent disability for a non-admitted injury (d_n) is the sum of its non-admitted partial ($d_{p,n}$) and total ($d_{t,n}$) components. The probability of temporary work loss for an employed, non-admitted injury victim is the difference between the proportion of all non-admitted victims who lose work (p) and the proportion of non-admitted victims who are permanently disabled (d_n). The proportion of the population that is employed at wage work is e.

Example. For the 40-year-old female shoulder fracture victim, the probability of being employed (e) is 0.745, and the probability she is not employed is 0.255. Under victim long-term costs, we estimated her probabilities of permanent partial (d_p) and permanent total (d_t) disability.

$d_h = d_{p,h} + d_{t,h} = .2382 + .0125 = .2507$
$d_n = d_{p,n} + d_{t,n} = .00665 + .0000 = .00665$

$v_{1,h} = .745 \times .2507 = .1868$
$v_{1,n} = .745 \times .00665 = .00495$
$v_2 = .745 \times (1 - .2507) = .5582$
$v_3 = .745 \times (.367 - .00665) = .2685$
$v_4 = .745 \times (1 - .367) = .4716$
$v_5 = .255$

$EM_h = (.1868 \times \$11,138) + (.5582 \times \$1,342) + (.255 \times \$268) = \$2,898$

$EM_n = (.00495 \times \$11,138) + (.2685 \times \$403) + (.4716 \times \$34) + (.255 \times \$268) = \$248$

Total work loss (WL) is the sum of its four components: short-term work loss (VS), long-term work loss (VL), work loss of family/friends (FF), and employer costs (EM). For the 40-year old female shoulder fracture victim, this loss is:

$$WL = VS + VL + FF + EM$$

$$WL_h = \$24,684 + \$30,287 + \$142 + \$2,898 = \$58,011 \quad \text{(if admitted)}$$

$$WL_n = \$3,021 + \$608 + \$12 + \$243 = \$3,884 \quad \text{(if non-admitted)}$$

As Figure 5 shows, victim losses dominate total work-loss costs. Visitor work losses contribute negligibly to the total – less than 0.4%.

Figure 4. Injury Cost Model Work Loss Equations

Work loss includes the following four major components (VS, VL, FF, and EM):

- **(VS)** Injury victims may experience *short-term work losses* as a consequence of their physical inability to work while being treated for and recovering from an injury. The lost work includes both paid employment (wage work) and household work.

- **(VL)** *Injury victims* may experience *long-term work losses*, such as those associated with full or partial permanent disability following the injury recovery period.

- **(FF)** *Family and/or friends* of the injury victim may incur work loss because of time spent transporting, visiting, and caring for the victim.

- **(EM)** *Employer* costs include losses by supervisors and co-workers to modify schedules and otherwise accommodate the absence of the victim.

Estimation of victim short-term loss:

$\mathbf{VS_h} = [(T^*_h \times w^*) + (T'_h \times w')]$ (for hospital-admitted victims)

$\mathbf{VS_n} = p \times [(T^*_n \times w^*) + (T'_n \times w')]$ (for non-admitted victims)

where,

T^* = mean duration of *wage* work loss across all victims with wage work loss
T^*_h = duration of *wage* work loss for hospital-admitted victims
T^*_n = duration of *wage* work loss for non-admitted victims with wage work loss

T' = mean duration of *household* work loss across all victims with wage work loss
T'_h = duration of *household* work loss for hospital-admitted victims
T'_n = duration of *household* work loss for non-admitted victims with wage work loss

w^* = valuation of lost *wage* work
w' = valuation of lost *household* work

p = probability non-admitted victim will lose work
q = probability victim is hospital-admitted
r = proportion of all victims with work loss $= q + [(1 - q) \times p]$

and

$T^*_n = (r \times T^*) / \{(3 \times q) + [(1 - q) \times p]\}$
$T^*_h = 3 \times T^*_n$
$T'_n = 0.9 \times (365/243) \times T^*_n$
$T'_h = 0.9 \times (365/243) \times T^*_h$

Estimation of victim long-term loss:

$$\mathbf{VL_h} = K \times [d_{t,h} + (i \times d_{p,h})] \text{ (for hospital-admitted victims)}$$
$$\mathbf{VL_n} = K \times [d_{t,n} + (i \times d_{p,n})] \text{ (for non-admitted victims)}$$

where,

K = present value of lifetime work (by age group and sex)
$d_{t,h}$ = probability of long-term *total* disability for hospital-admitted victims
$d_{t,n}$ = probability of long-term *total* disability for non-admitted victims
$d_{p,h}$ = probability of long-term *partial* disability for hospital-admitted victims
$d_{p,n}$ = probability of long-term *partial* disability for non-admitted victims
i = percent lifetime earnings loss by victims with long-term partial disability

Estimation of family/friend work loss:

$$\mathbf{FF} = (W \times v) + (H \times v \times B)$$

where,

W = initial transportation/waiting time = 2 hours
v = value of time = $6 per hour
H = visiting time per bed day = 3 hours
B = number of bed days = twice the number of inpatient days (=0 if non-admitted)

Therefore,

$$\mathbf{FF} = \$12 + (\$18 \times B)$$

Estimation of employer costs from victim work loss:

$$\mathbf{EM_h} = e \times [(d_h \times C_{pd}) + ((1 - d_h) \times C_{td,h})] + (1 - e) \times C_{cg}$$
(for hospital-admitted victims)

$$\mathbf{EM_n} = e \times [(d_n \times C_{pd}) + ((p - d_n) \times C_{td,n}) + (1 - p) \times C_{nd}] + (1 - e) \times C_{cg}$$
(for non-admitted victims)

where,

e = probability victim is (wage) employed
d_h = combined probability of full or partial *permanent* disability for hospital-admitted victim = $d_{t,h} + d_{p,h}$
d_n = combined probability of full or partial *permanent* disability for non-admitted victim = $d_{t,n} + d_{p,n}$
p = probability of *temporary* work loss for non-admitted victim

C_{pd} = cost of full and partial permanent disability = $11,138
$C_{td,h}$ = cost of temporary disability = $1,342
$C_{td,n}$ = cost of temporary disability = $403
C_{nd} = cost if no work loss = $34
C_{cg} = cost for caregiver work loss effect = $268

Table 12. Unweighted Count of Workers Suffering Medically Treated, Non-Admitted Injuries and Weighted Probability Their Injuries Caused Work Loss, by ICD Diagnosis Group

ICD-9 Code	Raw Count	Probability of Work Loss
800-804, 850-854	22	0.4090
805-809	16	0.4859
810-819	70	0.3669
820-829	66	0.4988
830-839	24	0.4602
840, 841	35	0.4548
842	40	0.1975
843, 844	50	0.5053
845	93	0.4577
846, 847	145	0.6091
848	29	0.3572
870-874	75	0.2471
875-880	12	0.4148
881, 882, 884	82	0.2980
883	151	0.1835
890, 891, 904	39	0.3075
892, 893	36	0.1783
910, 918, 920, 921	71	0.3897
911-917, 919	39	0.2417
922	20	0.3158
923	47	0.2886
924	82	0.3512
925-9, 860-9, 950-9	111	0.4068
930-939	39	0.0967
940-949	50	0.4490
990-994	7	0.2324

Source: 1987-1992 NHIS.

Table 13. Estimated Mean Days of Work Lost per Person Losing Work, by BLS Diagnosis Group

Diagnosis Group	Estimated Mean Days	Estimated Median
Traumatic injuries to bones nerves, spinal cord	44.5	13
Fractures, crushings, dislocations to head and neck	35.6	9
Fractures, crushings, dislocations to other body parts	43.1	20
Sprains, strains, tears, etc. to muscles, tendons, ligaments, joints, etc. in back	31.5	6
Sprains, strains, tears, etc. to muscles, tendons, ligaments, joints, etc. in other parts	28.6	6
Open wounds - bites, cuts, avulsions, punctures*	11.5	3
Amputations, enucleations, gunshot wounds, injuries to organs and blood vessels of trunk	42.6	24
Surface wounds - abrasions, bruises, blisters, foreign body injuries, friction burns*	12.5	3
Burns - chemical, heat, electrical	13.4	4
Intra-cranial injuries - concussion, contusion, cerebral hemorrhage*	21.6	5
Environmental injuries - frostbite, hypothermia, heat fatigue, etc.*	7.3	2
Other injuries - drowning, suffocation, electrocution, embolism*	28.9	6
Poisonings - animal and insect bites*	8.3	2

* Results using Weibulls unadjusted for heterogeneity.

Source: Computed from 1993 BLS Annual Survey of Occupational Illness and Injury, with durations estimated for cases that still were open when the survey was completed.

Table 14. Average Days of Work Lost Per Lost-Work Injury and Probability Non-Admitted Injury Victims Will Lose Work, by Body Part Injured or Nature of Injury

NEISS Nature of Injury	Days of Lost Work Males	Days of Lost Work Females	Probability of Losing Work
41 Ingested Foreign Object	37.3	37.1	0.10
42 Aspirated Foreign Object	37.3	37.1	0.10
46 Burns, electrical	28.1	28.1	0.45
47 Burns, not specified	14.6	14.6	0.45
48 Burns, scald	14.8	14.7	0.45
49 Burns, chemical	8.2	8.1	0.45
50 Amputation	37.2	37.2	0.19
51 Burns, thermal	11.8	11.6	0.45
52 Concussions	19.5	19.0	0.41
53 Contusions, Abrasions	12.6	12.8	0.33
54 Crushing	22.7	22.7	0.40
55 Dislocation	40.0	40.0	0.46
56 Foreign Body	6.1	6.3	0.20
57 Fracture	48.8	48.8	0.42
58 Hematoma	15.2	15.3	0.36
59 Laceration	10.9	10.9	0.25
60 Dental Injury	37.3	37.1	0.25
61 Nerve Damage	43.0	43.0	0.41
62 Internal Organ Injury	22.6	22.1	0.41
63 Puncture	9.3	9.2	0.23
64 Strain or Sprain	24.0	24.1	0.45
65 Anoxia	37.3	37.1	0.10
66 Hemorrhage	22.3	22.4	0.28
67 Electric Shock	24.5	24.3	0.23
68 Poisoning	11.2	10.9	0.41
69 Submersion	9.4	9.1	0.23
70 Not Stated	37.3	37.1	0.37
71 Other	25.9	25.7	0.36
72 Avulsion	18.4	18.4	0.21
73 Burns, radiation	14.5	14.5	0.45
74 Dermatitis, Conjunctivitis	15.0	15.2	0.24
AVERAGE	21.2	21.2	0.34

NEISS Body Part	Days of Lost Work Males	Days of Lost Work Females	Probability of Losing Work
00 Internal	37.3	37.1	0.10
30 Shoulder	40.0	40.1	0.38
31 Upper Trunk	28.8	28.9	0.38
32 Elbow	23.8	24.0	0.34
33 Lower Arm	31.5	31.6	0.34
34 Wrist	30.5	30.6	0.30
35 Knee	27.4	27.5	0.42
36 Lower Leg	33.5	33.6	0.38
37 Ankle	20.0	20.2	0.45
38 Pubic Region	23.6	23.7	0.33
75 Head	14.5	14.4	0.35
76 Face	9.8	9.8	0.29
77 Eyeball	8.3	8.4	0.35
79 Lower Trunk	39.1	39.2	0.48
80 Upper Arm	38.0	38.0	0.35
81 Upper Leg	28.4	28.4	0.39
82 Hand	15.4	15.4	0.31
83 Foot	18.3	18.4	0.33
84 25-50% of Body	18.5	18.4	0.35
85 All Parts of Body	20.8	20.5	0.32
87 Not Stated	32.4	32.3	0.36
88 Mouth	12.9	12.8	0.26
89 Neck	31.1	31.1	0.56
92 Finger	15.0	15.1	0.24
93 Toe	17.8	17.9	0.38
94 Ear	7.1	7.1	0.20
AVERAGE	21.2	21.2	0.34

Source: Estimated from 1993 BLS Annual Survey and 1987–1992 NHIS data.

Table 15. Present Value of Lifetime Wage Work (Including Fringe Benefits) and Household Work, and Value of Household Work in the Current Year, by Age Group and Sex (1994 dollars)

	Annual Household Production		Lifetime Household Production*		Lifetime Earnings*		Lifetime Total*	
Age	Male	Female	Male	Female	Male	Female	Male	Female
<1	0	0	107,493	233,701	872,188	500,961	979,681	734,662
1-4	0	0	115,560	250,733	914,380	524,135	1,029,940	774,868
5-9	0	0	129,389	280,651	978,824	560,903	1,108,213	841,554
10-14	0	0	146,587	317,833	1,055,105	604,384	1,201,692	922,217
15-19	4,659	10,218	156,619	338,643	1,124,615	638,882	1,281,234	977,525
20-24	4,612	9,123	153,344	331,234	1,163,049	644,351	1,316,393	975,585
25-29	4,708	10,780	149,803	323,096	1,155,011	617,688	1,304,814	940,784
30-34	5,106	12,125	144,838	305,850	1,094,159	563,975	1,238,997	869,825
35-39	5,422	12,492	137,589	281,464	991,427	493,540	1,129,016	775,004
40-44	5,539	11,881	128,446	254,376	852,410	408,475	980,856	662,851
45-49	5,596	11,206	118,030	227,767	685,607	314,080	803,637	541,847
50-54	5,714	11,728	106,530	199,765	501,826	217,988	608,356	417,753
55-59	6,182	12,473	93,382	166,070	326,251	132,671	419,633	298,741
60-64	6,985	13,845	76,816	123,790	186,139	66,965	262,955	190,755
65-69	6,735	7,808	57,190	84,562	101,053	28,311	158,243	112,873
70-74	5,567	6,983	38,673	62,430	53,484	11,415	92,157	73,845
75-79	4,281	6,075	23,985	42,675	22,850	3,705	46,835	46,380
80-84	3,229	5,333	12,996	24,906	10,895	1,480	23,891	26,386
>84	2,060	3,848	4,744	9,297	3,489	469	8,233	9,766

*Calculated using 2.5% real discount rate.

Source: Computed with national demographic data, a standard age-earnings model, and the method for valuing household production recommended by Douglass et al. (1990).

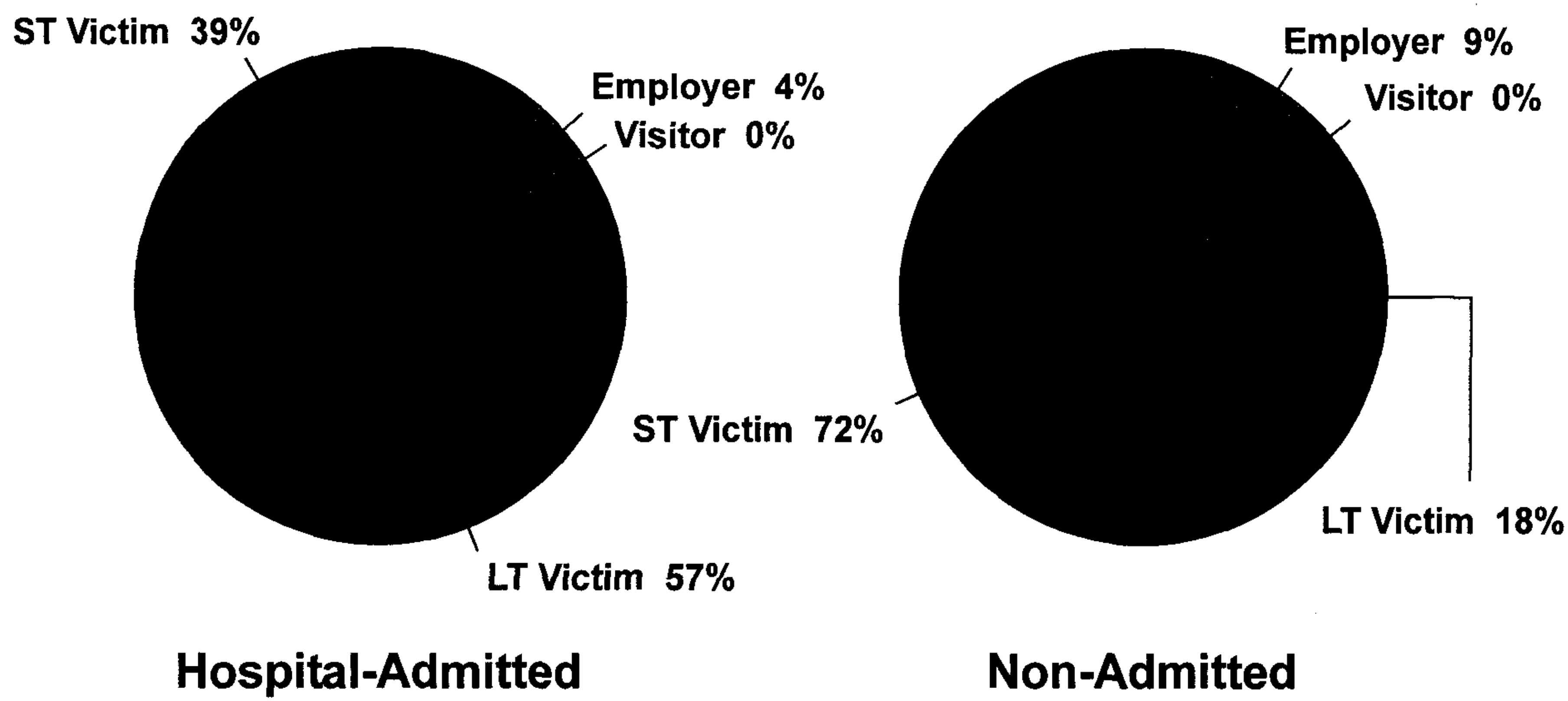
Table 16. Total of Short-Term and Long-Term Victim Work-Loss* Costs per Consumer-Product Injury Survivor by Victim's Admission Status and Nature of Injury or Body Part Injured (in 1995 dollars)

NEISS Injury Diagnosis	Non-Admitted	Hospital-Admitted
41 Ingested Foreign Object	363	16,160
42 Aspirated Foreign Object	281	12,273
46 Burns, electrical	2,703	33,165
47 Burns, not specified	1,910	23,674
48 Burns, scald	941	24,593
49 Burns, chemical	722	18,660
50 Amputation	27,272	146,711
51 Burns, thermal	1,145	22,971
52 Concussions	1,217	22,277
53 Contusions, Abrasions	456	12,025
54 Crushing	1,894	32,719
55 Dislocation	2,449	41,203
56 Foreign Body	205	30,880
57 Fracture	2,935	26,817
58 Hematoma	597	15,439
59 Laceration	391	24,780
60 Dental Injury	1,731	10,973
61 Nerve Damage	2,766	59,111
62 Internal Organ Injury	1,898	37,898
63 Puncture	331	56,932
64 Strain or Sprain	1,565	22,808
65 Anoxia	224	175,176
66 Hemorrhage	840	20,276
67 Electric Shock	460	67,387
68 Poisoning	636	18,991
69 Submersion	177	225,261
70 Not Stated	1,580	39,215
71 Other	1,334	23,341
72 Avulsion	1,122	44,356
73 Burns, radiation	1,297	10,957
74 Dermatitis, Conjunctivitis	433	4,487
AVERAGE	1,149	29,619

NEISS Body Part	Non-Admitted	Hospital-Admitted
00 Internal	360	15,906
30 Shoulder	1,908	25,777
31 Upper Trunk	1,407	19,042
32 Elbow	1,128	43,681
33 Lower Arm	2,032	51,704
34 Wrist	1,418	56,387
35 Knee	1,553	31,403
36 Lower Leg	1,469	43,681
37 Ankle	1,184	40,215
38 Pubic Region	1,059	31,290
75 Head	735	28,712
76 Face	408	17,778
77 Eyeball	423	59,657
79 Lower Trunk	1,918	12,340
80 Upper Arm	1,806	29,698
81 Upper Leg	945	18,697
82 Hand	785	35,292
83 Foot	1,229	34,144
84 25-50% of Body	767	37,164
85 All Parts of Body	605	59,215
87 Not Stated	1,415	19,487
88 Mouth	739	19,816
89 Neck	2,166	47,150
92 Finger	1,053	79,906
93 Toe	1,155	89,154
94 Ear	979	39,078
AVERAGE	1,193	29,619

* Including work loss by caregivers of injured children.

Figure 5. Work Losses for a Fractured Shoulder by Admission Status



8. INTANGIBLE LOSS ESTIMATION

Traditionally, illness and injury costs have been estimated as the sum of medical care, insurance claims processing, litigation, and work loss costs. This cost framework, which is called human capital costs, originated with Adam Smith in 1776.

Human capital costs lack comprehensiveness. They value only the monetary aspects of our lives. They fail to value the intangibles like the pleasure lost because a quadriplegic will never again pet a cat or hug a spouse. As a second example, an injury that does not require medical treatment and restricts the victim although the victim still is able to work has a human capital cost of $0. Nevertheless, victim quality of life may be reduced – for example, by having to cancel a tennis game or piano lesson. The victim may also be in pain. By ignoring the intangible losses, human capital costs systematically undercount costs.

An appealing way to overcome this problem is to add intangibles to human capital costs. One approach values the losses directly in dollars guided by an analysis of jury verdicts for similar cases. A second approach, the quality-adjusted-life-year or QALY approach, measures the intangibles in non-monetary terms. A third approach, which we examined but concluded should not be included in ICM, estimates a family's willingness to pay for the health and safety of a member and adds the costs external to the family (essentially, the medical and litigation costs, plus any income replacement the family receives). Miller, Calhoun, and Arthur (1989) show that this framework operationally equates to placing a dollar value on (monetizing) the QALYs, then adding human capital costs.

The intangible losses are quite important. When valued in dollars, they comprise 65–80% of total injury costs (Miller 1997). Because these losses are both large and difficult to measure, the revised ICM places special emphasis on measuring them and assessing their reliability. To assess reliability, the model examines how values vary between the available valuation methods. As this chapter describes, ICM estimates the intangible losses from jury verdicts. It applies the QALY approach in sensitivity analysis.

Values Based on Jury Verdicts

The jury verdict approach directly estimates dollar values for the intangibles. The values come from nonfatal-injury jury verdicts for non-economic damages – damages other than medical costs and work losses. Cohen (1988), Viscusi (1988), and Rodgers (1993) establish the theoretical framework for estimating pain and suffering from jury verdicts. The basic notion is that pain and suffering to an injury survivor can be approximated by the difference between the amount of compensatory damages awarded by a jury minus the actual out-of-pocket costs associated with the injury.[35] Lopez, Dexter, and Reinert (1995), Cohen (1988), Miller, Cohen, and Rossman (1993), Miller, Cohen, and Wiersema (1996), Bovbjerg, Sloan, and Blumstein (1989), Rodgers (1993), and Miller, Brigham et al. (1993) previously used regressions on jury verdicts to value pain and suffering for serious birth defects, assault, rape, medical malpractice, consumer product injury, and burns.

Valuing losses with jury-based values only makes sense if jury verdicts are reasonably predictable. Juries are informed in detail about the victim's health status and prognosis. As a group, they debate the veracity of plaintiff and defense views on this question. They then attempt to set compensation at a level the group agrees is fair. When large numbers of cases are analyzed, the pain and suffering component of U.S. jury verdicts to injury survivors is quite predictable. Miller, Cohen, and Wiersema (1996) estimates pain and suffering for physical assaults from jury verdict regressions, then compares the results with the monetized QALY estimates by ICD-9 diagnosis code from Miller, Pindus et al. (1995). Estimates for individual diagnoses by hospitalization status vary fairly significantly in some cases; averaged across diagnoses, however, the mean estimates for physical assaults from the two methods differ by only 5%. Moreover, both Miller, Cohen, and Wiersema (1996) and the study of consumer-product-injury jury verdicts described below are able to explain more than half the variation in pain and suffering awards among samples of 500–1,000 jury verdicts to injury survivors.

The remainder of this section describes the jury verdict data base and analysis in greater detail. Juries are generally instructed to award an amount that will make the victim "whole," and are given details on the nature of the injury, its prognosis, out-of-pocket losses, and associated pain and suffering.

Data on jury awards, settlements and mediation were collected from Jury Verdict Research (JVR).[36] All cases involving consumer products were collected – even if the product's manufacturer was not subject to litigation. As shown in Table 17, we sampled 1,986 JVR cases that matched the above criteria. Of these cases, 828 involved a specified consumer product. The

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[35] In fatality cases, the victim is not present to recover. State laws limit fatal injury awards in widely varying ways, making it difficult and possibly inappropriate to value pain and suffering with fatal awards.

[36] Many jury awards did not differentiate pain and suffering costs from past and future medical and work losses (monetary losses). We tried to estimate the monetary losses with data from awards, settlements, and mediation. Regression models that predicted pain and suffering from known monetary losses had better predictive power than equations that also included cases where we estimated how the total award was split between monetary loss and pain and suffering (the full sample of awards). Therefore, we believe the more restricted sample yields a model that more accurately reproduces jury estimates of pain and suffering. Only that model is reported here.

remaining 1,158 cases generally involved some form of premises liability. The premises liability cases related to injuries that involved consumer products (e.g., someone tripping over a hose and falling down stairs, or slipping on a freshly waxed floor). Of the 828 consumer product-related injuries, the largest category of products involved bicycles (173),[37] hand tools (83), elevators (62), mopeds (46),[38] ladders (42), furniture (39), lawn mowers (33), beverage containers (32), and all-terrain vehicles (ATVs) (28). Other product categories contained 10 or fewer cases.[39]

About 54.8% of injured consumers whose sex was identified were male and 45.2% female. These figures are close to national estimates of consumer product injury victims as reported in the 1994 NEISS data set, where 57.2% of injury victims were reported to be males. Children under age 13 represent about 14.7% of those whose age was identified, compared to 33.1% in the NEISS data set.[40] Injuries to individuals ages 65 or over represent 8.4% of injured consumers identified by age in the JVR data set, compared to about 9.3% in the NEISS data. About 56.8% of the injuries occurred to individuals who were known to be employed at the time of injury. Minors represented about 28.3%,[41] while the unemployed, retired, students or homemakers represented 15% of the total.

All cases involved awards or judgments that were made between the years of 1988 and 1995. In order to calculate pain and suffering estimates, all monetary values were updated to 1995 dollars (using wage-specific and medical cost-specific inflation adjustments).

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[37] Although 173 cases involved bicycles, 111 of these cases also involved moving motor vehicles. The regression includes a zero-one variable that identifies the automobile-related victims.

[38] Although 46 injuries involved mopeds, all but three cases also involved motor vehicles.

[39] The original JVR data set contained an additional 403 injuries involving a bicycle and motor vehicle accident, and an additional 6,646 cases of premises liability involving some form of consumer product. Because of the large number of cases, the burden of coding, and the fact that these cases did not involve liability of a consumer product itself, we took random samples of 21% of the bicycle and vehicle collisions and 15% of the premises liability cases.

[40] It is possible that the reason for the lower percentage of children in our sample is due to the exclusion of many premises liability cases noted in a prior footnote. We tested this to see if there was a higher percentage of children in premises liability than consumer product liability cases, and found just the opposite. Premises liability cases actually had fewer children than consumer product liability cases.

[41] Although 28.3% were noted to be minors, only 21.6% were identified as either being in the under age 13 or age 13–18 categories. The reason for this discrepancy is that some individuals were identified in the JVR case summaries as being minors, but not enough information was available to classify their age further.

Table 18 summarizes past losses, awards and pain and suffering for all jury awards (n=1,154) and settlements (n=781). The mean compensatory jury award was $619,747, while the median award was $108,767. Past wage losses averaged $64,987 for the 338 cases that had data on wage losses, while past medical costs averaged $55,035 for the 710 cases with medical cost estimates. Median losses are considerably lower, $17,961 for wages and $13,544 for medical costs. Only about 20% of cases (223) estimated future losses. However, when future losses were estimated, they were substantial, with mean losses of $575,324 and median losses of $102,518.

Table 18 also contains estimates of pain and suffering which are computed by subtracting past and future losses from the compensatory jury awards. Pain and suffering is not estimated for cases where the award is less than past and future losses.[42] For the 655 cases where pain and suffering could be estimated, the mean pain and suffering is $625,459, while the median is $96,761. Note that the mean pain and suffering estimate shown in Table 18 is higher than the mean jury award. However, the mean jury award is based on 1,154 cases. When we restrict the comparison to the 655 cases that explicitly state pain and suffering, the mean jury award is higher, $709,568 compared to $625,459 for pain and suffering (and the median award is $123,761 compared to $96,761 for pain and suffering).[43]

Pain and suffering estimates are based on an assumption that JVR data include all past and future compensable losses, since we have constructed pain and suffering by subtracting these reported losses from the total compensatory award. Some cases indicate medical losses but no lost wages - even if the plaintiff was employed. Thus, it is possible that JVR did not state some losses in these cases explicitly, in which case pain and suffering is overestimated. Unfortunately, it is impossible to distinguish between cases in which losses were excluded and those in which there were simply no losses.

Since past and future losses are mostly estimates reported by the plaintiff for purposes of litigation, they may be overstated. To the extent that losses reported by JVR overstate the actual out-of-pocket losses, the pain and suffering estimates are likely to be underestimates. Furthermore, if plaintiffs overstate losses, jurors might discount these claims when awarding damages.[44]

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[42] Past losses presumably exceed awards in some cases because jurors were not convinced about fault or the legitimacy of past loss claims.

[43] An additional 63 cases involve awards just equal to past losses, indicating a zero pain and suffering award. If these cases are factored into the analysis, the average jury award is $619,747 and the median award is $108,767. The mean pain and suffering award (including those with zero awards) is $562,742, while the median pain and suffering award is $75,188.

[44] Many states have contributory negligence rules that require a reduction in the actual award to account for the percentage of plaintiff negligence. We have *not* reduced awards to

Table 19 compares the mean and median jury awards and medical losses (in jury award cases) by type of product injury. Recall that the average award overall was about $620,000. Eight product types had average awards that were more than 50% greater than average: propane gas ($5.3 million), swimming pool injuries ($3.7 million), lawn mowers ($2.2 million), ATVs ($2 million), ladders ($1.4 million), toys ($1.1 million), hand tools ($1 million) and elevators ($980,000). Five product categories had average awards that were about 50% or less of the average: bicycles ($320,000),[45] exercise equipment ($234,000), automatic doors ($233,000), escalators ($159,000), and large kitchen appliances ($110,000).

Since mean awards may be skewed by one or two very large awards, the median is often a better measure for understanding the severity of "typical" cases that go to trial. Recall that the median overall jury award was about $110,000, considerably less than the $620,000 average award. Eight product categories had median awards that were more than three times the overall median: swimming pools ($1.8 million), propane gas ($1.6 million), ATVs ($1.4 million), toys ($672,000), lawn mowers ($515,000), ladders ($358,000), hand tools ($348,000), and cleaners ($337,000). Only three categories had awards with median losses that were about half of the overall median or less: heaters ($58,000), bicycles ($50,000),[46] and mopeds ($54,000).

In addition to those listed in Table 19, there were 77 cases involving products with less than 10 cases each. The bulk of miscellaneous cases involving large awards were for burn or electrical injuries: two cases of disposable lighters ($4 million each), six cases involving clothing (average award $1.8 million), five cases involving water heaters ($2.5 million average), and two cases involving lighting fixtures (average $850,000). Two other large cases involved helmets, with an average award of $7.4 million.

We derived a measure of pain and suffering for each case by subtracting total past and future losses from the actual compensatory damage award. In 63 cases, the total award was less than or equal to the claimed past and estimated future medical and work losses. We believe the juries in these cases either felt the loss estimates were exaggerated or implicitly factored in contributory negligence. Since our purpose is to predict the pain and suffering resulting from injury rather than to predict the amounts juries award, we omitted these cases from further analysis, obtaining a final sample of 655 cases.

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account for contributory negligence. To do so would dramatically and incorrectly decrease the pain and suffering estimates in many cases.

[45] Cases involving motor vehicles had a lower average award of $154,320 (n=57), while those not involving motor vehicles had a higher average award of $588,843 (n=35).

[46] Cases involving motor vehicles had a lower median award of $40,000 (n=57), while those not involving motor vehicles had a higher median award of $56,000 (n=35).

The natural logarithm of pain and suffering was estimated using a log-linear regression model.[47] Table 20 reports the regression results.[48] In addition to the demographic, product-specific, and injury-specific variables, Table 20 includes a few legally defined variables to control for important differences in the nature of jury awards across the country. In particular, we include a dummy (zero-one) variable to account for states in which nonmonetary damages (e.g., pain and suffering) are capped, and one for states in which punitive damages are capped. These variables are defined to have a value of one only during years in which the relevant cap was in existence. Neither variable has a significant coefficient. Note that although we do not include punitive damages in our jury award (as they are based on a theory of punishment, not compensation), it is possible that juries in states in which punitive awards are outlawed or severely limited would partially offset this limitation by increasing their compensatory awards. That does not appear to be the case in this sample. We also coded the type of defendant to control for the possible tendency of juries to award more when defendants are wealthy (a business), the "deep pockets" effect. The regressions report the existence of this effect, although the coefficients are not strongly significant. Finally, we included other dummy variables to distinguish premises liability and automobile-related liability from product liability.[49] Premises or auto liability cases reduce the pain and suffering award somewhat, perhaps because of differing views of the extent of plaintiff versus defendant negligence in cases like these.[50]

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[47] Pain and suffering estimates from regressions on the full sample of awards including cases where medical and work losses were estimated (not shown here) were higher than estimates from the subset of cases with known jury verdict details. Tobit regressions that included the cases with no pain and suffering awarded yielded lower estimates than the regressions that excluded these cases.

[48] Because both pain and suffering and past and future losses are expressed in log-linear form, the coefficient on losses is what economists call an *elasticity*. The other coefficients show the percentage change in pain and suffering cost (from the reference case where all zero-one variables are set to zero and other variables are evaluated at their mean values) for a unit change in the variable.

[49] We also ran regressions that included product-specific variables instead of the liability-type variables. These regressions were not used in ICM because the sample size on many types of product injuries is extremely small. Thus, for example, although the median jury award for toy injuries shown in Table 19 was $672,812, this is based on four cases. Although the coefficient on toy-related injuries was large, positive and significant, that variable drops out in a step-wise regression. More importantly, since not all toy-related injuries are likely to be as serious as those in the sample, it would be unreasonable to use this specification for estimating the pain and suffering caused by other toy-related injuries.

[50] Because JVR often does not state age and the age coefficients in preliminary regressions were far from significant (in this model and the variants noted above, where their signs sometimes varied), we decided against including age group variables in the Table 20 regression.

Table 20 can be used to estimate pain and suffering for any type of injury sustained as a result of a consumer-product-related incident. Table 21 computes a few selected pain and suffering estimates based on typical injuries. For example, a minor contusion, abrasion, or laceration without medical costs results in a pain and suffering estimate of $100. This increases when some medical costs or lost wages are present, so that pain and suffering is $1,180 with $100 in past losses and $3,900 with past losses of $1,000. Not surprisingly, the same monetary costs associated with a more severe injury such as an arm or hand fracture results in higher pain and suffering, $14,150. Loss of a finger or toe with $2,000 in past costs results in $57,000 pain and suffering. Severe brain damage injuries result in pain and suffering of $342,000 to $2,076,000, depending on the magnitude of past and future losses.[51]

Table 22 summarizes mean pain and suffering costs by level of treatment and separately by NEISS nature of injury or NEISS body part. The losses are largest for admitted survivors, generally followed by non-admitted ED victims. Nerve damage, which is dominated by spinal cord injury, imposes the most pain and suffering of any injury type. Internal injuries and amputations also impose very large losses. By body part, head injuries, whole-body injuries (typically severe burns), and the rare admitted toe injury (generally a potentially crippling crush or multiple traumatic amputation) impose the most pain and suffering. Pain and suffering is lowest for non-admitted doctor's office or clinic cases of dermatitis, contusions, abrasions, foreign bodies, and hematomas, and for non-admitted, ED-treated dermatitis cases.

Example. Pain and suffering was estimated with the regression equation in Table 20 and the estimated costs of a fractured shoulder for a woman ages 35–54 from earlier chapters. The equation was evaluated at the mean employment rate for women in their early 40s, 74.5%. The medical losses inserted in the equation excluded claims processing costs, and the work losses were confined to losses that juries compensate – victim wage, household production, and fringe benefit losses. The types of liability (premises, product, auto) were evaluated at their mean values in the sample data. The estimate was for a trunk injury without legislatively imposed damage caps and with only an individual defendant (to control for the suspected tendency of sympathetic juries to pad an award when a defendant has deep pockets). We estimated pain and suffering for victims who were permanently disabled by the shoulder fracture and victims who were not. We then multiplied the estimates by the probabilities of disability and no disability,

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In Table 20, we group past and future losses. Preliminary regressions that separated these losses yielded similar results.

[51] As a robustness check, we estimated similar pain and suffering values using the other model specifications and found that predicted pain and suffering estimates were close regardless of the specification.

respectively, and summed them to get the revised ICM's pain and suffering estimates.[52] These pain and suffering calculations were performed separately for admitted, non-admitted ED, and other non-admitted cases.

Estimated pain and suffering costs are $60,057 for the hospital-admitted case without permanent disability and $124,356 for the permanently disabling case. With the 25.07% permanent disability probability for an admitted shoulder fracture, the mean value of pain and suffering is $76,176 ($58,540 × .7493 + $124,356 × .2507). Similar computations yield pain and suffering estimates of $17,740 for the victim treated in the ED and released, and $18,233 for the victim treated only at a doctor's office or clinic. By comparison, estimated medical and victim work-loss costs total $70,433 for the admitted case, $4,198 for the case treated in the ED and released, and $4,416 for the case treated only at a doctor's office or clinic. Thus, 52% of estimated costs for the hospital-admitted victim and 81% of costs for the non-admitted victims are pain and suffering. These values are consistent with the typical 65–85% range for pain and suffering costs as a percentage of total victim costs (Miller, Perth 1997).

Quality-Adjusted Life Years

A quality-adjusted life year (QALY) represents a year in perfect health. QALY losses show the percentage loss in health associated with a health state. The concept of valuing health effects in QALYs was popularized by Fanshel and Bush (1970). It forms the basis for cost-utility analysis. Patrick and Erickson (1993), Miller, Pindus et al. (1995), Miller (1997b), and Gold et al. (1996) review many of the QALY scales.

QALY measurement was considered in the original ICM but never implemented. Subsequently, the National Highway Traffic Safety Administration created functional capacity indices that were applied to a broad range of injury diagnoses (Hirsch et al. 1983). Luchter (1987), for example, used these indices to compute the years of life and functioning lost to highway crash injuries. Numerous peer-reviewed injury cost studies are based on QALYs related to those in the ICM sensitivity analysis – notably, Miller, Luchter, and Brinkman (1989), Miller et al. (1991), Miller (1993), Miller, Douglass, and Pindus (1994), Miller and Blincoe (1994), Miller, Pindus et al. (1995), and Miller and Galbraith (1995). These studies built QALY estimates from the functional capacity loss ratings, then monetized them. Miller, Pindus et al. (1995) details the computations.

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[52] This two-stage computation is necessary because the regression variable is the natural logarithm of past and future losses, which is non-linear. Since medical and work losses vary widely between the permanently disabled group and the group that will fully recover, the mean pain and suffering cannot be estimated accurately by evaluating the regression equation with the mean medical and work losses across victims in the two disability groups.

First, a six-dimensional Injury Impairment Scale (IIS) was developed for rating the functional capacity losses that typically result from an injury (Hirsch et al. 1983). The scale assessed impacts on mobility, cognitive, bending and grasping, pain, sensory, and cosmetic aspects of functioning. For example, the mobility scale points are 0 – intact mobility, 1 – impaired mobility with intact functional ability, 2 – impaired mobility with mildly abnormal function; partially dependent on mechanical assistance, 3 – severely impaired mobility with abnormal function; dependent on mechanical assistance and wheelchair, occasionally needs attendant, and 4 – complete mobility loss; entirely dependent on attendant or otherwise confined to bed.

Second, physicians rated the typical functional capacity losses of a survivor for each survivable injury diagnosis with a threat-to-life severity of 2 or more (Hirsch et al. 1983).[53] They estimated the expected number of weeks of functional loss at each level during the year after injury (e.g., 15 weeks at mobility level 3) and the probable levels of impairment in years 2–5 and thereafter. Third, estimates derived from the work-loss impacts of the injuries were added for some previously unrated diagnoses (Carsten 1986) and for victims with the lowest threat-to-life severity score on the most commonly used severity scoring system, the Abbreviated Injury Scale (AAAM 1985). Fourth, data on a seventh dimension – the probability of permanent partial or total work-related disability – were estimated from DCI data (following the procedures described in the chapter on work loss and more fully in Miller, Pindus et al. 1995 and Pindus et al. 1991) and added for each injury.

Fifth, the seven dimensions of functional capacity loss (in a given time period) were converted into a single measure of lost utility (an economic measure of something's value) by applying published population survey estimates of the utility losses associated with different functional losses. This step uses opinion polling of the general population to convert the physician's estimates of the impacts of injury on physical functioning into QALY losses. For example, the physicians might estimate a hip fracture will leave the victim able to walk normally but unable to run or climb stairs. The opinion poll might ask people how much this restriction reduces their quality of life along a scale where 100% is normal ability to walk, run, and climb stairs and 0% is confinement to bed. Ratings not only were needed within dimensions, but across dimensions (e.g, the loss associated with severe disfigurement versus loss of sight in both eyes).

The utility loss estimates primarily came from Torrance (1982) (which is presented more simply in Drummond, Stoddart, and Torrance 1987). This study relies on time-tradeoff, a survey method that is a popular way to combine loss ratings by dimension into a single QALY measure. Some experts praise this technique; others question it (Gold et al. 1996). Miller, Calhoun, and Arthur (1989) find the available direct survey estimates of utility losses for specific health

[53] Threat-to-life severity was rated on a generally accepted scale, the Abbreviated-Injury-Scale or AIS (AAAM 1985).

conditions (e.g., people's ratings of how much quality of life a blind person loses) compare reasonably well with ratings from Torrance's scale. Additional values and checks on Torrance's values came from rating efforts by Kaplan (1982), Green and Brown (1978), and Carsten (1986), as well as Kind, Rosser, and William's (1982) analysis of the non-economic component of British jury awards, which reportedly follow "an informal schedule". This step yielded an estimate of the quality-adjusted life years (QALYs) lost.

Several QALY rating scales have been developed since the analysis in Miller et al. (1991) and Miller, Pindus et al. (1995) was completed. Most notable are EuroQol (Williams 1995) and two impairment scales that Torrance has calibrated with two rating approaches (Torrance et al. 1992, Gold et al. 1996). Torrance's two new sets of ratings are somewhat inconsistent with one another; for virtually every functional loss category and severity level, however, at least one of the two new ratings appears to be consistent with the values used to convert IIS ratings to utility losses.

Where possible, ICM offers QALY loss estimates that can be used as an alternative to the jury verdict estimates. Pindus et al. (1991) mapped the QALY loss ratings by time after injury that Miller, Pindus et al. (1995) fully detail and document into NEISS diagnosis categories. These loss estimates originate with the IIS. To add the losses related to permanent disability[54], we use the formula

$$QALY_t = 1 - (1 - IISimp_t) \times (1 - .33 \times (ptotperm + pptperm \times \%imp))$$

where:

$QALY_t$ is the QALY loss in time period t (measured separately for year 1, for years 2-5 collectively, and for years 6 until death collectively)

$IISimp_t$ is the 6-dimensional IIS-based QALY loss in time period t, which generally ranges from 0 to 1 (but is larger for fates that have a greater impact on the family than death, notably a head injury that leaves the patient in a persistent vegetative state)

.33 is the QALY weighting factor for loss of ability to work, from Drummond, Stoddart, and Torrance (1987)

ptotperm is the probability of total permanent disability

[54] The QALY estimates deliberately exclude short-term work loss to the extent possible. Therefore, the short-term work loss costs can be added to the QALYs without double-counting. When QALYs are monetized, the dollar value used is adjusted to avoid double-counting the monetary value of the work loss resulting from permanent disability.

pptperm is the probability of partial permanent disability

%imp is the average percentage of earning power lost to partial permanent disability

As in Miller, Pindus et al. (1995), total QALYs lost are computed (at a 2.5% real discount rate) as

$$QALY_{tot} = QALY_1 + 3.762 \times QALY_{2\text{-}5} + (PVyrs - 4.762) \times QALY_{6\text{-}99}$$

where:

3.762 is the sum of the present values, at a 2.5% annual discount rate, of years 2 through 5, i.e. $(1/1.025) + (1/1.025)^2 + (1/1.025)^3 + (1/1.025)^4$

PVyrs is the present value of the victim's expected lifespan according to a standard life table, discounted at a 2.5% discount rate

Example. Continuing with the fractured shoulder example from earlier chapters, exclusive of the permanent disability factor, Pindus et al. (1991) estimate the QALY losses for an admitted case are 3.23% of annual utility in year 1 and 0.06% thereafter. Recall that the hospital-admitted fractured shoulder victim has a 1.25% probability of total permanent disability and a 23.82% probability of partial permanent disability. Adding permanent disability, the losses are 4.65% in year 1:

$$1 - (1 - .0323) \times [1 - .33 \times (.0125 + .2382 \times .1345)] = .0465$$

and 1.53% per year thereafter:

$$1 - (1 - .0006) \times [1 - .33 \times (.0125 + .2382 \times .1345)] = .0153$$

The present value of average future lifespan for a woman age 40 is 24.22 years. Therefore, lifetime losses for the hospital-admitted shoulder fracture are 0.402 quality-adjusted life years:

$$.0465 \times 1 \text{ year} + .0153 \times 23.22 \text{ years} = .402 \text{ years}$$

The permanent disability probabilities for a non-admitted victim are 0.00% and 2.33%. The QALY losses for the non-admitted fracture are 2.09% in year 1 and nothing thereafter without the permanent disability factor. With the permanent disability factor, they are 2.19% in year 1:

$$1 - (1 - .0209) \times [1 - .33 \times (.0000 + .0233 \times .1345)] = .0219$$

and 0.103% per year thereafter:

$$1 - (1 - .0000) \times [1 - .33 \times (.0000 + .0233 \times .1345)] = .00103$$

Lifetime losses are 0.046 QALYs:

$$.0219 \times 1 \text{ year} + .00103 \times 23.22 \text{ years} = .046 \text{ years}$$

To put these losses in context, the admitted case costs 1.7% of lifetime utility (.402 / 24.22) and the non-admitted case costs 0.2% (.046 / 24.22).

Comparability of the QALY Estimates and Jury Award Estimates. We compared the pain and suffering estimates from the non-monetized QALY approach to the independent estimates from the jury awards approach. This comparison attempts to cross-validate the pain and suffering estimates from the two approaches. To compare, we redid the regression analysis shown in Table 20, substituting QALYs lost for past losses and the injury variables. Thus, the present value of future QALYs lost (stated as a fraction of the person's lifetime QALYs) replaces the variables used earlier to describe the injury. The coefficient on QALYs is highly significant (with t-values between 6.0 and 10.0) and positive. The strong significance of the QALY variable implies that the independent QALY and jury award estimates are reasonably consistent, which increases our confidence in their validity.

Table 17. Distribution of Product Injuries in Jury Awards, Settlements, and Mediation

Product	Number	Percent
Bicycle /Motor Vehicle	111	5.6%
Bicycle (w/o Motor Vehicle)	62	3.1%
Hand Tool	83	4.2%
Elevator	62	3.1%
Moped *	46	2.3%
Ladder	42	2.1%
Furniture	39	2.0%
Lawn Mower	33	1.7%
Beverage Container	32	1.6%
ATV	28	1.4%
Cleaner	15	0.8%
Small Kitchen Appliance	15	0.8%
Swimming Pool	14	0.7%
Escalator	13	0.7%
Exercise Equipment	13	0.7%
Automatic Door	12	0.6%
Propane Gas	12	0.6%
Toys	11	0.6%
Heaters	10	0.5%
Large Kitchen Appliance	10	0.5%
Ski Equipment	9	0.5%
Other (< 10 cases)	156	7.9%
Premises Liability	1158	58.3%
Total	**1986**	**100%**

* All but three moped cases involved motor vehicles.

Table 18. Summary of Past and Future Losses and Awards (Jury Awards and Settlements)

	Cases	Mean	Median	Minimum	Maximum
Settlements					
Monetary Settlement	781	$ 320,705	$ 28,305	$ -	$ 29,000,000
Past Medical Costs	379	$ 46,302	$ 7,123	$ 139	$ 5,119,028
Past Wage Losses	110	$ 38,992	$ 7,281	$ 88	$ 1,713,503
Future Losses	46	$ 590,432	$ 17,005	$ 108	$ 12,968,525
Jury Awards					
Compensatory Award	1154	$ 619,747	$ 108,767	$ 12	$ 41,000,000
Past Medical Costs	710	$ 55,035	$ 13,544	$ 51	$ 5,567,596
Past Wage Losses	338	$ 64,987	$ 17,961	$ 55	$ 1,822,178
Future Losses	223	$ 575,324	$ 102,518	$ 1	$ 14,601,291
Pain and Suffering	655	$ 625,459	$ 96,761	$ 224	$ 40,268,344

NOTE: Settlements are cases that settled out of court, while jury awards involve cases that ultimately went to trial.

NOTE: The rows are independent of each other – different but overlapping sets of cases appears in each row.

Table 19. Summary of Past Medical Loss and Jury Awards by Type of Product, For Jury Award Cases and Jury Award Cases with Separately Stated Medical Loss

Product	Jury Award Mean	Jury Award Median	Jury Award Cases	Medical Loss Mean	Medical Loss Median	Medical Loss Cases
Bicycle	$319,628	$50,000	92	$48,646	$7,900	57
- Bicycle w/MV	$154,320	$56,000	57	$22,830	$4,733	24
- Bicycle w/o MV	$588,843	$40,000	35	$84,143	$10,956	33
Hand tools	$1,026,166	$348,579	58	$66,548	$28,861	35
Elevator	$981,430	$162,500	44	$88,246	$6,635	26
Moped	$741,976	$53,597	24	$55,390	$9,627	4
- Moped w/MV	$760,677	$54,315	22	$62,933	$8,930	22
- Moped w/o MV	$24,000	$24,000	2	$10,133	$10,133	2
Ladder	$1,449,983	$358,200	32	$56,908	$14,320	22
Furniture	$370,284	$128,047	17	$14,447	$10,435	12
Lawn Mowers	$2,214,991	$515,000	24	$57,467	$33,000	15
Beverage Container	$577,696	$102,111	18	$13,888	$8,250	12
ATV	$2,039,859	$1,383,500	16	$118,441	$58,000	9
Cleaner	$409,333	$337,500	6	$8,037	$7,000	3
Small Kitchen App	$404,062	$126,000	9	$16,127	$2,500	5
Swimming Pool	$3,710,541	$1,778,666	8	$97,858	$118,500	4
Escalator	$159,518	$75,000	9	$18,288	$8,700	5
Exercise Equip	$234,422	$85,000	9	$15,236	$12,500	8
Automatic Door	$233,270	$157,210	5	$21,086	$21,472	4
Propane Gas	$5,348,975	$1,600,000	11	$208,784	$122,500	8
Toys	$1,102,907	$672,812	4	$16,545	$16,545	2
Heaters	$401,269	$58,105	9	$2,962	$2,680	4
Large Kitchen App	$110,144	$100,000	3	$16,366	$26,155	2
Ski Equipment	$668,970	$150,000	7	$96,396	$96,396	2
Other (< 10 cases)	$1,248,912	$400,000	77	$164,951	$17,515	49
Not Classified	$320,461	$70,000	672	$20,623	$9,971	412

Table 20. Regression Predicting Pain and Suffering from Jury Verdicts

Variable	Coefficient	Test Statistic	P(Insignificance)	Mean Value
Constant	6.156	15.887	.000	
Female	-.166	-1.458	.145	.4552
Employed	.061	.483	.630	.7608
Brain	.752	3.035	.003	.0756
Moderate/Severe Brain *	.353	.857	.392	.0247
Facial Fracture	-.139	-.485	.628	.0355
Facial Scarring	.718	1.690	.092	.0170
Dental	-.720	-1.579	.115	.0139
Serious Eye/Ear	.917	3.566	.000	.048
Paralyzed	1.613	4.649	.000	.0293
Other Nerve	.358	1.618	.106	.0633
Other Head/Neck Fracture	.220	.707	.480	.0309
Fracture of Digit	-.203	-.520	.603	.0185
Loss of Digit	1.188	3.641	.000	.0293
Other Amputation	1.608	3.534	.000	.0139
Arm/Hand Fracture	.154	.905	.366	.1235
Leg/Foot Fracture	.248	1.550	.122	.1435
Limb Sprain/Strain/Lacerat	-.390	-1.151	.250	.0309
Limb Disloc/Crush/Ligament	.291	1.282	.200	.0725
Other Back	-.208	-1.419	.156	.2130
Internal Injury	-.033	-.082	.934	.0185
Trunk Fracture	.455	2.025	.043	.059
Burn	.746	2.881	.004	.0571
Laceration/Puncture	-.262	-1.216	.224	.076
Minor Contus/Abras Only	-1.142	-2.080	.038	.00926
PTSD/Emotional Distress	.376	1.454	.146	.0448
Aggravate Existing Condition	.268	1.083	.279	.0478
Premises Liability	-.375	-2.873	.004	.6049
Auto Involved	-.594	-2.170	.030	.0602
Damage Cap	-.372	-1.719	.086	.0617
Punitive Damage Cap	.054	.358	.720	.1420
Business Defendant Only	.141	1.016	.310	.6559
Government Defendant Only	-.204	-.780	.436	.0556
Individual Defendant Only	-.433	-1.910	.057	.0988
Ln (Medical + Work Losses)	.516	16.037	.000	10.31

648 Observations, 612 Degrees of Freedom
Adjusted R-squared = .557
F (35,612) = 24, P(F) = 0.00000
* Moderate/Severe Brain is additive with Brain.

Injury Variable Definitions

Brain	Concussion, hematoma, other minor inj.
Moderate/Severe Brain	Moderate to severe brain injury (additive with Brain)
Facial Fracture	Fracture or other serious face injury
Facial Scarring	Residual scarring to the face
Dental	Any injury to the teeth
Serious Eye/Ear	Serious injury to sight or hearing
Other Sensory	Minor injury involving partial or full loss of senses
Paralyzed	Any paralysis, paraplegia, or quadriplegia
Other Nerve	Nerve damage
Other Head/Neck/Back Fracture	Fractures to neck or head, including TMJ
Loss of Digit	Loss of finger or toe
Other Amputation	Loss of limb(s) except finger or toe
Arm/Hand Fracture	Fracture of arm or hand (not fingers)
Leg/Foot Fracture	Fracture of leg or foot (not knee or toes)
Other Limb	Injuries to limbs except most fractures, amputations, nerve damage; includes fractures to fingers and toes, and dislocated shoulders
Other Back	Ruptured disc, sprained vertebrae, etc.
Internal Injury	Injury to internal organ(s)
Trunk/Shoulder Fracture	Fracture to back, pelvis, ribs, spine or chest
Burn	Any burn injury
Puncture	Puncture injury not elsewhere classified (exclude internal inj.)
Minor Contus/Abras Only	Abrasions, contusions, lacerations, hematoma, not elsewhere classified only
PTSD	Post-traumatic stress disorder
Emotional Distress	Emotional distress claimed
Other/Miscellaneous	Other miscellaneous injuries

Table 21. Predicted Pain and Suffering for Some Illustrative Hypothetical Injuries

Injury Type	Medical & Work Loss	Pain & Suffering
Minor Contus/Abras Only	-	$ 100
Minor Contus/Abras Only	$ 100	1,180
Minor Contus/Abras Only	1,000	3,900
Arm/hand Fracture	1,000	14,150
Loss of Digit	2,000	57,000
Burn	15,000	103,500
Moderate Brain Damage	150,000	342,000
Severe Brain Damage	2,500,000	2,076,400

Table 22. Pain and Suffering Cost per Survivor of Consumer-Product Injury by Nature of Injury or Body Part Injured (in 1995 dollars)

NEISS Injury Diagnosis	Non-Admitted: Doctor or Clinic	Non-Admitted: Emergency Department	Hospital-Admitted
41 Ingested Foreign Object	5,941	6,768	34,727
42 Aspirated Foreign Object	7,486	8,514	144,332
46 Burns, electrical	25,188	25,930	124,771
47 Burns, not specified	19,929	22,085	127,216
48 Burns, scald	18,094	20,247	135,230
49 Burns, chemical	15,343	17,260	119,680
50 Amputation	77,364	91,510	337,065
51 Burns, thermal	17,423	19,185	134,224
52 Concussions	21,058	27,477	90,620
53 Contusions, Abrasions	2,260	2,612	13,187
54 Crushing	14,881	14,887	77,729
55 Dislocation	20,952	19,033	83,077
56 Foreign Body	1,895	2,452	14,560
57 Fracture	17,883	16,210	71,763
58 Hematoma	2,420	2,485	12,990
59 Laceration	5,716	7,134	36,664
60 Dental Injury	6,159	7,168	21,393
61 Nerve Damage	67,191	58,945	824,884
62 Internal Organ Injury	59,273	44,681	390,195
63 Puncture	4,622	6,282	44,286
64 Strain or Sprain	7,762	7,607	36,141
65 Anoxia	6,176	6,742	157,702
66 Hemorrhage	2,469	4,036	17,914
67 Electric Shock	7,440	7,849	54,492
68 Poisoning	6,460	8,542	34,133
69 Submersion	5,929	6,571	107,645
70 Not Stated	7,681	8,541	71,342
71 Other	7,382	8,126	61,189
72 Avulsion	17,860	23,629	100,671
73 Burns, radiation	20,505	22,501	109,094
74 Dermatitis, Conjunctivitis	2,003	2,098	12,537
AVERAGE	8,671	9,085	92,943

NEISS Body Part	Non-Admitted: Doctor or Clinic	Non-Admitted: Emergency Department	Hospital-Admitted
00 Internal	5,993	6,828	41,892
30 Shoulder	11,582	11,118	61,922
31 Upper Trunk	12,003	11,092	65,293
32 Elbow	6,754	8,034	64,068
33 Lower Arm	9,230	11,286	72,615
34 Wrist	8,062	9,850	91,689
35 Knee	7,666	7,340	56,416
36 Lower Leg	8,584	9,273	81,631
37 Ankle	7,317	8,047	70,507
38 Pubic Region	5,050	6,141	46,891
75 Head	20,881	16,277	210,171
76 Face	4,711	6,463	44,484
77 Eyeball	3,029	5,153	46,738
79 Lower Trunk	10,126	10,103	64,649
80 Upper Arm	9,883	11,145	63,920
81 Upper Leg	6,248	7,304	72,878
82 Hand	6,453	7,581	71,741
83 Foot	6,791	7,311	76,426
84 25-50% of Body	4,977	6,464	154,211
85 All Parts of Body	6,288	7,883	68,507
87 Not Stated	5,235	5,916	31,346
88 Mouth	6,377	8,259	36,357
89 Neck	10,613	10,811	96,906
92 Finger	6,795	8,425	137,187
93 Toe	7,174	7,728	175,524
94 Ear	3,542	5,340	41,711
AVERAGE	8,671	9,085	88,457

9. PRODUCT LIABILITY COSTS

This chapter describes product liability costs, which include two related cost factors: (1) the costs of product liability insurance ("insurance") and (2) legal costs associated with product liability, such as litigation in which plaintiffs claim damages resulting from product defects ("legal"). Costs borne by insurers to defend against product liability litigation are included under insurance costs, not legal costs.

Product Liability Insurance Administrative Costs

Like the original model, the revised ICM includes the costs of administering the product liability insurance system. These costs include costs of defending the insured manufacturer or seller, the costs of claims investigation and payment, and general underwriting and administrative expenses. The product liability insurance administration component of ICM includes only administrative costs; to avoid double-counting, it excludes the medical, work loss, and pain and suffering compensation paid to injury victims and their families.

The original model also included the costs associated with product liability insurance brokerage and commissions. In 1991–1995, these costs averaged 11.1% of premiums paid, $250 million annually (A.M. Best 1996). Although these fixed sales costs are legitimate costs of consumer product injury in the aggregate, they are not marginal costs that decline when injuries are averted and are excluded from the revised ICM.

Product liability insurance premiums totaled $2.34 billion in 1994 and $2.16 billion in 1995 (Insurance Information Institute 1996). In 1991–1995, product liability claims processing costs averaged 30.4% of premiums; general underwriting and administrative expenses averaged 16.4% (A.M. Best 1996). Thus, claims investigation and payment processing costs totaled $684 million and general underwriting expenses totaled $369 million. These costs are spread across a base of roughly $446 billion in what this chapter calls victim-related costs – the sum of all wage, medical, and pain and suffering costs related to fatal[55] and non-fatal consumer product injury. They equate to 0.24% of the victim-related costs. Multiplying that percentage times the victim-related costs for a given product-related injury yields its estimated product liability insurance administrative costs. These administrative costs average $35 per product-related injury victim (averaged across the 29.9 million victims that the ICM estimates were medically treated in 1995).

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[55] For this calculation, we add $42.8 billion for fatalities - 21,400 annual consumer fatalities valued at $2 million per life. The $2 million value is our estimate, based on a review of awards for consumer product injury deaths, of the average wrongful death award.

Legal Costs

To model legal costs, we first estimate the number of product liability lawsuits filed annually and the average legal and court costs per lawsuit. From this information, we estimate a percentage multiplier on victim-related costs in the same way we derived the liability insurance administrative cost multiplier. Note that legal costs include fees, often proportions of awards, paid by plaintiffs to lawyers as compensation for their services. Beyond this, awards are merely transfers of responsibility for paying injury costs from plaintiffs to defendants. They are not included in the ICM because it counts costs, not who pays them.

Number of Liability Lawsuits. Smith et al. (1995) report 572,041 tort liability lawsuits were filed during 1993 in 29 reporting states. We calculate that these states have 3.3 tort liability lawsuits per thousand population. Assuming this rate holds for the remaining 21 states, we estimate 827,144 tort liability lawsuits are filed annually. In the nation's 75 most populous counties 3.38% of tort liability lawsuits were product liability lawsuits (Smith et al. 1995). Multiplying that percentage by the number of tort liability lawsuits yields an estimate of 27,957 product liability lawsuits filed annually.

Cost per Lawsuit. A lawsuit involves three categories of costs besides the defense attorney costs covered as part of insurance claims payment expenses: court and claiming expenses, plaintiff attorney fees, and time spent by plaintiffs, defendants, and witnesses. A major study by Kakalik and Pace (1986) estimates the average costs for these components in a tort case other than a motor vehicle crash is $25,365 (inflated to 1995 dollars with the Consumer Price Index – All Items). This estimate includes $2,383 in court and claiming expenses, $12,938 in plaintiff attorney fees, and time valued at $10,044.

Legal Costs Multiplier. Annual product liability litigation costs exclusive of defense costs counted in insurance claims processing are an estimated $689.6 million or 0.15% of the $446 billion in victim-related costs.[56] The costs average $23 per consumer product injury victim.

Total Costs

With the legal and liability costs now included, our estimates of consumer product injury costs are complete. Table 23 shows the average total cost per nonfatal case – the sum of medical, work loss, pain and suffering, and legal and liability costs – by NEISS nature of injury and body part. Nerve damage and amputation are the most costly injury diagnoses, overall. Hospitalized cases of aspirated objects, anoxia, and submersion also have high average costs because of the permanent brain damage that can result. The head is the most expensive body part to injure.

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[56] This estimate excludes $328.6 million in defense legal expenses ($12,087 per case), which are treated as liability insurance claims payment expenses.

Table 23. Average Total Cost per Nonfatal Consumer-Product Injury by Nature of Injury or Body Part Injured (1995 dollars)

NEISS Injury Diagnosis	Non-Admitted: Doctor or Clinic	Non-Admitted: Emergency Department	Hospital-Admitted
41 Ingested Foreign Object	6,927	7,930	57,947
42 Aspirated Foreign Object	8,678	9,985	406,112
46 Burns, Electrical	28,692	29,491	172,108
47 Burns, Not Specified	22,657	24,994	181,035
48 Burns, Scald	19,810	22,257	188,084
49 Burns, Chemical	16,747	18,769	154,317
50 *Amputation*	105,756	123,420	502,217
51 Burns, Thermal	19,285	21,269	200,479
52 Concussions	23,211	30,556	119,803
53 Contusions, Abrasions	3,295	3,910	42,592
54 Crushing	17,718	17,736	135,198
55 Dislocation	25,365	22,880	146,207
56 Foreign Body	2,681	3,593	56,674
57 Fracture	22,608	20,648	120,142
58 Hematoma	3,652	3,779	41,557
59 Laceration	6,843	8,686	76,583
60 Dental Injury	9,326	11,018	45,917
61 Nerve Damage	75,731	66,356	1,372,164
62 *Internal Organ Injury*	65,896	49,282	593,260
63 Puncture	5,468	7,580	114,341
64 Strain or Sprain	10,037	9,827	74,799
65 Anoxia	7,037	7,730	521,868
66 Hemorrhage	4,117	6,789	62,044
67 Electric Shock	8,548	9,065	127,743
68 Poisoning	7,641	10,221	62,534
69 Submersion	6,815	7,586	368,168
70 Not Stated	10,523	11,930	138,345
71 Other	9,976	11,121	112,578
72 Avulsion	19,489	26,022	158,525
73 Burns, Radiation	22,573	24,540	139,034
74 *Dermatitis, Conjunctivitis*	2,802	2,945	38,661
AVERAGE	10,824	11,328	149,142

NEISS Body Part	Non-Admitted: Doctor or Clinic	Non-Admitted: Emergency Department	Hospital-Admitted
00 Internal	6,987	8,001	80,708
30 Shoulder	14,580	13,996	111,479
31 Upper Trunk	15,004	14,013	102,682
32 Elbow	8,655	10,296	121,568
33 Lower Arm	12,186	14,811	140,271
34 Wrist	10,115	12,426	195,116
35 Knee	10,116	9,655	106,968
36 Lower Leg	10,939	11,768	147,661
37 Ankle	9,285	10,314	126,890
38 Pubic Region	6,904	8,469	94,096
75 Head	23,528	18,480	322,843
76 Face	5,890	8,020	78,010
77 Eyeball	3,910	6,328	130,787
79 Lower Trunk	13,143	13,276	98,224
80 Upper Arm	12,725	14,335	115,060
81 Upper Leg	7,916	9,185	122,320
82 Hand	7,886	9,206	121,484
83 Foot	8,697	9,288	131,835
84 25-50% of Body	6,463	8,292	238,220
85 All Parts of Body	7,566	9,631	178,903
87 Not Stated	7,708	9,012	65,446
88 Mouth	8,194	10,708	69,064
89 Neck	13,856	14,209	185,878
92 Finger	8,492	10,487	230,923
93 Toe	8,921	9,612	277,938
94 Ear	5,095	7,678	96,281
AVERAGE	10,824	11,328	149,142

10. MAPPING INTO NEISS DIAGNOSIS CODES

The Injury Cost Model operates by merging cost estimates onto individual NEISS cases. The merge is by body part, nature of injury code, and when appropriate, victim sex and age group. NEISS codes the victim's most severe injury into a two-column coding system. The injury is coded as a two-digit injury diagnosis (e.g., fracture, laceration) and a two-digit body part (e.g., elbow, toe). That means every injury is coded with the same body part categories. NEISS is designed for coding injuries treated in a hospital emergency department.

As Chapter 4 explains, most of the data sets in the cost computations – NHDS, NHIS, NMES, CHAMPUS, and state hospital discharge data sets – code injuries using the Ninth Edition of the International Classification of Diseases (ICD-9; DHHS 1994). ICD-9 is not limited to injury-related morbidity or mortality. It is organized around nature of injury or illness codes. ICD-9 codes a nature category in three digits. The Clinical Modification, ICD-9-CM, provides greater coding detail by adding two more digits. In contrast to NEISS, ICD body part descriptors are not uniform. Sometimes body parts are described in the first three digits, but often they are described by the fourth or fifth digit. For example, for a fracture of the lower limb, ICD-9-CM specifies the particular bone involved. For an open wound of the lower limb, however, the relevant body part groupings are: hip and thigh; knee, ankle, and leg (except thigh); foot; and toe.

NEISS codes often lack the diagnostic detail of ICD-9-CM categories. For example, where NEISS would code any fracture of the lower arm as 5733 (57 = fracture, 33 = lower arm), ICD-9 would distinguish between fractures of the radius and the ulna; the upper end, shaft, or lower end of each bone; and whether the fracture is open or closed. ICD-9 also contains codes for injuries that have only a generic NEISS match, most notably injuries to internal organs and to nerves. In some instances, however, NEISS has more specific injury types than the ICD. For example, the ICD-9 Open Wound category groups three NEISS categories: Avulsion, Laceration, and Puncture.

Because most of our medical data sources use ICD-9-CM, our estimates largely were built by ICD diagnosis. To put the estimates in the ICM, we had to map them from ICD-9-CM to NEISS diagnoses. In most cases, this was straightforward, because we were going from a more detailed to a less detailed coding system. Difficulties arose, however, because of differences in how the body was divided into parts.

The next section illustrates how information is mapped between two simple body-part coding systems. The following section provides details of the ICD-NEISS mapping and provides an example.

A Simple Body Part Mapping

Developing maps between coding systems was essential to this study. The problem is similar to the problem of comparing chicken prices between retailers. Suppose you want to buy half a chicken. The first store, SuperMarket, offers:

Breast quarters	$.89 each
Leg quarters	.59 each

Its competitor, The Grocer, offers:

Breasts	$1.09/lb
Wings	.89/lb
Thighs	.49/lb
Drumsticks	.89/lb
Backs	.45/lb

To determine where it would be least costly to buy which parts, you first need to map the parts between systems. Breasts and wings obviously are in breast quarters, thighs and drumsticks in leg quarters. Backs, however, are split between the leg and breast quarters.

Once the mapping is complete, you still need weights – in this case quite literally – to combine the data into a comparable format. Suppose backs are split equally between quarters, left and right breasts each weigh .6 pounds, wings each weigh .2 pounds, and a back weighs .5 pounds. Then The Grocer would charge:

$$(.6 \times \$1.09) + (.2 \times \$.89) + [(.5 / 4) \times \$.45] = \$.88825$$

for a breast quarter. The two stores price breast quarters almost identically.

The only differences between this example and our mapping between coding systems are that this example involves only a few codes and the names of these codes are quite familiar. ICD and NEISS used hundreds of codes cloaked in medical jargon.

ICD-NEISS Mapping

Chapter 6 and Appendix B describe the range of ICD-9 codes mapped into NEISS codes. We built two maps from ICD-9-CM to NEISS – one from 5-digit ICD-9 codes, and another from 3-digit ICD-9 codes. Dorland's Illustrated Medical Dictionary (1988), Stedman's Medical Dictionary (1990), the NEISS Coding Manual (1997), and the NEISS injury coder's helpline were used in constructing the maps. We also drew heavily on earlier maps developed by Pindus et al. (1990, 1991) and Miller, Pindus et al. (1995).

We began the mapping not with raw ICD diagnosis codes, but with roughly 700 ICD diagnosis groups formed at earlier stages of analysis to ensure that each group had a reasonable sample size. In the simplest case, a single ICD group mapped to a single NEISS code. In more complex cases, an ICD group mapped to multiple NEISS codes, some of which were also mapped from other ICD groups. For some ICDs, notably late effects of injury (ICD 905-909), a single ICD group may map to many NEISS codes. For example, late effects of tendon injuries (ICD 905.8) maps to 72 different NEISS groups.

A cost estimate for a given NEISS code was computed as the weighted average of the costs for the various ICD diagnosis groups mapped to the NEISS code. For the 5-digit mapping applied to hospital-admitted cases, each ICD group was weighted by its case count in the pooled five-state (CA, MD, NY, VT, WA) data set of admitted consumer product injuries. In the 3-digit mapping applied to non-admitted cases, NHIS case counts further segmented in proportion to CHAMPUS case counts within ICD groupings were used as weights. When a given ICD group was mapped to multiple NEISS codes, its weight was divided evenly among the codes it was mapped to.

Example. Sprains and strains of shoulder and upper arm (ICD 840) was split into two ICD groups at an earlier stage – rotator cuff (capsule) sprain and strain (ICD 840.4), with 4,755 hospital-admitted cases, and all others (ICDs 840.0-840.3, 840.5-840.9), with 692 admitted cases. The rotator cuff diagnosis is mapped to NEISS code 6430 (64 = strain or sprain, 30 = shoulder). The other diagnosis group is mapped to both 6430 and 6480 (80 = upper arm). The 692 cases in the other group are divided evenly between the two NEISS codes, giving each a weight of 346 cases. The cost for an admitted survivor with diagnosis 6480 equals the average cost for the corresponding ICD group. The medical cost, in 1994 dollars, for NEISS diagnosis 6430 for admitted males ages 20–54 is:

$$[(4{,}755 \times \$8{,}649) + (346 \times \$8{,}616)] / (4{,}755 + 346) = \$8{,}647$$

11. CONCLUSION

Strengths of the ICM Estimates

The Revised Injury Cost Model (ICM) improves on the original model in a number of significant ways. For example, incidence estimates for non-ED medically treated injuries are now linked to injury groupings and the age of the injury victim, unlike in the original model, and may therefore differ substantially from the original model's estimates depending on the types of injuries involved. Generally, more severe injuries are treated in non-ED settings less often than minor injuries (for example, three-fourths of sprained ankles are treated in non-ED settings, but fewer than half of dislocations are treated in non-ED settings). Also, the original model did not estimate the injury victims admitted directly to hospitals from doctors' offices or directly to burn centers or other trauma facilities.

The ICM also greatly simplifies the reporting of costs, if not their estimation. Costs have been grouped into four easy-to-understand categories: medical costs, work loss, pain and suffering, and product liability costs. All four cost groupings are more comprehensive in the ICM than in the original model. Professional fees, ancillary costs, and long-term costs are captured better in the medical cost estimates of the ICM. Work loss estimates of the ICM now include permanent disability resulting from non-admitted injuries. Since the regression equations to estimate pain and suffering include medical costs and lost work as independent variables, the pain and suffering estimates will reflect the more comprehensive estimates of these costs. Also, all four cost groupings are far more up-to-date than the original model, since they are based on data that reflect the enormous changes in medical technology and practice, the work force, and the legal landscape that have occurred over the last 20 years.

ICM estimates the cost of all 29.9 million medically treated, nonfatal consumer product injuries at $405 billion for 1995, with medical costs accounting for 9 percent of the costs, lost work for 13 percent, and pain and suffering for 78 percent. The comparable cost estimate from the original model would be less than half of the ICM estimate.

The ICM estimates costs for both the emergency department (ED) injuries estimated by CPSC's NEISS and non-ED injuries treated in doctor's offices, walk-in clinics, and other settings. ED-treated injuries account for 40 percent of total injuries, but 50 percent of total costs. Costs for ED-treated injuries were, on average, 52 percent greater than those treated in other settings. This difference is explained by the relatively high proportion of ED-treated injuries admitted to the hospital (4.2 percent) versus those treated initially in doctors' offices and other non-ED settings (less than 0.5 percent) and the higher costs associated with treatment in an ED relative to treatment in doctors' offices and clinics.

Limitations of the ICM

Earlier chapters described numerous ICM limitations and assumptions. Additionally, for certain cost estimates for certain diagnoses - for example, medical costs for amputation of the arm above the elbow (ICD 887.2, 887.3) - we were unable to accumulate enough data points to be assured of statistical reliability, despite our best efforts to combine injury and victim categories. As a result, certain estimates may be problematic. These instances are relatively rare and the effects on any analysis are likely to be limited by the mapping process, which tends to spread the impact of cost estimates over several NEISS codes. Furthermore, the injury categories with these problems also tend to occur infrequently in the NEISS injuries - for example, NEISS has no hospitalized cases of amputations of the elbow (5032) or upper arm (5080); thus their impact on any analysis is likely to be highly diluted.

Since the ICM injury costs are based on NEISS estimates, they also necessarily embody the limitations of the NEISS estimates. NEISS estimates based on small numbers of cases in the sample will lack statistical reliability, and ICM estimates of costs for those cases should be regarded with caution.

Further Research

This revision of the Injury Cost Model addresses many of the limitations of the original model, but several potential areas of benefit analysis could not be fully addressed. Addressing them may require long-term follow-up of NEISS cases. For example, some evidence suggests that head injuries, even apparently minor ones, can cause long-term cognitive deficits or behavioral problems that may significantly affect the quality of life for the head injury victim and his or her family. Following head injury cases supplied by the NEISS system could help determine whether the ICM adequately reflects these injury sequelae. Follow-up of NEISS cases may also provide valuable information on the impact of children's injuries on parents or caregivers. In addition, follow-up of selected groups of NEISS injuries could provide a method for validating the ICM cost estimates. These longitudinal projects are, by their nature, rather time-consuming.

Nursing home costs were not fully developed in the ICM because of resource constraints; costs for nursing homes can be developed from existing databases. Nursing home costs are likely to be a minor factor for all but the most severe consumer product injuries.

For lack of data, this study has not estimated permanent disability probabilities for poisonings (essentially setting them to 0). The only poisoning disability data we were able to locate was an all-exposure average for occupational exposures. The mix of toxins seems likely to differ greatly between occupational and consumer product incidents. The best source for information on disability caused by consumer-product poisonings probably is follow-up on a sample of NEISS poisoning cases, possibly as part of in-depth investigations involving specific products.

The ICM does not estimate costs for a large body of injuries where no medical treatment was sought, but injury victims restricted their activities for at least a half-day. These injuries are self-diagnosed and the severities of the injuries are difficult to assess. These activity-restricting injuries consist primarily of cracked ribs, strains, contusions, and superficial injuries. While costs for these relatively minor injuries are difficult to assess, they number in the millions. Additional study of these injuries may suggest innovative costing methods. However, any costs developed are likely to be a small fraction of total costs estimated by the ICM.

Finally, this study has not estimated costs for a variety of illnesses resulting from exposure to chemicals in consumer products. These illnesses range from flu-like symptoms resulting from indoor air quality problems to cancers resulting from exposure to certain chemicals. The Commission conducted a cost of illness study in 1980 dealing primarily with several types of illness caused by asbestos. That study used the human capital method for costing illnesses that was commonly employed in the public health field at the time. It preceded a variety of medical care cost containment efforts. Since then, measures of lost quality of life have become more accepted and medical costs have shifted treatment regimens. It may be time to revisit the costing of illnesses.

An essential difference between evaluating the costs of chemically related illness vs. injuries is the lack of a surveillance system such as the NEISS to measure the incidence or prevalence of these illnesses. Identifying the causes for illnesses is also much more problematic than identifying the causes of injuries, except in rare cases such as illnesses related to asbestos exposure.

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APPENDIX A: Example of Cost Calculations

This appendix recapitulates the running example used in Chapters 6–9. The example builds a step-by-step cost estimate for a 40-year-old woman's fractured scapula (i.e., shoulder blade, ICD-9 diagnosis 811).

Medical Costs for Hospital-Admitted Cases

Length of stay. For scapula fractures, the NHDS length of stay averages 4.2 days. The regression on pooled 5-state data shows the length of stay for consumer product-related scapula fractures of women ages 20–54 is 80% of the average for all scapula fractures. Multiplying 4.2 by 80%, we estimate the length of stay for our victim to be 3.36 days.

Ratio of professional fees to hospital costs. For a fractured scapula, CHAMPUS shows the ratio of professional fees to hospital payments is .1814. The costs incurred during a hospital admission for scapula fracture will be 1.1814 times the hospital's costs. This factor will be applied to the total hospital charge for each scapula-fracture case in the Maryland and New York hospital discharge data sets.

Average cost of hospital admission. The estimated regression equation for a hospital-admitted scapula fracture (in 1994 dollars) is:

Cost = \$2,038.60 + (\$740.40 × Length of Stay)

In this equation, the dollar amounts are the coefficients estimated by the regression. Given the mean length of stay of 3.36 days for a woman 20–54 years old, the estimated cost is \$4,526.

Readmissions. The average scapula fracture results in 1.072 hospital admissions. Multiplying 1.072 by the \$4,526 cost per admission yields total hospital costs of \$4,852.

Additional short-term costs. Estimated pre-hospital and short-term post-discharge costs for a hospitalized injury are 11.8% of \$4,852, or \$573. Total short-term care costs equal \$5,425 (\$4,852 + \$573). (These costs include ambulance transportation, follow-up care, prescriptions, and ancillary goods.)

Lifetime medical costs. DCI data show short-term costs are 69.11% of the total medical costs of a hospital-admitted fractured scapula. Dividing \$5,425 by 69.11%, we estimate total medical costs for a 40-year-old woman admitted with a scapula fractured in a consumer-product incident will be \$7,850.

Claims processing costs. For a fractured scapula, NHDS suggests claims processing costs will average 5.57% of total medical payments. Multiplying 5.57% by \$7,850, estimated claims processing costs are \$437. Total estimated health care costs for the fracture equal \$8,287 (\$7,850 + \$437).

Medical Costs for Non-Admitted Cases

Average cost per visit. For a scapula injury, CHAMPUS reports payments per non-admitted medical visit average $184 (in 1995 dollars).

Separating costs for ED and Non-ED Cases. For scapula fractures originating in the ED, payments per visit, including follow-up visits to other treatment settings, average $130. Payments per visit for cases originating in doctor's offices or walk-in clinics average $335. (This pattern is atypical. For most non-admitted injuries, the costs per visit are higher for cases originating in the ED.)

Average costs per case. ED-treated scapula fractures average 3.68 visits per case; doctor's office cases average 2.02 visits. That means ED-treated cases have average CHAMPUS-based costs of $478 (3.68 × $130) and doctor's office cases have average costs of $677 (2.02 × $335).

Additional short-term costs. Ambulance, prescription, and ancillary costs average $11 for ED-treated scapula/clavicle cases, yielding short-term costs of $489 per case ($478 + $11). Doctor's offices cases in the NMES data incurred no costs in these categories, so the short-term cost averages $677.

Lifetime medical costs. DCI data show short-term costs are 85.29% of the total medical costs of a non-admitted fractured scapula. Dividing $489 by 85.29%, we estimate medical costs for a fractured scapula victim who is treated in the ED and released total $573. Similarly, costs average $793 for a victim treated only in a doctor's office or clinic.

Claims processing costs. For an ED-treated-and-released fractured scapula, NHAMCS suggests claims processing costs will average 6.74% of total medical payments. Multiplying 6.74% by $573, estimated claims processing costs are $39. Total estimated health care costs for the fracture equal $612 ($573 + $39). NAMCS suggests claims processing costs for the fracture treated in the doctor's office will average 7.28% or $58. Total costs equal $851 ($793 + $58).

Short-Term Work Loss Costs

Probability of short-term work loss. For all hospital-admitted cases, the probability of losing work is 100%. For non-admitted cases, the probability of losing work after fracturing a shoulder is 36.7%, according to results of regression analysis of the NHIS data.

Duration of short-term wage work loss. Our analysis of the BLS annual survey data (summarized in Tables 13 and 14) reveals that the mean duration of wage-work loss from a lost-work shoulder fracture is 61.8 days. For this injury, the work-loss duration does not vary by sex, but for someone of age 35–54 it is 6% higher than the overall mean. Therefore, the mean work-loss duration for a woman age 35–54 is 65.5 days.

Of medically treated shoulder fractures, 3.65% are hospital-admitted. Recall that 36.7% of non-admitted cases result in work loss (p=.367). That means the percentage of **all** medically treated shoulder fracture victims who incur work losses is

$.0365 + [(1 - .0365) \times .367] = .390$

Estimated mean duration of work loss per non-admitted victim age 35–54 with work loss (T^*_n, as defined on page 68) is

$(.390 \times 65.5 \text{ days}) / [(3 \times .0365) + (.9635 \times .367)] = 55.2$ days

The average work loss duration for admitted cases is 3 times as long, or 165.5 days.

Duration of short-term household work loss. If the woman's fractured shoulder results in work loss, it is expected to cause 223.7 days of household work loss (165.5 × .9 × 365/243) if hospital-admitted and 74.6 days of household work loss (55.2 × .9 × 365/243) if non-admitted.

Cost of short-term work loss. The estimated cost of short-term work loss for a 40-year-old woman with a hospital-admitted shoulder fracture will be $17,215 (165.5 days × $104.02/day) in wage work plus $7,469 (223.7 days × $33.39/day) in household work. For a non-admitted case of the same injury, her estimated work loss cost would be $2,107 (36.7% probability of work loss × 55.2 days × $104.02/day) in wage work and $914 (36.7% probability of work loss × 74.6 days × $33.39/day) in household work.

Other Work-Loss Costs

Permanent disability. A hospital-admitted fractured-shoulder victim has a 1.25% probability of total permanent disability ($d_{t,h}$) and a 23.82% probability of partial permanent disability ($d_{p,h}$). The corresponding probabilities for a non-admitted victim who misses at least four days of work are 0.00% and 2.33%. The probability that a non-admitted case results in work loss (p) is 36.7% and the probability that such a work loss lasts at least four days is 77.8%. We conservatively assume that any worker injured severely enough to be permanently disabled will miss at least four days of work. Therefore, the probabilities of permanent disability for a non-admitted victim are $d_{p,n} = .000 \times .367 \times .778 = .000$ and $d_{t,h} = .0233 \times .367 \times .778 = .00665$. A partially permanently disabled shoulder-injury victim suffers an average 13.45% loss of earning capacity. From Table 15, the present value of expected lifetime work for a 40-year-old female is $662,851 in 1994 dollars, or $680,026 inflated to 1995 dollars. The value of expected long-term work loss for an admitted injury is $680,026 × [(.0125 + (.1345 × .2382)] = $30,287. For a non-admitted injury, the losses amount to $680,026 × [(.0000 + (.1345 × .00665)] = $608.

Work loss of family and friends. A hospital-admitted shoulder-fracture victim averages 4.2 days per admission. Thus, each such case results in an average of 4.2 hospital days and an additional 4.2 post-discharge bed days, for a total of 8.4 bed days. Visitor costs are estimated at $163 ($12 + $18 × 8.4). For a non-admitted case, family cost includes only transportation time at $12.

Employer costs. The cost of an injury to employers depends on the victim's employment status, admission status, whether the victim loses work, and whether the victim is permanently disabled. The costs of the various scenarios, explained on page 65, will be used below without further explanation. For a 40-year-old female, the probability of being employed is 74.5%, and the probability of not being employed is 25.5%. If she fractures her shoulder, she has a 100% probability of losing work if hospital-admitted and 36.7% if non-admitted. Using the probabilities of permanent partial and permanent total disability that we estimated under victim long-term disability, the probability of permanent disability is 25.07% (23.82% + 1.25%) for a hospital-admitted injury and 0.665% (0.665% + 0.00%) for a non-admitted injury.

For a hospital-admitted injury, three scenarios are possible: employed victim permanently disabled ($11,138), employed victim not permanently disabled ($1,342), and unemployed victim ($268). The expected employer cost of a 40-year-old woman's hospital-admitted shoulder fracture is the sum of these three values times their respective probabilities:

$$\{.745 \times [(.2507 \times \$11{,}138) + ((1 - .2507) \times \$1{,}342)]\} + (.255 \times \$268) = \$2{,}898$$

For a non-admitted injury, there are four scenarios: employed victim permanently disabled ($11,138), employed victim with temporary work loss ($403), employed victim with no work loss ($34), and unemployed victim ($268). The expected employer cost of a 40-year-old woman's non-admitted shoulder fracture is the sum of these four values times their respective probabilities:

$$\{.745 \times [(.00665 \times \$11{,}138) + ((.367 - .00665) \times \$403) + ((1 - .367) \times \$34)]\} + (.255 \times \$268) = \$248$$

Total cost of work loss. Total work loss is the sum of its four components: short-term work loss, long-term work loss, work loss of family/friends, and employer costs. For the 40-year old female shoulder injury victim, this loss is:

$24,684 + $30,287 + $142 + $2,898 = $58,011	(if admitted)
$3,021 + $608 + $12 + $243 = $3,884	(if non-admitted)

Pain and Suffering Costs

Jury verdict approach. Pain and suffering was estimated with the regression equation in Table 20 and the estimated costs of a fractured shoulder for a woman of age 35–54. The equation was evaluated at the mean employment rate for women in their early 40s, 74.5%. The medical losses inserted in the equation excluded claims processing costs, and the work losses were confined to losses that juries compensate – victim wage, household production, and fringe benefit losses. The types of liability (premises, product, auto) were evaluated at their mean values in the sample data. The estimate was for a trunk injury without legislatively imposed damage caps and with only an individual defendant (to control for the suspected tendency of sympathetic juries to pad an award when a defendant has deep pockets). We estimated pain and suffering for victims who were permanently disabled by the shoulder fracture and victims who were not. We then multiplied these two estimates by the probabilities of disability and no disability, respectively, and summed them to get the revised ICM's pain and suffering estimates.[57] These pain and suffering calculations were performed separately for admitted, non-admitted ED, and other non-admitted cases.

Estimated pain and suffering costs are $60,057 for the hospital-admitted case without permanent disability and $124,356 for the permanently disabling case. With the 25.07% permanent disability probability for an admitted shoulder fracture, the mean value of pain and suffering is $76,176 ($60,057 × .7493 + $124,356 × .2507). Similar computations yield pain and suffering estimates of $17,740 for the victim treated in the ED and released, and $18,233 for the victim treated only at a doctor's office or clinic.

QALY approach. Exclusive of the permanent disability factor, Pindus et al. (1991) estimate the QALY losses for an admitted case are 3.23% of annual utility in year 1 and 0.06% thereafter. Recall that the hospital-admitted fractured shoulder victim has a 1.25% probability of total permanent disability and a 23.82% probability of partial permanent disability, and in the latter case will suffer a 13.45% reduction in earning capacity. Adding permanent disability, the losses are 4.65% in the first year:

$$1 - (1 - .0323) \times [1 - .33 \times (.0125 + .2382 \times .1345)] = .0465$$

and 1.53% thereafter:

$$1 - (1 - .0006) \times [1 - .33 \times (.0125 + .2382 \times .1345)] = .0153$$

(These calculations use the formula on pp. 84–85.) The present value of average future lifespan for a woman age 40 is 24.22 years. Therefore, lifetime losses for the hospital-admitted shoulder fracture are 0.402 quality-adjusted life years:

$$.0465 \times 1 \text{ year} + .0153 \times 23.22 \text{ years} = .402 \text{ years}$$

The permanent disability probabilities for a non-admitted victim are 0.00% and 2.33%. The QALY losses for the non-admitted fracture are 2.09% in the first year and nothing thereafter without the permanent disability factor. With permanent disability, they are 2.19% in the first year:

$$1 - (1 - .0209) \times [1 - .33 \times (.0000 + .0233 \times .1345)] = .0219$$

and 0.103% thereafter:

$$1 - (1 - .0000) \times [1 - .33 \times (.0000 + .0233 \times .1345)] = .00103$$

with the permanent disability factor. Lifetime losses are 0.046 QALYs:

$$.0219 \times 1 \text{ year} + .00103 \times 23.22 \text{ years} = .046 \text{ years}$$

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[57] This two-stage computation is necessary because the regression variable is the natural logarithm of past and future losses, which is non-linear. Since medical and work losses vary widely between the permanently disabled group and the group that will fully recover, the mean pain and suffering cannot be estimated accurately by evaluating the regression equation with the mean medical and work losses across victims in the two disability groups.

APPENDIX B: Additional Injury Diagnoses

TABLE B1. ICD-9-CM Diagnoses Outside 800–994 Range That Are Always Acute Injuries When E-Coded

ICD Diagnosis	Description
294.0	Amnestic syndrome
310.2	Postconcussion syndrome
366.2	Traumatic cataract
507.1	Pneumonitis due to inhalation of oils and essences
508.0	Acute pulmonary manifestations due to radiation
521.2	Abrasion of teeth
525.1	Loss of teeth
692–693	Dermatitis and other eczema
719.0	Effusion of joint
719.5	Stiffness of joint
722.0–722.2	Displacement of intervertebral disc
724.2–724.8	Other and unspecified disorders of back
726.1	Rotator cuff syndrome of shoulder, related disorders
780.0	Coma and stupor
799.0	Asphyxia
V71.3–V71.4	Observation following accident
V71.5–V71.6 *	Observation following alleged rape, seduction, or other inflicted injury

* Omitted from CPSC study – not consumer product-related.

TABLE B2. ICD-9-CM Diagnoses Outside 800–994 Range That Are Sometimes Acute Injuries When E-Coded

ICD Diagnosis	Description
344	Paralytic syndromes (incl. quadriplegia, paraplegia, diplegia, monoplegia)
348.1	Anoxic brain damage
349.0	Reaction to spinal or lumbar puncture
354–355 *	Mononeuritis (incl. carpal tunnel syndrome)
361	Retinal detachments and defects
363.6	Choroidal hemorrhage and rupture
363.7	Choroidal detachment
369	Blindness and low vision
384.2	Perforation of tympanic membrane
385.83	Retained foreign body of middle ear
388.1	Noise effects on inner ear
428.1 †	Left heart failure
430	Subarachnoid hemorrhage
431	Intracerebral hemorrhage
432	Other and unspecified intracranial hemorrhage
459.0	Hemorrhage, unspecified
470	Deviated nasal septum
500–505 *	Pneumoconioses
506	Respiratory conditions due to chemical fumes and vapors
507	Pneumonitis due to solids and liquids
508	Respiratory conditions due to other and unspecified external agents
514 †	Pulmonary congestion and hypostasis
525.1	Loss of teeth due to accident, extraction, or local periodontal disease
578	Gastrointestinal hemorrhage
608.2	Torsion of testis
634	Spontaneous abortion
640	Hemorrhage in early pregnancy
641	Antepartum hemorrhage, abruptio placentae, and placenta previa
644	Early or threatened labor
646.8–646.9	Other or unspecified complication of pregnancy
648.9	Other conditions complicating pregnancy, childbirth, or puerperium
656.7	Other placental conditions
661	Abnormality of forces of labor
681–682	Cellulitis and abscess
717	Derangement of knee
718	Derangement of other joint
719.4	Pain in joint
724.1	Pain in thoracic spine
728.9	Unspecified disorder of muscle, ligament, fascia
729.5	Pain in limb
729.6	Residual foreign body in soft tissue
733.1 *	Pathological fracture
733.8	Malunion and nonunion of fracture
781.4	Transient paralysis of limb
784.7	Epistaxis
786.50	Unspecified chest pain
789.0	Abdominal pain
995.2	Unspecified adverse effect of drug, medicinal and biological substance, NEC

* Omitted from CPSC study – not consumer product-related.
† Only if fire-related.

APPENDIX C: Updating the ICM's Inflators

All data needed for updating the inflators used in the ICM can be found in the *Economic Report of the President*, published annually by the U.S. Government Printing Office, usually in February.

The medical inflator is computed from 1) medical care expenditures, the final column in TABLE B-14.—*Personal consumption expenditures, 1959-99*, and 2) U.S. population, the final column in TABLE B-29.—*Total and per capita disposable personal income and personal consumption expenditures in current and real dollars, 1959-99.* (The table numbers may change slightly from one year to the next. The table numbers shown are for 2000. In 1999, these tables were numbered 16 and 31, respectively.) The former figure is divided by the latter to obtain our inflator, medical expenditures per capita. Table C1 shows both of the input series and the resulting inflator series.

For inflating work loss and pain and suffering costs, the ICM uses the total private total compensation index, the first column in TABLE B-46.—*Employment cost index, private industry, 1980-99.* The CPI-All Items was used to inflate some series to 1995 dollars for use in the ICM when neither the medical nor the compensation index seemed appropriate, but these calculations all took place at preliminary stages. The CPI is not used in annual updates of the ICM's inflators. For reference, the CPI-All Items is the first column in TABLE B-58.—*Consumer price indexes for major expenditure classes, 1958-99.* Both the compensation index and the CPI are shown in Table 1 in Chapter 3.

Preliminary figures for the most recent year are sometimes given in the *Economic Report of the President*, but these should not be used, as they are subject to substantial revision. As of the date of publication of this report, the 1998 inflators were in use.

The medical and compensation inflators appear in two places in the program, CPSCTOTL.SAS, which creates the final look-up tables - once in the DATA step for non-admitted cases, and again in the DATA step for hospital-admitted cases. The inflators must be changed in both places when they are to be updated.

Table C1. Computation of Medical Cost Inflator

	Medical Care Expenditures (*billions*)	Population (*thousands*)	Medical Care Expenditures per Capita
1980	$181.2	227,726	$ 796
1981	$213.0	230,008	$ 926
1982	$239.3	232,218	$1,030
1983	$267.9	234,332	$1,143
1984	$294.6	236,394	$1,246
1985	$322.5	238,506	$1,352
1986	$346.8	240,682	$1,441
1987	$381.8	242,842	$1,572
1988	$429.9	245,061	$1,754
1989	$479.2	247,387	$1,937
1990	$540.6	249,981	$2,163
1991	$591.0	252,677	$2,339
1992	$652.6	255,403	$2,555
1993	$700.6	258,107	$2,714
1994	$737.3	260,616	$2,829
1995	$780.7	263,073	$2,968
1996	$814.4	265,504	$3,067
1997	$850.2	268,046	$3,172
1998	$894.3	270,595	$3,305
1999*	$941.3	273,161	$3,446

*Preliminary.

APPENDIX D: Tracing the Impacts of Hypothetical Data Changes

In the two following examples, hypothetical data changes are introduced, and their impacts are traced through the rest of the ICM.

Example #1. For a hospital-admitted four-year-old male victim of a concussion (ICD-9 850, NEISS 52 75), the average length of stay is reduced from 2.83 days to 2.50 days.

A change in the average length of a hospital stay will affect **medical** costs directly, and **pain and suffering** and **legal/liability** costs indirectly. The only **work loss** costs affected are costs to family and friends.

In the ICM, the base length of stay estimates come from NHDS 1987–1992, by ICD-9 diagnosis group. Average length of stay (AvgLoS) varies across the five concussion diagnosis groups (DXG in the table below), but the overall average is 2.83. The five-state (CA, MD, NY, VT, WA) hospital discharge dataset is used to estimate regression-based adjustments to length of stay for the age and sex of the victim and whether the injury was consumer-product-related. (The latter adjustment relies on E-codes for identification of consumer product injuries, and thus could not be estimated from NHDS, which was not E-coded.) For concussion, as for most diagnoses, all three of these factors - male, under 20, and consumer product - affect length of stay negatively. Combined, they reduce the average length of stay to 1.93 (shown below in the EstLoS column, but not actually stored as a variable in any dataset of the ICM). (These methods are described on pp. 40-41 of this report.)

For each diagnosis group, the estimated cost of a hospital *visit* (YngMal) is calculated as FIXCOST + (EstLoS × DAYCOST). (FIXCOST and DAYCOST come from regressions on Maryland and New York hospital costs. This method is described on pp. 41-43 of this report.) YngMal is factored up by (1 + READMRAT) to get the estimated hospital treatment cost per *case* (YngMalC), which is multiplied by AVGADM to get the claims administration cost, YngMalA.

All of these costs are then averaged across the five detailed diagnosis groups, using the five-state case counts (COUNT) as weights, and the results appear under diagnosis 850 in MEDICAL\HOSP\NEISCOST.SD2.[58] The total hospital cost (YngMalC+YngMalA=$3,100.97), is then divided by the share of costs that occur in the first six months (PCT6MO2=0.74819), to get the lifetime medical cost (YngMal=$4,144.62). The nonadministrative portion of this cost (YngMalNA=$3,885) is found by subtracting the long-term claims administration cost (YngMalA/PCT6MO2=$259) from YngMal. These costs are then mapped from ICD-9 (diagnosis 850) to NEISS (diagnosis 52 75).

[58]The file extension .SD2 is associated with SAS datasets. The other file extension that appears in this appendix, .SAS, is associated with SAS programs.

dxq	Count	AvgLoS	FixCost	DayCost	YngMal	ReadmRat	YngMalC	AvgAdm	YngMalA	EstLoS
850.0	2191	2.6404	999.60	634.97	2141.48	0.05813	2533.68	0.0617	156.34	1.79832
850.1	2415	2.6293	1683.32	484.97	2551.79	0.03922	2965.18	0.0701	207.80	1.79078
850.2-4	87	7.5049	3211.99	728.16	6933.99	0.04231	8081.26	0.0858	693.00	5.11152
850.5	565	3.5493	218.62	1113.46	2910.27	0.10058	3581.41	0.0653	233.91	2.41738
850.9	691	2.9591	747.30	679.97	2117.71	0.13327	2683.48	0.0635	170.48	2.01540
850	**5949**	**2.8303**			**2448.39**		**2906.88**		**194.09**	**1.92772**

To initiate the proposed decrease in length of stay, we reduced the length of stay for all five concussion diagnosis groups by 11.67%, across the board. The weighted average length of stay fell from 2.83 days to 2.50 days. The calculations of the above table were repeated with the reduced lengths of stay. The results:

- Average adjusted length of stay (AVGLOS) fell from 1.93 days to 1.70.
- Average hospital cost (YngMal) fell from $2,448 to $2,303.
- Average short-term medical cost (excluding claims processing costs) (YngMalC) fell from $2,907 to $2,733.
- Average claims processing (YngMalA) cost fell from $259 to $244.
- Average lifetime medical costs (excluding claims processing costs) (YngMalNA in the dataset MEDICAL\HOSP\NEISCOST.SD2) fell from $3,885 to $3,653.
- Average total medical cost (YngMal in the dataset MEDICAL\HOSP\NEISCOST.SD2) fell from $4,145 to $3,897.

When medical cost excluding claims administration cost (YngMalNA) drops from $3,885 to $3,653, the estimated average pain and suffering cost also drops. The programs PAINSUFF\HOSP.SAS and PAINSUFF\HOSPPERM.SAS are run, substituting the new YngMalNA for the old. The latter program estimates pain and suffering costs for permanently disabled victims, while the former program covers non-disabled victims. In HOSP, the pain and suffering cost (Mal04HOP) drops from $62,105.02 to $61,302.71, while in HOSPPERM, the pain and suffering cost (Mal04HPP) drops from $388,386 to $388,244.

The work loss of family and friends of a hospital-admitted patient also depends directly on the length of the hospital stay (see p. 63). There is a fixed cost of $12 for transport to the hospital, plus an additional $18 for each bed day. It is assumed that a patient's total bed days are twice the length of the average hospital stay for the diagnosis. Therefore, a decrease in average length of stay from 2.83 days to 2.50 days reduces the estimated work loss of family and friends from $113.88 to $102.00. This change has no impact on pain and suffering costs, which depend on *victim* work loss, but not on work loss of family and friends.

All of the medical, work loss, and pain and suffering costs enter the final calculations in TOTAL\CPSCTOTL.SAS (including calculation of the legal/liability costs). Similar calculations are carried through to the end in the next example.

Example #2. For a non-admitted 40-year-old female victim of a shoulder fracture (NEISS 57 30), the estimated probability of permanent partial disability, given at least four days of work loss, is raised from .0233 to .0350.

A change in the probability of disability directly affects **work loss** costs and indirectly affects **pain and suffering** and **legal/liability** costs, which depend on work loss. **Medical** costs are unaffected. Within the work loss category, a change in disability probability will affect long-term work loss and costs to the victim's employer, but *not* short-term work loss or costs to the victim's family.

The initial part of the long-term work loss calculations take place in the program LTWLNONH.SAS, which CPSC does not have. The main calculation is identical to the non-admitted part of the example on pp. 59-61 of this report. Note that, in this example, the probability of permanent complete disability (called COMPPCT in the program) is 0, and the probability of permanent partial disability (PARTPCT) is .0233. Since these probabilities are based on cases with at least four days of work loss, they are multiplied by the probability that a non-admitted case results in work loss (PCTWKLOS=.367) and the probability that such work loss lasts at least four days (PCT4DAY×PCTNONH4/PCTNONHW=.778). This program creates two SAS datasets that feed into programs further down the run stream:

- LTDANONH.SD2 contains long-term work-loss costs averaged across *all* non-admitted cases, including Fem44NCD (disability cost for non-admitted females 40-44 years old). This dataset feeds into the program NONPAIN\NONH.SAS, which collects medical and work-loss cost estimates before feeding them into TOTAL\CPSCTOTL.SAS.

- LTDVNONH.SD2 contains average long-term work-loss costs *for cases with permanent disability*. The dataset includes the variable LTDFem44 (long-term disability cost for non-admitted females 40-44). This dataset is used by PAINSUFF\NEDPERM.SAS and PAINSUFF\EDPERM.SAS, programs that calculate pain and suffering costs for patients with permanent disability treated in clinics/doctor's offices and EDs, respectively.

The numeric results of the increased probability of permanent partial disability are summarized in the following table:

Program	Variable	Actual Value	Hypoth Value
LTWLNONH.SAS	PartPct	0.0233	0.035
	CompPct	0	0
LTDANONH.SAS	Fem44NCD	769.80	1,154.70
LTDVNONH.SAS	LTDFem44	115,604.43	115,604.43
NEDPERM.SAS	Fem44DPP	105,629.44	105,629.44
EDPERM.SAS	Fem44EPP	105,537.84	105,537.84
NONHPAIN.SAS	Fem44DCP	18,310.24	18,602.91
	Fem44ECP	17,817.97	18,111.99

Note that Fem44NCD increases in proportion to the increase in PARTPCT, but LTDFem44 does not change at all. This results from the fact that COMPPCT is 0. Because *all* permanent disabilities resulting from this injury (non-admitted shoulder fracture) are partial, rather than complete, the higher probability of partial disability does not change the balance between partial and complete disability - 100% of disabilities are still partial. Therefore, the average cost of long-term work loss from a permanent disability, LTDFem44, does not change. As a result, the average pain and suffering costs associated with shoulder fractures, Fem44DPP and Fem44EPP, also remain the same. However, the average pain and suffering of *all* shoulder fracture victims (as opposed to the pain and suffering of *permanently disabled* shoulder fracture victims) increases somewhat because of the greater probability of disability, as we see in Fem44DCP and Fem44ECP (the average pain and suffering figures for females age 40-44 who are treated, respectively, in a doctor's office/clinic or in an ED).

The other type of cost affected by the change in disability probability is the cost to the victim's employer. This calculation occurs in NONPAIN\NONH.SAS, and it is similar to the calculations in the example on p. 65 of this report, where it appears as $248. It can be found as the variable FEM44NOE in the output dataset from NONPAIN\NONH.SAS, with a value of $247.53. Increasing the raw disability probability from .0233 to .035 raised the adjusted probability from .00666 to.00999 and FEM44NOE to $274.16.

The long-term work loss, employer costs, and pain and suffering all feed into the final program, TOTAL\CPSCTOTL.SAS, whose function is to inflate costs from 1995 to 1997 dollars and add everything up. It calculated the legal/liability costs, DOCLIAB and EMDLIAB, by multiplying the subtotal by a fixed ratio.

Variable	Actual Value	Hypoth Value	
nonhwdis	820.84	1,231.25	long-term work loss
nonhwrkv	4,040.54	4,450.95	victim work loss
nonhwemp	263.94	292.34	employer cost
nonhwrkt	**4,317.28**	**4,756.08**	**total work loss cost**
docpain	19,524.18	19,836.25	doctor/clinic pain
emdpain	18,999.28	19,312.78	ED pain
docsub	24,682.97	24,995.04	doc/clinic subtotal
docliab	80.97	81.99	doc/clinic legl/liab
doctotl	**24,763.94**	**25,077.04**	**doctor/clinic total**
emdsub	23,925.35	24,238.85	ED subtotal
emdliab	78.48	79.51	ED legal/liability
emdtotl	**24,003.83**	**24,318.37**	**ED total**

APPENDIX E: Estimated Medical Costs of Fatalities

Medical costs of unintentional fatalities were estimated by E-code and age group, according to the formula:

$$ftmedcst = pos \times dos + poa \times doa + ped \times ded + phosp \times dhosp + phome \times dhome + pnurs \times dnurs$$

where dos, doa, ded, dhosp, dhome, and dnurs denote the costs associated with six different places of death (on-scene, on-arrival, emergency department, hospital [admitted], home, and nursing home, respectively); and pos, poa, ped, phosp, phome, and pnurs denote relative shares of deaths that occurred at each place by E-code and age group.

Place-of-death shares for each E-code/age group were estimated from US Vital Statistics 1994, after deleting all cases with unknown place of death (2,410 out of 147,482 cases, or 1.63%). Vital Statistical identifies two other places of death, besides the six considered - "hospital - status unknown" and "other." "Hospital - status unknown" (0.4% of cases) was collapsed into "hospital (admitted)." "Other" (30% of cases) was collapsed into "dead-on-the-scene." This assumption seemed reasonable because 86% of "other" deaths were associated with traffic accidents.

Medical cost for the six places of death was estimated by summing the following components:

dos = coroner + funeral;
doa = coroner + funeral + transport + ed;
ded = coroner + funeral + transport + ed;
dhosp = coroner + funeral + transport + hospital;
dhome = coroner + funeral + transport;
dnurs = coroner + funeral + transport + hospital + nursing home;

The coroner and funeral components represent the difference in present value of burial and coroner costs in 1996 versus at the end of the victim's expected life span (from Miller, Pindus et al. 1995 and NHTSA 1983, respectively). Except for deaths at the scene, we added costs of emergency transport from 1987 NMES data. It was assumed that victims who died at home were not first treated at a medical facility. For deaths on arrival or in the emergency department, we added average charges for fatalities in the emergency department by external cause grouping from 1997 South Carolina emergency department discharge data, adjusted to US prices using the ACCRA medical care cost index (Bureau of the Census 1998). Deaths in hospital were costed using the same methods as other hospital admissions, but with no post-discharge costs. We assumed deaths in nursing home were preceded by hospital admissions of average cost and involved a one-month skilled nursing facility stay (double the cost of an intermediate care facility according to Bureau of the Census (1998), as discussed on p. 43 of this report).

Table E1. Fatal Unintentional Injuries: Medical Cost by Cause and Age (*1996 dollars*)

Cause	0-19	20-44	45-64	65+
Bite/Sting	8,531	13,330	9,887	16,787
Caught in/between Objects	8,515	5,976	6,810	13,423
Cut/Pierce	22,780	7,314	5,361	4,996
Drowning/Submersion	7,349	5,921	4,450	3,517
Fall	9,639	12,283	17,808	20,714
Burn/Anoxia	8,830	15,930	24,893	26,075
Firearm	7,172	5,954	4,510	3,331
Motor Vehicle	8,512	13,638	19,631	15,390
Pedestrian - MV Traffic	8,510	13,636	19,626	15,386
Pedalcycle - MV Traffic	8,505	13,628	19,598	15,287
Pedalcycle - Other	8,504	13,626	19,593	15,260
Other Vehicles	7,186	8,641	8,535	12,077
Machinery	8,504	12,624	3,955	4,032
Natural/Environmental	8,510	13,633	19,614	15,388
Overexertion	8,517	13,619	9,859	9,715
Poisoning	9,773	6,476	6,875	12,643
Struck by/against	9,754	9,364	8,584	9,269
Suffocation/Choking	6,524	6,725	6,054	18,683
Other	8,504	13,623	19,591	15,368
Unknown	9,296	12,403	19,301	25,006