- For lost-housework-day injury of a person who is not employed, 2 days (due to the caregiver's absence from work, which forces the caregiver's supervisor to adjust schedules and distracts other employees from their tasks).[37]

Miller and Galbraith estimate that the value of the mix of supervisory and non-supervisory wages and fringe benefits per lost supervisor/co-worker day (M) is $130.80 (in 1994 dollars); inflating to 1995 dollars gives us $134.19. Under the above assumptions for number of days lost under various injury scenarios, we can calculate order-of-magnitude estimates of total costs (C) for each of the following five scenarios:

- Employed, permanently disabled, admitted or non-admitted: $C_1 = 83 \times M = \$11{,}138$
- Employed, *not* permanently disabled, hospital-admitted: $C_2 = 10 \times M = \$1{,}342$
- Employed, temporary work loss, non-admitted: $C_3 = 3 \times M = \$403$
- Employed, no work loss, non-admitted: $C_4 = 0.25 \times M = \$34$
- Not employed: $C_5 = 2 \times M = \$268$

To determine the employer costs (EM) for any victim, whether hospital-admitted (EM_h) or non-admitted (EM_n), we require the probabilities of occurrence of each of the above five scenarios (v_1, v_2, v_3, v_4, v_5).

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:

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

where the v multipliers are:

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

[37] Given that some of these unemployed injury victims who are presumed to require caregivers might be adults, this assumption creates a middle ground when combined with our assumption that family and friends incur caregiver costs only for victims up to 14 years old.

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.

$$d_h = d_{p,h} + d_{t,h} = .2382 + .0125 = .2507$$
$$d_n = d_{p,n} + d_{t,n} = .0233 + .0000 = .0233$$

$$v_{1,h} = .745 \times .2507 = .1868$$
$$v_{1,n} = .745 \times .0233 = .0174$$
$$v_2 = .745 \times (1 - .2507) = .5582$$
$$v_3 = .745 \times (.367 - .0233) = .2561$$
$$v_4 = .745 \times (1 - .367) = .4716$$
$$v_5 = .255$$

$$EM_h = (.1868 \times \$10,856) + (.5582 \times \$1,308) + (.255 \times \$262) = \$2,825$$

$$EM_n = (.0174 \times \$10,856) + (.2561 \times \$392) + (.4716 \times \$34) + (.255 \times \$262) = \$372$$

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:

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

$$WL_h = \$24,684 + \$36,037 + \$142 + \$2,825 = \$63,688 \quad \text{(if admitted)}$$

$$WL_n = \$3,021 + \$770 + \$12 + \$372 = \$4,175 \quad \text{(if non-admitted)}$$

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:

$VS_h = [(T^*_h \times w^*) + (T'_h \times w')]$ (for hospital-admitted victims)
$VS_n = p \times [(T^*_n \times w^*) + (T'_n \times w')]$ (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:

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

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
- f = percent lifetime earnings loss by victims with long-term partial disability = .17

Estimation of family/friend work loss:

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

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,

$$FF = \$12 + (\$18 \times B)$$

Estimation of employer costs from victim work loss:

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

$$EM_n = e \times [(d_n \times C_{pd}) + ((p - d_n) \times C_{td,n}) + (1 - p) \times C_{nd}] + (1 - e) \times C_{cg}$$
(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 = \$10,856
- $C_{td,h}$ = cost of temporary disability = \$1,308
- $C_{td,n}$ = cost of temporary disability = \$391
- C_{nd} = cost if no work loss = \$33
- C_{cg} = cost for caregiver work loss effect = \$262

Table 10. 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 11. 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 12. 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 13. 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).

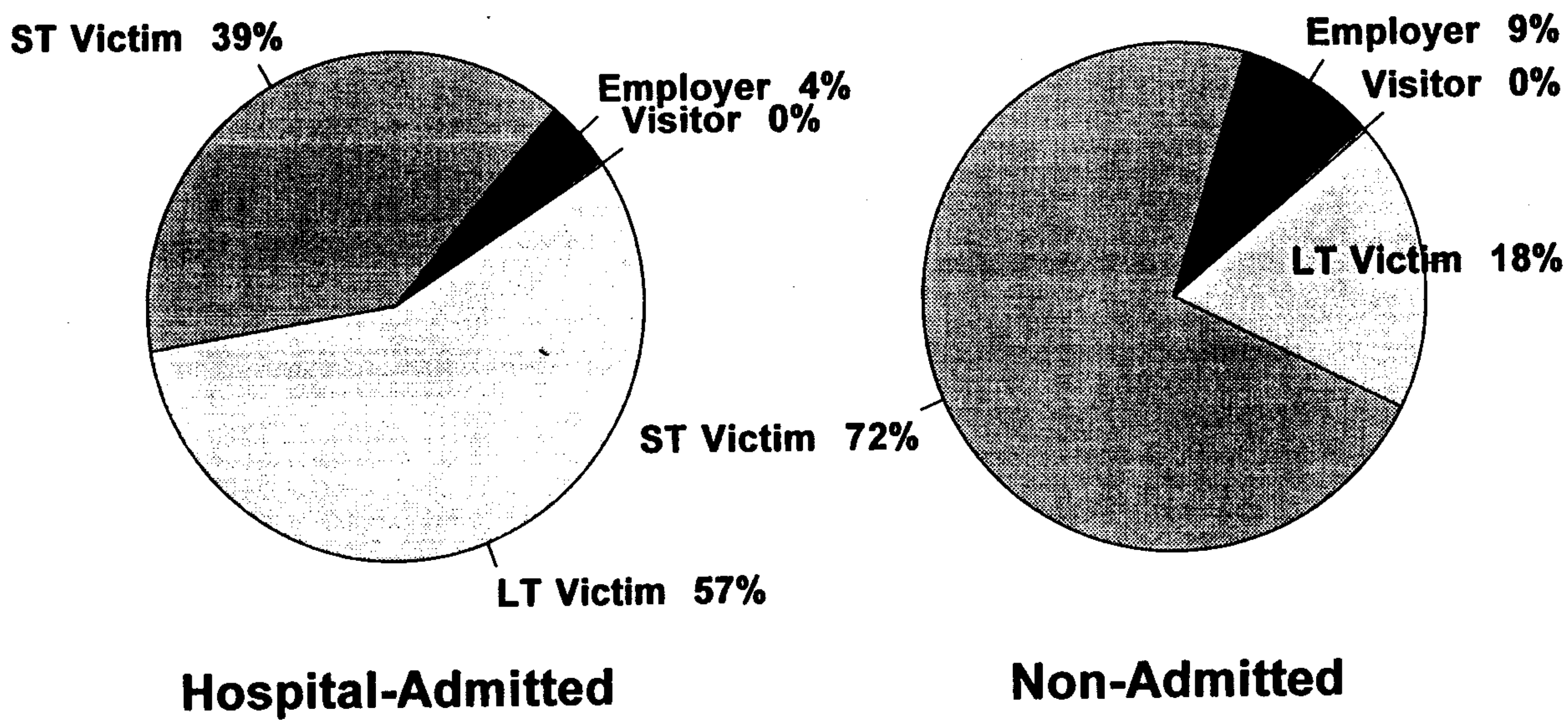
Table 14. Total of Short-Term and Long-Term Victim Work-Loss* Costs per Consumer-Product Injury Survivor by Victim's Admission Status and Nature of Injury or Body Part Injured (in 1995 dollars)

NEISS Injury Diagnosis	Non-Admitted	Hospital-Admitted
41 Ingested Foreign Object	351	15,322
42 Aspirated Foreign Object	278	20,340
46 Burns, electrical	2,789	36,672
47 Burns, not specified	2,402	41,773
48 Burns, scald	1,054	32,308
49 Burns, chemical	822	27,718
50 Amputation	16,202	89,619
51 Burns, thermal	1,339	28,801
52 Concussions	1,273	34,309
53 Contusions, Abrasions	450	14,654
54 Crushing	2,111	44,519
55 Dislocation	2,555	45,513
56 Foreign Body	212	29,332
57 Fracture	3,094	30,538
58 Hematoma	613	20,563
59 Laceration	416	30,270
60 Dental Injury	1,388	10,973
61 Nerve Damage	3,016	78,659
62 Internal Organ Injury	1,842	61,265
63 Puncture	313	45,598
64 Strain or Sprain	1,519	29,100
65 Anoxia	215	175,176
66 Hemorrhage	868	25,242
67 Electric Shock	438	54,805
68 Poisoning	528	10,897
69 Submersion	169	225,261
70 Not Stated	1,599	42,611
71 Other	1,250	24,147
72 Avulsion	1,123	37,636
73 Burns, radiation	1,448	20,872
74 Dermatitis, Conjunctivitis	397	4,487
AVERAGE	1,149	33,526

NEISS Body Part	Non-Admitted	Hospital-Admitted
00 Internal	349	15,650
30 Shoulder	1,979	29,535
31 Upper Trunk	1,409	22,429
32 Elbow	1,246	51,514
33 Lower Arm	2,179	57,616
34 Wrist	1,527	53,072
35 Knee	1,429	38,762
36 Lower Leg	1,665	53,508
37 Ankle	1,310	46,049
38 Pubic Region	1,048	32,782
75 Head	729	44,921
76 Face	464	21,294
77 Eyeball	447	44,011
79 Lower Trunk	1,795	13,636
80 Upper Arm	2,204	34,368
81 Upper Leg	1,131	31,488
82 Hand	790	37,714
83 Foot	1,289	39,118
84 25-50% of Body	810	42,643
85 All Parts of Body	565	57,107
87 Not Stated	1,444	20,990
88 Mouth	729	24,588
89 Neck	1,978	50,135
92 Finger	960	59,230
93 Toe	1,224	71,274
94 Ear	730	31,928
AVERAGE	1,149	33,526

* 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.[38] 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).[39] All cases involving consumer products were collected -- even if the product's manufacturer was not subject to litigation. As shown in Table 15, we sampled 1,986 JVR cases that matched the above criteria. Of these cases, 828 involved a specified

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[38] 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.

[39] 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.

consumer product. The 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),[40] hand tools (83), elevators (62), mopeds (46),[41] ladders (42), furniture (39), lawn mowers (33), beverage containers (32), and all-terrain vehicles (ATVs) (28). Additional product categories contained 10 or fewer cases.[42]

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.[43] 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%,[44] while the unemployed, retired, students or homemakers represented 15% of the total.

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[40] 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.

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

[42] 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.

[43] 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.

[44] 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.

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).

Table 16 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 16 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.[45] 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 16 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).[46]

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 primarily estimates reported by the plaintiff for purposes of litigation, they may be overestimated. To the extent that losses reported by JVR are overestimates of the actual out-of-pocket losses, the pain and suffering estimates are likely

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

[46] 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.

to be underestimates. Furthermore, if plaintiffs overstate losses, jurors might discount these claims when awarding damages.[47]

Table 17 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),[48] exercise equipment ($234,000), automatic doors ($233,000), escalators ($159,000), and large kitchen appliances ($110,000).

Since mean awards may be skewed by the presence of 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 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 50% or less of the overall median: heaters ($58,000), bicycles ($50,000),[49] and mopeds ($54,000).

In addition to those listed in Table 17, 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

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

[48] 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).

[49] 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).

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.

The natural logarithm of pain and suffering was estimated using a log-linear regression model.[50] Table 18 reports the regression results.[51] In addition to the demographic, product-specific, and injury-specific variables, Table 18 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.[52] Premises or auto liability cases reduce

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[50] 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.

[51] 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 (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.

[52] 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 17 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.

the pain and suffering award somewhat, perhaps because of differing views of the extent of plaintiff versus defendant negligence in cases like these.[53]

Table 18 can be used to estimate pain and suffering for any type of injury sustained as a result of a consumer-product-related incident. Table 19 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.[54]

Table 20 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 18 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

[53] 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 18 regression. In Table 18, we group past and future losses. Preliminary regressions that separated these losses yielded similar results.

[54] 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.

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, respectively, and summed them to get the revised ICM's pain and suffering estimates.[55] 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 $131,163 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 $77,883 ($60,057 × .7493 + $131,163 × .2507). Similar computations yield pain and suffering estimates of $17,818 for the victim treated in the ED and released, and $18,310 for the victim treated only at a doctor's office or clinic. By comparison, estimated medical and victim work-loss costs total $75,377 for the admitted case, $4,325 for the case treated in the ED and released, and $4,526 for the case treated only at a doctor's office or clinic. Thus, 53% of estimated costs for the hospital-admitted victim and 80% 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

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[55] 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.

built QALY estimates from the functional capacity loss ratings, then monetized them. Miller, Pindus et al. (1995) details the computations.

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).[56] 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

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

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 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[57], we use the formula

$$QALY_i = 1 - (1 - IISimp_i) \times (1 - .33 \times (Ptotperm + Pptperm \times .17))$$

where:

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

$IISimp_i$ is the 6-dimensional IIS-based QALY loss in time period i, 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

[57] 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

.17 is the average percentage of earning power lost to partial permanent disability according to Berkowitz and Burton (1987)

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 4.92% in year 1:

$$1 - (1 - .0323) \times [1 - .33 \times (.0125 + .2382 \times .17)] = .0492$$

and 1.8% per year thereafter:

$$1 - (1 - .0006) \times [1 - .33 \times (.0125 + .2382 \times .17)] = .0180$$

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 0.469 quality-adjusted life years:

$$.0492 \times 1 \text{ year} + .0180 \times 23.22 \text{ years} = .469 \text{ years}$$

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 3.37% in year 1:

$$1 - (1 - .0209) \times [1 - .33 \times (.0000 + .0233 \times .17)] = .0337$$

and 0.13% per year thereafter:

$$1 - (1 - .0000) \times [1 - .33 \times (.0000 + .0233 \times .17)] = .0013$$

Lifetime losses are 0.064 QALYs:

$$.0337 \times 1 \text{ year} + .0013 \times 23.22 \text{ years} = .064 \text{ years}$$

To put these losses in context, the admitted case costs 1.9% of lifetime utility (.469 / 24.22) and the non-admitted case costs 0.3% (.064 / 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 18, 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 15. 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 16. 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 17. 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 18. 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 19. 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 20. 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	5,920	6,765	34,485
42 Aspirated Foreign Object	7,386	8,515	146,342
46 Burns, electrical	24,844	26,092	127,450
47 Burns, not specified	20,318	22,542	139,528
48 Burns, scald	18,106	20,344	140,712
49 Burns, chemical	14,659	17,402	128,119
50 Amputation	67,481	79,368	279,385
51 Burns, thermal	17,417	19,368	138,682
52 Concussions	20,829	27,509	91,790
53 Contusions, Abrasions	2,229	2,613	13,549
54 Crushing	14,720	14,998	83,542
55 Dislocation	20,807	19,089	85,779
56 Foreign Body	1,926	2,453	14,556
57 Fracture	16,737	16,288	74,624
58 Hematoma	2,336	2,492	13,572
59 Laceration	5,800	7,142	38,280
60 Dental Injury	6,220	7,126	21,543
61 Nerve Damage	63,757	59,103	839,078
62 Internal Organ Injury	59,632	44,549	390,939
63 Puncture	4,694	6,276	42,151
64 Strain or Sprain	7,195	7,630	38,043
65 Anoxia	6,128	6,741	157,720
66 Hemorrhage	2,586	4,038	18,502
67 Electric Shock	7,311	7,847	51,121
68 Poisoning	6,433	8,516	32,095
69 Submersion	5,917	6,569	107,645
70 Not Stated	7,711	8,591	71,265
71 Other	7,121	8,132	61,735
72 Avulsion	18,651	23,620	104,167
73 Burns, radiation	20,288	22,714	119,180
74 Dermatitis, Conjunctivitis	1,893	2,098	12,363
AVERAGE	8,674	9,082	89,096

NEISS Body Part	Non-Admitted Doctor or Clinic	Non-Admitted Emergency Department	Hospital-Admitted
00 Internal	5,970	6,825	41,798
30 Shoulder	11,479	11,163	64,095
31 Upper Trunk	11,394	11,135	64,977
32 Elbow	7,701	8,061	67,228
33 Lower Arm	10,306	11,311	73,871
34 Wrist	9,417	9,828	90,836
35 Knee	7,265	7,352	59,448
36 Lower Leg	8,932	9,376	84,950
37 Ankle	7,560	8,081	73,139
38 Pubic Region	5,230	6,131	43,865
75 Head	18,609	16,285	211,305
76 Face	5,551	6,477	42,185
77 Eyeball	4,356	5,208	44,088
79 Lower Trunk	9,416	10,129	67,098
80 Upper Arm	11,044	11,304	65,755
81 Upper Leg	6,763	7,425	79,249
82 Hand	7,136	7,579	68,238
83 Foot	6,568	7,352	75,615
84 25-50% of Body	5,724	6,500	149,400
85 All Parts of Body	6,330	7,873	67,186
87 Not Stated	5,276	5,921	30,859
88 Mouth	6,807	8,258	36,005
89 Neck	9,824	10,819	98,024
92 Finger	7,114	8,274	118,334
93 Toe	6,795	7,764	156,582
94 Ear	4,279	5,061	37,490
AVERAGE	8,674	9,082	89,096

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 totalled $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 totalled $684 million and general underwriting expenses totalled $369 million. These costs are spread across a base of roughly $502 billion in what this chapter calls victim-related costs -- the sum of all wage, medical, and pain and suffering costs related to fatal[58] and non-fatal consumer product injury. They equate to 0.21% 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 $28 per product-related injury victim (averaged across the 34.5 million victims that the ICM estimates were medically treated in 1995).

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[58] 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 0.14% of the $502 billion in victim-related costs.[59] The costs average $19 per consumer product injury victim.

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

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. The cost for an admitted survivor with diagnosis 6480 equals the average cost for the corresponding ICD group. The medical cost for NEISS diagnosis 6430 for admitted males ages 20–54 is:

$$(4{,}755 \times \$8{,}677 + 346 \times \$8{,}627) / (4{,}755 + 346) = \$8{,}673$$

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 33.5 million medically treated, nonfatal consumer product injuries at $461 billion for 1995, with medical costs accounting for 9 percent of the costs, lost work for 15 percent, and pain and suffering for 76 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 injuries account for slightly more than one-third of total injuries, but about 45 percent of total costs. Non-ED injuries account for almost two-thirds of injuries, but only 55 percent of total costs. Costs for ED-treated injuries were, on average, 59 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 0.4 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 dose 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 = \$2038.60 + (\$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 11 and 12) 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) × .367] = .390

Estimated mean duration of work loss per non-admitted victim age 35–54 with work loss (T^*_n, as defined on page 66) is

(.390 × 65.5 days) / [(3 × .0365) + (.9635 × .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 and a 23.82% probability of partial permanent disability. The corresponding probabilities for a non-admitted victim are 0.00% and 2.33%. Total disability results in 100% earnings loss, while partial disability results in 17% earnings loss, on average. 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%. From Table 13, 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 + (.17 × .2382)] = $36,037

For the non-admitted injury, the losses would amount to

$680,026 × [(.0000 + (.17 × .0233)] × .367 × .778 = $770

Work loss of family and friends. A hospital-admitted female shoulder-fracture victim age 35-54 averages 3.36 days per admission and 1.072 lifetime admissions for this injury. Thus each such case results in an average of 3.6 hospital days and an additional 3.6 post-discharge bed days, for a total of 7.2 bed days. Visitor costs are estimated at $142 ($12 + ($18 × 7.2)). 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 63, 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 2.33% (2.33% + 0.00%) for a non-admitted injury.

For a hospital-admitted injury, three scenarios are possible: employed victim permanently disabled ($10,856), employed victim not permanently disabled ($1,308), and unemployed victim ($262). 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:

$$\{.745 \times [(.2507 \times \$10{,}856) + ((1 - .2507) \times \$1{,}308)]\} + (.255 \times \$262) = \$2{,}825$$

For a non-admitted injury, there are four scenarios: employed victim permanently disabled ($10,856), employed victim with temporary work loss ($403), employed victim with no work loss ($34), and unemployed victim ($262). 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:

$$\{.745 \times [(.0233 \times \$10{,}856) + ((.367 - .0233) \times \$392) + ((1 - .367) \times \$34)]\} + (.255 \times \$262) = \$372$$

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 + $36,037 + $142 + $2,825 = $63,688 (if admitted)
$3,021 + $770 + $12 + $372 = $4,175 (if non-admitted)

Pain and Suffering Costs

Jury verdict approach. Pain and suffering was estimated with the regression equation in Table 18 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.[60] 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 $131,163 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 $77,883 ($60,057 × .7493 + $131,163 × .2507). Similar computations yield pain and suffering estimates of $17,818 for the victim treated in the ED and released, and $18,310 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. Adding permanent disability, the losses are 4.92% in the first year:

$$1 - (1 - .0323) \times [1 - .33 \times (.0125 + .2382 \times .17)] = .0492$$

and 1.8% thereafter:

$$1 - (1 - .0006) \times [1 - .33 \times (.0125 + .2382 \times .17)] = .0180$$

(These calculations use the formula on pp. 83–84.) 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 0.469 quality-adjusted life years:

$$.0492 \times 1 \text{ year} + .018 \times 23.22 \text{ years} = .469 \text{ years}$$

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, theyare 3.37% in the first year:

$$1 - (1 - .0209) \times [1 - .33 \times (.0000 + .0233 \times .17)] = .0337$$

and 0.13% thereafter:

$$1 - (1 - .0000) \times [1 - .33 \times (.0000 + .0233 \times .17)] = .0013$$

with the permanent disability factor. Lifetime losses are 0.064 QALYs:

$$.0337 \times 1 \text{ year} + .0013 \times 23.22 \text{ years} = .064 \text{ years}$$

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[60] 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.