Chapter 2

Economic Cost of Injury

Injury, with its enormous death toll, high hospital costs, large number of nonhospitalized injured persons, and prevalence of long-term disabling conditions, imposes a multibillion dollar burden on the economy. The lifetime economic cost of injury to the nation is measured in this chapter in terms of the direct cost for medical treatment and rehabilitation of patients injured in 1985. Estimates also include life years lost and the indirect cost associated with loss of earnings due to short- and long-term disability and premature death from injury.

The method for estimating lifetime economic cost is based on the incidence data presented in Chapter 1. The estimated charge per person by type of expenditure is applied to the number of injured persons for the direct cost. Morbidity and mortality costs are based on the human capital method, which estimates a value for productivity lost or reduced due to injury. The calculation of morbidity cost involves applying average earnings to work years lost for the employed injured population and attaching a dollar value to housekeeping services for those unable to perform them because of injuries sustained.

Mortality cost is based on the number of injury fatalities reported in Chapter 1 and deaths occurring in later years due to injury sustained in 1985. If these injured persons had not died prematurely, they would have continued to be productive for a number of years. The present value of future productivity loss constitutes an important component of the indirect cost of injury. The estimated cost or value to society of all injury fatalities is the product of the number of deaths and the expected value of an individual's future earnings with sex and age taken into account. This method of derivation takes into consideration life expectancy for different age and sex groups, changing patterns of earnings at successive ages, varying labor force participation rates, imputed value for housekeeping services, and the discount rate by which to convert to present worth the potential aggregate earnings lost over the years.

Life years lost due to morbidity and premature death from injury are estimated. For morbidity, productive life years lost are derived from the number of years lost from work for employed persons and from performance of housekeeping services by those who perform them as their major activity. Life years lost due to premature injury fatalities are estimated on the basis of the number of years of life expectancy

remaining at age of death for men and women. This method is different from the years of potential life lost (YPLL) used by the Centers for Disease Control (CDC). YPLL is based on the number of years lost before age 65 (U.S. CDC, 1986). The latter method significantly understates the total years of life lost due to injury because it does not count deaths of persons aged 65 years or older. In addition, it omits the years lost beyond age 65 for those who die before age 65.

For each type of cost (i.e., direct, morbidity, and mortality), first and later year costs are based on a variety of studies and data bases providing estimates of the long-term disability associated with different types of injury. A 6 percent discount rate is used throughout to convert all costs to 1985 dollars. This discount rate is consistent with prior cost-of-injury studies.

The model for estimating lifetime cost is shown in Appendix B and a more detailed description of the data sources and methods is presented at the end of this chapter. Throughout this chapter, per person costs are presented to the last dollar, but the estimates may be less precise and can be rounded to thousands of dollars.

Overview

For the 57 million persons injured in 1985, the cost amounts to $157.6 billion, or $2,772 per injured person (Table 5). Direct expenditures for hospital and nursing home care, physician services, drugs, and other medical and rehabilitation services amount to $44.8 billion or $790 per injured person (Figure 11).

The direct cost is only the beginning. Disability from injury results in loss of output. Taking into account members of the labor force, housekeepers, and others unable to attend to their usual activities, more than 5 million life years are lost, 9 years per 100 injured persons, valued at $64.9 billion. The morbidity cost amounts to $1,145 per injured person.

Other losses result from premature injury fatalities. Approximately 143,000 premature deaths from injury occurred in 1985 and an additional 13,000 deaths occurred in later years due to injury sustained in 1985. Premature death due to injury is extremely costly to the nation, amounting to an estimated annual loss of 5.3 million life years, or 34 years per death. The loss to the economy amounts to $47.9 billion at a 6 percent discount rate, or $307,636 per death.

Sex Differences

The total lifetime economic cost of injury for males is more than double that for females -- $108 billion compared with $50 billion. The

Figure 11

Lifetime Cost of Injury by Type of Cost, 1985

$157.6 Billion

30%

29 %

41%

- ▦ Direct
- ▨ Morbidity
- ▥ Mortality
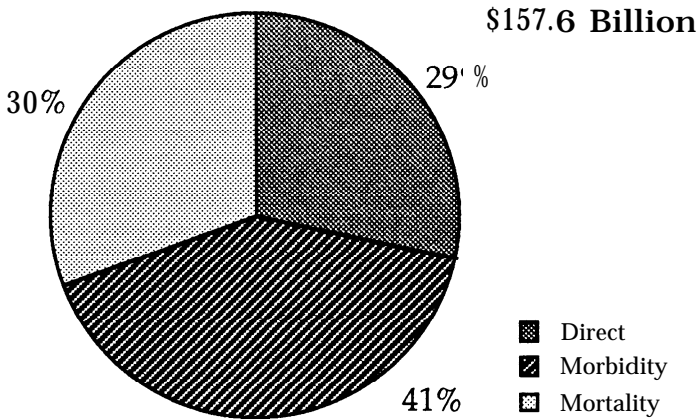
cost per injured person is two-thirds higher for males than for females -- $3,363 compared with $2,005. Males comprise 57 percent of the total injured population but account for 68 percent of the cost (Figure 12). The distribution of lifetime cost by sex varies considerably by type of cost. Slightly more than half the direct cost (53%) is for males, but males account for 69 percent of the morbidity cost and 82 percent of the mortality cost. The relatively high cost for males reflects their higher labor force participation rate, earnings, and fatality rate.

Age Differences

The group aged 25-44 ranks highest in the number of injured persons. More than 18 million, or 32 percent, of the total injured persons are in this age group, and they account for 42 percent of the total cost (Figure 13). Persons aged 15-24 rank second in number of injuries and in cost, comprising 22 percent of injuries and 25 percent of the total cost.

The distribution by age of each cost component (direct, morbidity, and mortality) varies. For the direct cost, the 25-44 age group ranks highest (28%), followed by those 65 years and over (24%). The high direct cost for the injured elderly reflects the large number of falls among this age group requiring long stays in hospitals and nursing homes and incurring high costs.

Table 5

Lifetime Cost of Injury by Age, Sex, and Type of Cost, 1985

Age and Sex		Cost* (millions)			Cost* per Injured Person			
			Indirect				Indirect	
	Total	Direct	Morbidity	Mortality	Total	Direct	Morbidity	Mortality**
Total	$157,615	$44,807	$64,920	$47,888	$2,772	$790	$1,145	$307,636
0-4	4,127	1,810	1,384	933	1,014	445	340	210,403
5-14	9,699	4,026	4,067	1,605	952	395	399	267,864
15-24	39,142	8,934	15,725	14,483	3,070	702	1,236	427,278
25-44	65,822	12,724	28,680	24,418	3,644	706	1,592	473,418
45-64	23,971	6,757	11,311	5,903	3,252	920	1,540	211,936
65+	14,853	10,555	3,752	546	3,364	2,407	856	17,095
Male	107,995	23,907	45,043	39,045	3,363	747	1,407	349,030
0-4	2,531	1,074	865	592	1,030	438	352	226,149
5-14	6,775	2,596	3,023	1,156	1,132	434	505	290,120
15-24	29,137	5,793	11,436	11,908	3,630	724	1,429	449,328
25-44	50,307	8,410	21,410	20,487	4,597	771	1,963	508,034
45-64	15,428	3,408	7,397	4,623	4,455	989	2,147	228,351
65+	3,817	2,626	913	278	3,077	2,147	746	15,279
Female	49,620	20,900	19,877	8,843	2,005	846	805	201,910
0-4	1,596	736	519	341	989	457	322	187,705
5-14	2,924	1,431	1,045	449	695	340	249	223,639
15-24	10,005	3,141	4,289	2,575	2,118	666	909	348,246
25-44	15,514	4,314	7,270	3,931	2,179	607	1,023	349355
45-64	8,544	3349	3,915	1,280	2,187	859	1,004	168,262
65+	11,036	7,929	2,839	268	3,476	2,508	898	19,503

* Discounted at 6 percent
** Based on 155,665 deaths, including 13,097 deaths in later years due to injuries sustained in 1985

Morbidity and mortality costs for injured persons aged 25-44 are highest. This age group accounts for 44 percent of the morbidity cost and 51 percent of the mortality cost. Losses for the 15-24 age group are also high, representing 24 percent of the morbidity cost and 30 percent of the mortality cost. Injured persons in the latter age group are in the prime of their lives. Many are severely injured and are disabled for several years or for life, thereby reducing their potential productivity.

Others are fatally injured, causing substantial losses to the economy. Morbidity and mortality costs for the injured elderly are relatively low. The elderly group accounts for only 6 percent of morbidity losses and

Figure 12

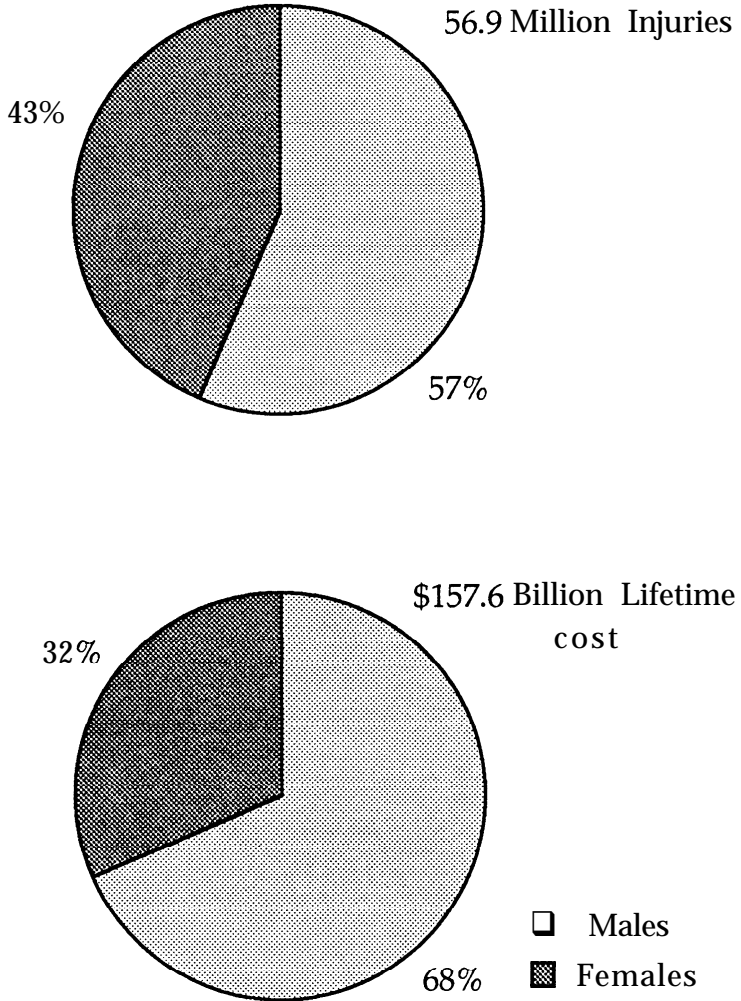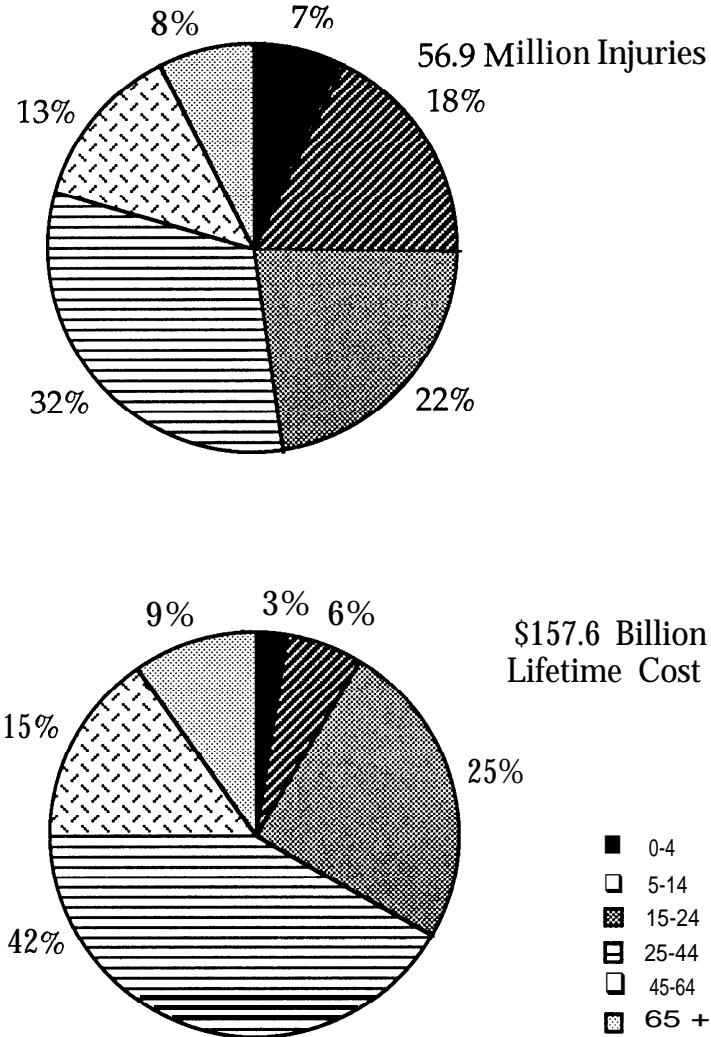**Distribution of Injured Persons and Lifetime Cost by Sex, 1985**

56.9 Million Injuries

43%

57%

$157.6 Billion Lifetime cost

32%

68%

☐ Males

▨ Females

Figure 13

Distribution of Injured Persons and Lifetime Cost by Age, 1985

8%   7%

56.9 Million Injuries

13%   18%

32%   22%

9%   3% 6%

$157.6 Billion
Lifetime Cost

15%   25%

42%

- 0-4
- 5-14
- 15-24
- 25-44
- 45-64
- 65 +

1 percent of the mortality cost because of their short life expectancy, low labor force participation rate, and low earnings.

The distribution by type of cost for each age group varies. For the elderly, direct cost far outweighs indirect cost -- direct, 71 percent;

morbidity, 25 percent; and mortality, 4 percent (Figure 14). By contrast, for injured persons aged 15-24, direct cost comprises 23 percent of total lifetime cost; morbidity and mortality costs represent 40 and 37 percent, respectively. The high indirect cost for the younger age group again reflects their high injury fatality rate, the large number of years lost to productivity, high labor force participation rate, and high lifetime earnings.

Figure 34

**Distribution of Lifetime Cost of Injury
by Age and Type of Cost, 1985**
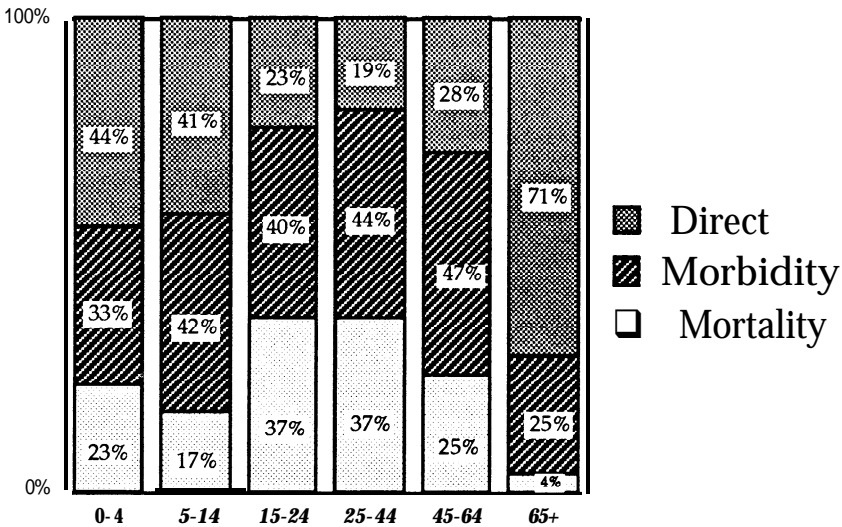
Cause of Injury

The distribution of total lifetime cost by cause shows that the greatest losses are caused by motor vehicles and falls, accounting for $49 billion and $37 billion, respectively (Table 6). Although the incidence rate for falls is higher than for motor vehicle crashes, the significantly larger number of motor vehicle fatalities among young persons results in higher lifetime costs. Motor vehicle injuries account for 9 percent of total injuries and 31 percent of the total economic cost (Figure 15).

Firearms rank third in economic toll, amounting to $14.4 billion, or 9 percent of the total cost. Injuries from firearms account for one-half of one percent of total injuries, but fatalities at young ages are high for this cause of injury, resulting in high costs.

Injuries due to other causes number 36 million, 63 percent of all injuries, and the total lifetime cost amounts to $42 billion or 27 percent of the total injury cost. Included in this category is a variety of injuries such as those due to cutting and piercing instruments; hangings; water, air, railway, and space transport accidents; and suffocation. For a complete list of the causes of injury included in the 'other' category, see Appendix A.

Table 6

Lifetime Cost of Injury by Cause and Type of Cost, 1985

| Cause of Injury	Cost* (millions)				Cost* per Injured Person			
			Indirect				Indirect	
	Total	Direct	Morbidity	Mortality	Total	Direct	Morbidity	Mortality**
Total	$157,615	$44,807	$64,920	$47,888	$2,772	$790	$1,145	$307,636
Motor Vehicles	48,683	12,270	19,085	17,328	9,062	2,304	3,583	330,843
Falls	37,279	14,689	21,049	1,541	3,033	1,197	1,715	93,554
Firearms	14,410	911	1,418	12,080	53,831	3,860	6,006	370,706
Poisonings	8,537	1,703	2,441	4394	5,015	1,007	1,444	369,402
Fires/Burns	3,832	920	1,548	1,364	2,619	631	1,062	238,841
Drownings t	2,453	78	107	2,268	64,993	2,466	3,389	360,707
Other	42,421	14,235	19,272	8,914	1,187	399	540	293,817
Male	107,995	23,907	45,043	39,045	3,363	747	1,407	349,030
Motor Vehicles	33,328	6,765	12,912	13,652	13,554	2,788	5,321	370,618
Falls	21,041	5,445	14,335	1,261	3,735	968	2,548	138,042
Firearms	12328	784	1,054	10,491	57,053	4,132	5,554	384,424
Poisonings	5,589	726	1,599	3,265	8,119	1,066	2,349	428,358
Fires/Burns	2,801	608	1,238	955	3,513	766	1,559	274,804
Drownings t	2,117	56	76	1,986	60,704	1,873	2,526	391,884
O ther	30,790	9,524	13,831	7,435	1,381	428	621	331,363
Female	49,620	20,900	19,877	8,843	2,005	846	805	201,910
Motor Vehicles	15,355	5,506	6,173	3,676	5,271	1,899	2,129	236,553
Falls	16,239	9,245	6,714	280	2,440	1,390	1,010	38,136
Firearms	2,081	128	365	1,589	40,338	2,749	7,855	300,035
Poisonings	2,948	977	842	1,129	2,907	968	834	264,252
Fires/Burns	1,030	312	310	408	1,548	470	468	182,844
Drownings t	335	22	31	282	117,372	13,302	19,171	231,220
Other	11,631	4,711	5,441	1,479	866	351	405	187,187

Discounted at 6 percent
Based on 155,665 deaths, including 13,097 deaths in later years due to injuries sustained in 1985
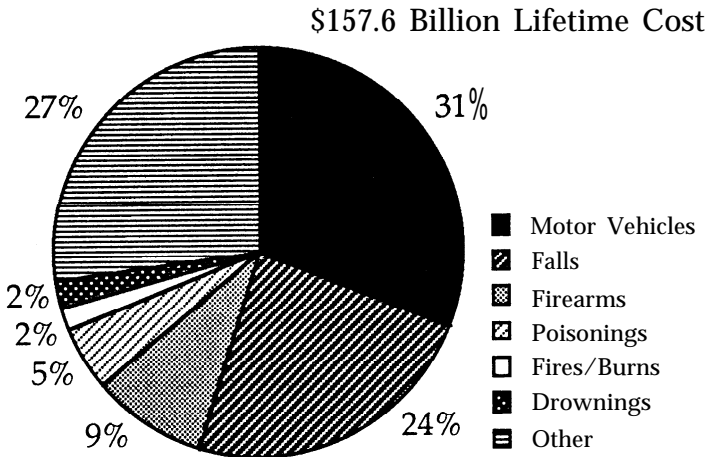Includes Near Drownings

Figure 15

Distribution of Injured Persons and Lifetime Cost **by** Cause, **1985**

56.9 Million Injured Persons

9%

21%

63%

*   3%

*   3%
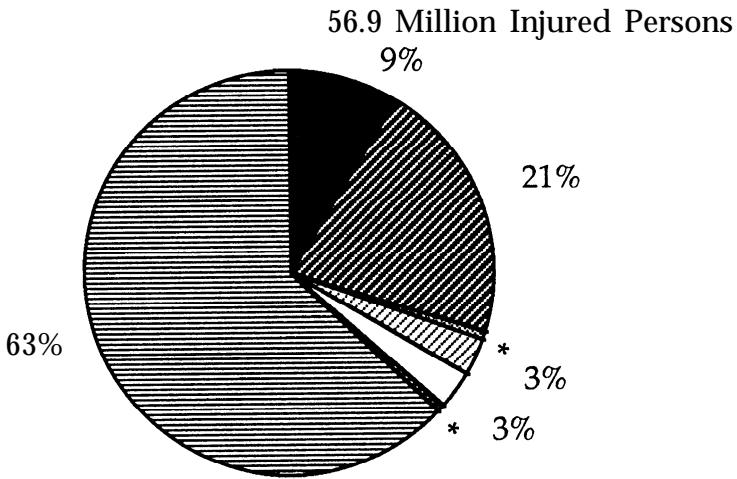
*   Injuries due to firearms and drownings each comprise less than .5% of total injuries

$157.6 Billion Lifetime Cost

27%   31%

2%

2%

5%

9%   24%

- ■ Motor Vehicles
- ▨ Falls
- ▨ Firearms
- ▨ Poisonings
- ☐ Fires/Burns
- ▨ Drownings
- ▤ Other

Distribution by cause of injury varies among the three cost components (i.e., direct, morbidity, and mortality costs), reflecting

differing age, sex, medical care use, morbidity, and mortality patterns. Figure 16 shows the distribution of each cost component by cause of injury. As expected, for injuries with high fatality rates, the mortality cost represents a larger proportion of the total than do direct and morbidity costs. For example, 93 percent of the total economic cost of drownings and near drownings is lost lifetime earnings resulting from deaths. For falls, which result in high disability, the morbidity cost comprises the largest proportion of the total at 57 percent. The direct cost for falls is also relatively high at 39 percent.

Figure 16

Distribution of Lifetime Cost of Injury by Cause
and Type of Cost, 1985
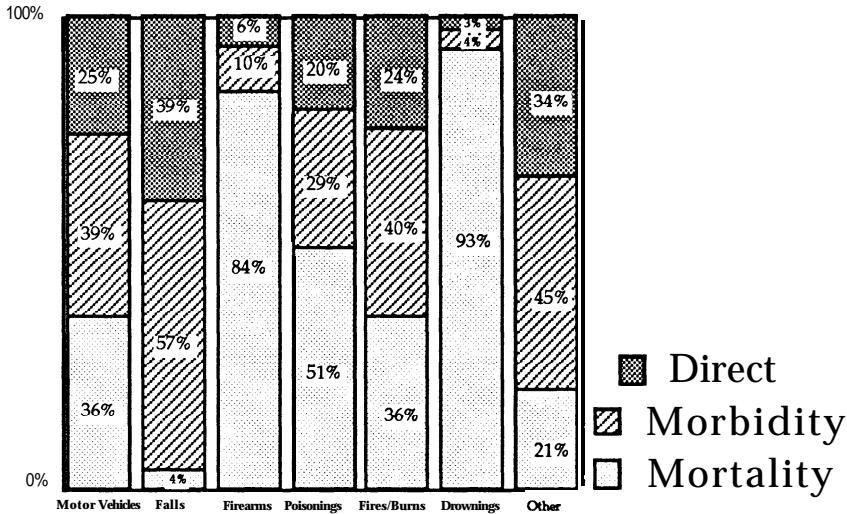
Lifetime cost per injured person varies for the different causes. Drownings and near drownings are highest, amounting to about $65,000 per person. Next highest is firearms, at $54,000 per person (Table 6). Fatality due to both of these causes is high, especially for young age groups, accounting for the high cost per person.

Table 7 presents the aggregate cost of injury by cause, age, and sex. For each cause of injury, the 25-44 age group has the highest total cost. The second costliest for each cause is the 15-24 age group, except for falls, for which the cost for persons aged 65 and over is second. The cost per injured person by cause, age, and sex shown in Table 8 presents a different picture. Because drownings are almost always fatal, their total cost per person is very high. The cost per person drowned for the 15-24 age group is highest, at about $351,000, followed closely by the 25-44 age

group at $340,000. The total cost per person injured by firearms ranks second and the highest cost is for persons aged 45-64, amounting to $149,000. Motor vehicle injuries rank third in total cost per injured person, estimated at about $9,000 with the highest cost for persons aged 25-44.

Table 7

Lifetime Cost of Injury by **Age, Sex,** and Cause, **1985**

Age and Sex	Cost* (millions)							
	Total	Motor Vehicles	Falls	Fire-arms	Poison-ings	Fires/ Burns	Drown-ings**	Other
Total	$157,615	$48,683	$37,279	$14,410	$8,537	$3,832	$2,453	$42,421
0-4	4,127	1,004	1,161	33	168	326	183	1,252
5-14	9,699	3,107	2,626	293	108	267	201	3,097
15-24	39,142	16,107	6,456	4,204	1,484	785	767	9,340
25-44	65,822	20,652	10,994	7,838	4,761	1,607	1,039	18,931
45-64	23,971	5,939	6,243	1,848	1,429	642	236	7,634
65+	14853	1,874	9,799	193	588	205	27	2,167
Male	107,995	33,328	21,041	12,328	5,589	2,801	2,117	30,790
0-4	2,531	628	690	20	96	188	122	788
5-14	6,775	2,145	1,820	241	52	176	163	2,178
15-24	29,137	11,379	4,792	3,669	942	630	700	7,025
25-44	50,307	14,987	8,224	6,740	3,452	1,233	928	14,744
45-64	15,428	3,511	3,539	1,535	870	489	191	5,294
65+	3,817	679	1,976	125	177	86	13	761
Female	**49,620**	15355	16,239	2,081	2,948	1,030	335	11,631
0-4	1,596	377	471	13	72	138	61	464
5-14	2,924	962	806	53	56	91	38	919
15-24	10,005	4,728	1,663	535	542	155	67	2,315
25-44	15514	5,665	2,770	1,098	1,309	374	111	4,187
45-64	8,544	2,429	2,705	314	558	153	45	2,340
65+	11,036	1,195	7,823	68	411	120	14	1,406

 * Discounted at 6 percent
** Includes Near Drownings

For each cause of injury, except drownings and near drownings, the cost per injured male is higher than for the average female. Relatively few women (3,000) compared with men (35,000) are injured in this manner. The cost per injured female is higher, however, because the few females included in the sample had high medical costs.

Appendix Tables C-9--C-15 show the total lifetime cost and the amount per injured person by age, sex, and type of cost for each cause of injury. Appendix Table C-16 shows the number of deaths, including deaths in later years, by which the mortality cost per injured person is calculated.

Lifetime Cost of Injury

The lifetime cost of injury in the United States takes into account the cost incurred in the first year in which the injury occurs as well as the cost incurred in later years. Since many injuries result in long-term disability and premature death, the economic cost incurred in later years is high. Of the total lifetime cost of $157.6 billion, almost three-fourths, $116.4 billion, is for the first year cost and the remaining $41.2 billion is estimated to be incurred in later years (Table 9). The estimating procedure is described at the end of this chapter.

The distribution of first and later year costs varies by cause of injury. For injuries resulting in a relatively large number of deaths, the first year cost comprises 94 to 98 percent of the total lifetime cost. This is because productivity losses due to premature death are considered to be a first year cost. For example, for drownings and near drownings, fatalities comprise 16 percent of the persons injured due to this cause, and the first year cost comprises 98 percent of the total. Likewise, 12 percent of firearm injuries are fatal and the first year cost accounts for 94 percent of the lifetime cost. By contrast, only one-tenth of one percent of falls result in death, and long-term disability often results from falls. For this cause of injury, 55 percent of lifetime cost is incurred in the first year and the remaining 45 percent in later years.

The distribution by type of cost of first and later year costs varies: 87 percent of the direct cost and 99.7 percent of the mortality cost occur in the first year. However, fully 54 percent of the morbidity cost occurs in later years.

Class of Injury

There are three classes of injury reflecting severity: 155,665 deaths (142,568 deaths occurring in 1985 plus 13,097 deaths occurring in later years due to injury sustained in 1985), 2.3 million hospitalized injured

Table 8

Lifetime Cost of Injury per Injured Person
by Age, Sex, and Cause, 1985

Age and Sex	Cost* per Injured Person							
	Total	Motor Vehicles	Falls	Fire- arms	Poison- ings	Fires/ Burns	Drown- ings**	Other
Total	$2,772	$9,062	$3,033	$53,831	$5,015	$2,619	$64,993	$1,187
0-4	1,014	8,963	882	108,386	495	2,253	6,376	588
5-14	952	9,485	1,057	12,087	405	1,583	159,021	448
15-24	3,070	9,135	3,538	69,720	10,839	2,118	351,406	1,087
25-44	3,644	10,005	4,244	47,746	8,706	3,252	340,247	1,552
45-64	3,252	7,485	3,558	148,516	5,582	4,977	155,285	1,726
65+	3,364	6,017	4,226	31,123	3,734	1,313	26,516	1,480
Male	3,363	13,554	3,735	57,053	8,119	3,513	60,704	1,381
0-4	1,030	8,993	996	148,146	608	3,173	4,434	543
5-14	1,132	11,336	1,437	12,242	398	3,816	153,160	503
15-24	3,630	14,912	4,476	70,078	22,973	3,509	379,937	1,187
25-44	4,597	14,472	5,852	52,450	15,728	3,371	359,571	1,893
45-64	4,455	13,801	4,943	150,637	9,523	4,541	159,460	2,319
65+	3,077	4,622	4,096	23,732	3,583	2,187	21,788	1,473
Female	2,005	5,271	2,440	40,338	2,907	1,548	117,372	866
0-4	989	8,913	755	77,694	398	1,615	54,257	683
5-14	695	6,952	662	11,430	411	741	190,483	355
15-24	2,118	4,727	2,205	67,363	5,652	811	196,748	866
25-44	2,179	5,507	2,337	30,791	3,998	2,914	234,848	949
45-64	2,187	4,505	2,603	138,946	3,394	7,182	139,839	1,093
65+	3,476	7,263	4,260	72,358	3,804	1,021	33,584	1,484

 * Discounted at 6 percent
** Includes Near Drownings

Table 9

Lifetime Cost of Injury by Cause, Type of Cost, and First and Later Years, 1985

Cause	Total	Total		Direct		Morbidity		Mortality'	
		First Year	Later Year	First Year	Later Year	First Year	Later Year	First Year	Later Year
Cost* (millions)									
Total	$157,615	$116,403	$41,212	$38,859	$5,948	$29,805	$35,115	$47,739	$150
Motor Vehicles	48,683	35,112	13,271	10,902	1,368	6,946	12139	17264	64
Falls	37,279	20,451	16,829	12,061	2,628	6,892	14,157	1,497	44
Firearms	14,410	13,515	894	812	100	638	780	12,065	14
Poisonings	8,537	8,285	253	1,462	240	2,429	12	4,394	0
Fires/Bums	3,832	3,065	766	852	68	850	697	1,363	1
Drownings†	2,453	2,405	48	69	9	70	37	2,266	2
Other	42,421	33,570	8,851	12,702	1,533	11,980	7,292	8,888	26
Percent Distribution by Cause									
Total	100.0 %	73.9 %	26.1 %	86.7 %	133 %	45.9 %	54.1 %	99.7 %	03 %
Motor Vehicles	100.0	72.1	27.9	88.8	11.2	36.4	63.6	99.6	0.4
Falls	100.0	54.9	45.1	82.1	17.9	32.7	673	972	2.8
Firearms	100.0	93.8	6.2	89.1	10.9	45.0	55.0	99.9	0.1
Poisonings	loo.0	97.0	3.0	85.9	14.1	99.5	05	100.0	0.0
Fires/Burns	loo.0	80.0	20.0	92.6	7.4	54.9	45.1	100.0	0.0
Dmwnings†	100.0	98.0	2.0	88.1	11.9	653	34.7	99.9	0.1
Other	loo.0	79.1	20.9	89.2	10.8	62.2	37.8	99.7	03

* Discounted at 6 percent

*+ First year mortality costs are those associated with the 142,568 deaths occurring in 1985; later year mortality costs are those associated with the 13,097 deaths occurring in later years due to injuries sustained in 1985

† Includes Near Drownings

persons, and 54.4 million nonhospitalized injured persons. The latter class, although large, involves the least severe injuries. The distribution of costs by class of injury reflects the severity of the injuries. Of the $157.6 billion lifetime cost, 31 percent is the cost of fatalities. Included is a small amount of direct cost for deaths occurring within the first year of injury and requiring medical care. More than half (51%) of the lifetime cost is for injuries involving hospitalization and less than one-fifth (18%) for nonhospitalized injuries (Table 10).

The cost per injured person by class of injury also reflects injury severity. The cost per fatal injury amounts to $317,189, the present value of forgone earnings for the average fatal injury. The cost per injured person hospitalized is $34,116, substantially greater than the $518 cost for nonhospitalized injured persons.

Age and Sex

The distribution of lifetime cost by class of injury varies by sex and age. Of the total 155,665 injury fatalities occurring in 1985 and in later years, 72 percent are males and 28 percent are females. The lifetime cost

for males, however, is significantly higher, 81 percent of the total, reflecting higher labor force participation and higher earnings.

Of the 2.3 million hospitalized injured persons, 1.3 million, or 56 percent, are males. The proportion of total cost for hospitalized injuries is higher for males —65 percent. Males are involved in more serious injuries that incur higher costs. Males also incur more minor injuries

Table **10**

Lifetime Cost of Injury by **Age, Sex,** and Class of Injury, **1985**

Age and Sex	Cost* (millions)				Cost* per Injured Person			
	Total	Fatalities**	Hospi-talized	Nonhospi-talized	Total	Fatalitiestt	Hospi-talizedt	Nonhospi-talizedt
Total	$157,615	$49,374	$80,063	**$28,178**	$2,772	$317,189	$34,116	**$518**
0-4	4,127	976	2,357	795	1,014	220,081	20,959	201
5-14	9,699	1,670	6,061	1,967	952	278,754	29,561	197
15-24	39,142	14,876	19,504	4,762	3,070	438,884	42,028	389
25-44	65,822	24,891	29,282	11,648	3,644	482,583	43,169	672
45-64	23,971	6,138	12,320	5,513	3,252	220,375	32,694	791
65+	14,853	822	10,538	3,493	3,364	25,771	20,661	901
Male	**107,995**	**40,086**	51,737	16,172	3,363	358344	39,148	527
0 4	2,531	617	1,432	**482**	1,030	235,664	**21,934**	202
5-14	6,775	1,198	4,381	**1,195**	1,132	300,607	31,747	205
15-24	29,137	12,205	14,267	**2,664**	3,630	460,550	44,807	347
25-44	50,307	20,850	21,482	**7,976**	4,597	517,012	47,311	763
45-64	15,428	4,786	7,491	**3,150**	4,455	236,423	37,153	971
65+	3,817	430	2,684	**704**	3,077	23,614	18,613	652
Female	**49,620**	9,288	28,325	12,006	**2,005**	212,075	27,630	507
0 4	**1,596**	359	924	313	989	197,617	19,608	200
5-14	2,924	472	1,680	772	695	235,331	25,059	187
15-24	10,005	2,671	5'237	2,097	2,118	361,227	35,951	459
25-44	15,514	4,042	7,801	3,672	2,179	359,190	34,783	533
45-64	8,544	1,352	4,829	2,362	2,187	177,677	27,562	634
65+	11,036	393	7,854	2,789	3,476	28,630	21,469	997

* Discounted at 6 percent
** Includes a small amount of direct cost occurring within the first year of injury and requiring medical care
t Nursing Home costs are distributed in hospitalized and nonhospitalized classes according to the source of admission to nursing home
†† Based on 155,665 deaths, including 13,097 deaths in later years due to injuries sustained in 1985

than females. Fifty-six percent of the 54 million nonhospitalized injured persons are males, and they incur about the same proportion (57%) of the $28 billion cost of nonhospitalized injury.

The 25-44 age group incurs the largest share of lifetime cost of fatalities. Of the 155,665 deaths resulting from injury in 1985, 33 percent is in this age group. The productivity losses for this age group comprise half the total cost of fatalities. People who die prematurely in this age group are at the height of their productivity and the present value of future earnings lost is significant. By contrast, 20 percent of fatalities are persons aged 65 and over, but less than 2 percent of the lifetime cost of fatalities is in this age group.

Injured persons aged 25-44 incur the most costly share of hospitalized and nonhospitalized injuries, comprising 37 percent and 41 percent, respectively. The 15-24 age group is the second costliest for hospitalized injury, while the 45-64 age group ranks second for nonhospitalized injury.

Cause of Injury

Table 11 shows total cost and cost per injured person by cause and class of injury. The cost of motor vehicle fatalities ranks highest, totaling $18.4 billion, and the cost of fatalities due to firearms is second in rank at $12.2 billion. The lowest ranking cost is for fires and burns, at $1.4 billion. On the basis of cost per fatality, firearms and poisonings rank highest at $373,520 and $372,691, respectively, reflecting the large number of deaths at younger ages for these causes of injury.

The least costly fatalities are those from falls, estimated at $99,669 per fatality. About 60 percent of the deaths resulting from falls are among persons aged 65 and over. Their labor force participation rate and earnings are low and life expectancy short, resulting in the lower cost per fatality ($99,669).

The cost per hospitalized injured person ranges from $17,631 for poisonings to $43,409 for motor vehicle injuries. The second and third most costly hospitalized injuries are falls and fires and burns, at $38,174 and $35,303, respectively. As expected, the cost per nonhospitalized injured person is by far the lowest, ranging from $4 to $1,570. Persons who sustain less severe injuries not requiring hospitalization use medical care services that are far less costly than services for hospitalized persons.

Type of Cost

As noted above, three types of lifetime cost are estimated: 1) direct cost, the expenditure for medical care services, amounting to $44.8

billion, or 29 percent of the total lifetime cost of injury; 2) morbidity cost, valued at $64.9 billion, or 41 percent of the total; and 3) mortality cost, amounting to $47.9 billion at a 6 percent discount rate, or 30 percent of the total. A detailed description of each of type of cost follows.

Table 11

Lifetime Cost of Injury by Cause and Class of Injury, 1985

Cause	Cost* (millions)				Cost* per Injured Person			
	Total	Fatalities**	Hospi-talizedt	Nonhospi-talizedt	Total	Fatalitiestt	Hospi-talizedt	Non hospi-talizedt
Total	$157,615	$49,374	$80,063	$28,178	$2,772	$317,189	$34,116	$518
Motor Vehicles	48,683	18,438	22,704	7,541	9,062	352,042	43,409	1,570
Falls	37,279	1,642	29,904	5,734	3,033	99,669	38,174	499
Firearms	14,410	12,172	2,160	78	53,831	373,520	33,159	458
Poisonings	8,537	4,433	3,853	251	5,015	372,691	17,631	171
Fires/ Burns	3,832	1,424	1,920	487	2,619	249,367	35,303	347
Drownings‡	2,453	2,278	175	0 ‡‡	64,993	362,292	31,408	4
Other	42,421	8,989	19347	14,086	1,187	296,266	27,769	402
Male	107,995	40,086	51,737	16,172	3,363	358344	39,148	527
Motor Vehicles	33,328	14,437	15,258	3,633	13554	391,921	48,984	1,718
Falls	21,041	1317	17347	2,377	3,735	144,143	54554	448
Firearms	12,328	10,567	1,694	67	57,053	387235	29,870	501
Poisonings	5,589	3,289	2,226	74	8,119	431,608	22,766	127
Fires/ Burns	2,801	992	1,463	346	3,513	285300	37556	459
Drownings‡	2,117	1,994	124	0 ‡‡	60,704	393,464	31,462	4
Other	30,790	7,490	13,626	9,674	1,381	333,803	27,540	444
Female	49,620	9,288	28,325	12,006	2,005	212,075	27,630	507
Motor Vehicles	15,355	4,001	7,446	3,908	5,271	257506	35,198	1,454
Falls	16,239	325	12,557	3357	2,440	44,267	26,982	543
Firearms	2,081	1,604	465	12	40,338	302,860	55337	309
Poisonings	2,948	1,143	1,628	177	2,907	267,610	13,476	199
Fires/ Burns	1,030	432	458	141	1548	193,416	29,622	217
Drownings+.	**335**	284	51	-	117,372	232,825	31,278	
Other	11,631	1,499	5,721	4,411	866	189,660	28,328	**333**

* Discounted at 6 percent

** Includes **a** small amount of direct cost occurring within the first year of injury and requiring medical care

t Nursing home costs are distributed in hospitalized and non-hospitalized classes according to the source of admission to nursing home

tt Based upon 155,665 deaths, including 13,097 deaths in later years due to injuries sustained in 1985

$ Includes Near Drownings

‡‡ Less than $500,000

Direct Cost

Direct cost includes all medical care costs and selected nonmedical costs. Medical care costs include amounts spent for personal health care of persons injured in 1985. Included are hospital and nursing home care,

physician visits, prescription drugs, physical therapy, ambulance and helicopter services, attendant care, and other expenses such as wheel chairs and appliances for injured persons. Included under hospital services are initial hospitalization, rehospitalization, emergency room visits, and inpatient rehabilitation. Nonmedical direct costs related to injuries include amounts spent for home modification, vocational rehabilitation, and overhead and administrative costs for automobile and health insurance. Other cost-of-injury studies, especially for motor vehicles, report substantially higher nonmedical costs because they include the value of property damage resulting from motor vehicle crashes (Faigin, 1976; U.S. NHTSA, 1983). Since the present report focuses on the cost of injury, nonmedical costs are limited to those related to the injured person and exclude the costs associated with the damage caused by the event resulting in injury. Settlements and benefit payments are transfer payments and are included in the medical care costs. Estimates of transfer payments are presented separately in Chapter 3.

Direct personal medical and nonmedical costs of care for injured persons amount to $44.8 billion. Of this total, $24.5 billion, or 55 percent, is spent for hospital care, including the cost of professional services provided to hospitalized patients (Table 12). Physician visits outside of hospitals rank second, estimated at $6.5 billion, or 15 percent of the direct cost. The third highest type of expenditure, $2.5 billion, or 5 percent of the direct cost, is for nursing home care.

Examination of the type of expenditure by cause of injury shows that hospital care is the most costly component for all causes of injury, ranging from $62 million for drownings and near drownings to $8.7 billion for falls. Physician services outside the hospital rank second for all causes of injury except falls, for which nursing home care ranks second.

Morbidity Cost

Morbidity cost is the value of goods and services not produced because of injury-related illness and disability. To the degree that injuries prevent or deter individuals from producing goods and services in the marketplace, the public sector, or the household, the value of these losses is the cost borne by society. As indicated above, estimates of morbidity cost involve applying average earnings to work-years lost and imputing a dollar value to housekeeping services for those unable to perform them. Lifetime morbidity cost includes the value of output lost by persons disabled in later years as a result of injury sustained in 1985.

Lifetime morbidity losses for persons injured in 1985 amount to 5.1 million years of life, or 9 life years lost per 100 injured persons. These

Table 12

Lifetime Direct Cost of Injury by Type of Expenditure and Cause, 1985

Type of Expenditure	Total	Motor Vehicles	Falls	Fire- arms	Poison- ings	Fires/ Burns	Drown- ings**	Other
Total	$44,807	$12,270	$14,689	$911	$1,703	$920	$78	$14,235
Medical	38,752	7,900	13,891	863	1,613	876	74	13,535
Hospital Services	24,515	5,937	8,734	753	1,281	671	62	7,077
Initial Hospitalization†	13,390	3374	4,941	455	742	471	32	3,375
Rehospitalization	5,288	1,137	1,989	156	417	107	18	1,464
Emergency Room Visits	2,619	336	490	18	33	67	3	1,672
Inpatient Rehabilitation	3,218	1,090	1,314	124	89	26	9	566
Physician Visits	6,504	1,105	1,573	54	148	110	5	3,509
Prescriptions	1,158	120	258	6	22	33	0	719
Physical Therapy	1,050	190	498	18	32	10	3	299
Nursing Home	2,460	145	2,037	0	97	0	0	181
Ambulance and Helicopter	668	97	240	9	33	51	1	237
Attendant Care	156	51	61	12	0	1	3	28
Other Expenses	2,241	255	490	11	0	0	0	1,485
Nonmedical	6,054	4,370	798	48	90	44	4	700
Home Modification	**420**	91	196	10	13	5	1	104
Vocational Rehabilitation	157	31	49	4	13	4	0	56
Auto Insurancett	3,934	3,934	0	0	0	0	0	0
Health Insurancett	1,543	314	553	34	64	35	3	540

* Discounted at 6 percent
** Includes Near Drownings
† Includes physician and other professional services for hospitalized persons
tt Includes only administrative expenses

losses translate to a total morbidity cost of $64.9 billion, or $1,145 per injured person. The greatest losses are for injured persons aged 25-44, followed by those aged 15-24. These two age groups have the largest number of hospitalized and nonhospitalized injuries resulting in employment and housekeeping losses. The morbidity cost for the **25-44** age group amounts to $28.7 billion, or $1,592 per injured person. For persons aged 15-24, the morbidity cost totals $15.7 billion, or $1,236 per injured person (Table 13).

The morbidity cost for males is significantly higher than for females, $45 billion compared with $20 billion. On the basis of cost per injured person, the morbidity cost amounts to $1,407 for males compared with $805 for females, reflecting lower earnings for women. Life years lost for injured males amount to **3.1** million years compared with 2.0 million for

Table 13

Injury Morbidity Losses by Age and Sex, 1985

Age and Sex	Number of Injured Persons** (thousands)	Life Years Lost		Morbidity Cost*	
		Total (thousands)	Per 100 Injured Persons	Total (millions)	Per Injured Person
Total	56,717	5,086	9.0	$64,920	$1,145
0-4	4,066	470	11.6	1,384	340
5-14	10,184	822	8.1	4,067	399
15-24	12,721	1,388	10.9	15,725	1,236
25-44	18,015	1,314	7.3	28,680	1,592
45-64	7,344	476	6.5	11,311	1,540
65+	4,386	616	14.0	3,752	855
Male	32,014	3,059	9.6	45,043	1,407
0-4	2,454	262	10.7	865	352
5-14	5,981	563	9.4	3,023	505
15-24	8,003	950	11.9	11,436	1,429
25-44	10,907	890	8.2	21,410	1,963
45-64	3,445	255	7.4	7,397	2,147
65+	1,223	137	11.2	913	746
Female	24,702	2,027	8.2	19,877	805
0-4	1,612	208	12.9	519	322
5-14	4,203	259	6.2	1,045	249
15-24	4,717	438	9.3	4,289	909
25-44	7,108	424	6.0	7,270	1,023
45-64	3,900	221	5.7	3,915	1,004
65+	3,162	478	15.1	2,839	898

* Discounted at 6 percent
** Excludes 142,568 deaths occurring in 1985

females due to the higher number of injuries among males. The number of life years lost for males is 9.6 years per 100 injured persons compared with 8.2 years for females.

Table 14 shows injury morbidity losses by cause of injury. Morbidity losses from falls rank highest, amounting to $21.0 billion, reflecting the large number of falls resulting in disability. Motor vehicle injuries rank second in total morbidity cost, amounting to $19.1 billion. The ranking by cause of injury for life years lost shows a different pattern: fires and burns, 1.3 million; motor vehicle injuries, 1.2 million; and falls, 363,000. The large number of life years lost for injuries from fires and burns and motor vehicles reflects the severity of these injuries that cause long-term disability.

Mortality Cost

A total of 155,665 deaths due to injury sustained in 1985 occurred in the United States. Alcohol is a major risk factor for many of these fatalities. About half the deaths due to motor vehicle traffic accidents, two-fifths of deaths from falls and from fires and burns, and three-tenths of drownings are estimated to involve alcohol (Parker, Shultz, Gertz, Berkelman, and Remington, 1987).

Applying expected lifetime earnings by age and sex to the 155,665 deaths from injury sustained in 1985, including deaths in later years, results in a loss of 5.3 million life years, or 34 years per death. These deaths represent a loss of $47.9 billion to the economy at a 6 percent discount rate, or $307,636 per death (Table 15). For the 111,867 males who died from injuries, an estimated 3.8 million life years are lost, 34 years per death, valued at $39.0 billion, or $349,030 per death. The 43,798 females who died from injuries represent a loss of 1.5 million life years, or 33 years per death. Because of the fewer deaths and lower earnings of females, losses for females are significantly lower than for males, amounting to a total of $8.8 billion, or $201,910 per death. Thus, males account for 72 percent of the injury deaths and life years lost, and 82 percent of the productivity losses for 1985 (Figure 17).

The number of injury deaths, life years lost, and discounted earnings vary by age. Most victims are relatively young -- one third are aged 25-44. The total of life years lost for this age group, a function of both age and number of deaths, represents 39 percent of all life years lost to injury. In terms of lost earnings, this age group accounts for 51 percent of the total. By contrast, 38 percent of injury deaths are persons over age 45, accounting for 18 percent of life years lost and 14 percent of productivity lost (Figure 18).

Table 14

Injury Morbidity Losses by Sex and Cause, 1985

Cause	Number of Injured Persons** (thousands)	Life Years Lost		Morbidity Cost*	
		Total (thousands)	Per 100 Injured Persons	Total (millions)	Per Injured Person
Total	**56,716**	**5,086**	9.0	$64,920	**$1,145**
Motor Vehicles	5,326	1,173	22.0	19,085	3,583
Falls	12,276	363	3.0	21,049	1,715
Firearms	236	188	79.8	1,418	6,006
Poisonings	1,691	18	1.0	2,441	1,444
Fires/Bums	1,457	1,259	86.4	1,548	1,062
Drownings t	32	161	511.3	107	3,389
Other	35,698	1,924	5.4	19,272	540
Male	**32,014**	**3,059**	9.6	45,043	1,407
Motor Vehicles	2,426	737	30.4	12,912	5,321
Falls	5,626	212	3.8	14,335	2,548
Firearms	190	126	66.4	1,054	5,554
Poisonings	681	11	1.6	1,599	2,349
Fires/Bums	794	636	80.2	1,238	1,559
Drownings t	30	100	332.6	76	2,526
Other	22,267	1,238	5.6	13,831	621
Female	**24,702**	**2,027**	8.2	19,877	805
Motor Vehicles	2,900	436	15.0	6,173	2,129
Falls	6,650	151	2.3	6,714	1,010
Firearms	46	62	134.6	365	7,855
Poisonings	1,010	7	0.7	842	834
Fires/Burns	663	622	93.8	310	468
Drownings t	2	62	3,780.9	31	19,171
Other	13,431	686	5.1	5,441	405

  * **Discounted at 6 percent**
 ** **Excludes 142,568 deaths occurring in 1985**
  t **Includes Near Drownings**

Table 15

Injury Mortality Losses by Age and Sex, 1985

Age and Sex	Number of Deaths**	Life Years Lost		Mortality Cost*	
		Total (thousands)	Per Death	Total (millions)	Per Death
Total	155,665	5,285	34.0	$47,888	$307,636
0-4	**4,434**	320	**72.2**	933	210,403
5-14	**5,992**	337	**56.2**	1,605	267,864
15-24	**33,896**	1,658	**48.9**	14,483	427,278
25-44	**51,579**	2,045	**39.6**	24,418	473,418
45-64	**27,854**	625	**22.4**	5,903	211,936
65+	**31,910**	300	**9.4**	546	17,095
Males	111,867	3,827	**34.2**	39,045	349,030
0-4	2,618	182	69.5	592	226,149
5-14	3,986	219	54.9	1,156	290,120
15-24	26,502	1,272	48.0	11,908	449,328
2544	40,327	1,561	38.7	20,487	508,034
45-64	20,245	431	21.3	4,623	228,351
65+	18,189	162	8.9	278	15,279
Females	43,798	1,458	33.3	8,843	201,910
0-4	1,816	138	76.0	341	187,705
5-14	2,006	118	58.8	449	223,639
15-24	7,394	386	52.2	2,575	348,246
25-44	11,252	484	43.0	3,931	349,355
45-64	7,609	194	25.5	1,280	168,262
65+	13,721	138	10.1	268	19,503

* Discounted at 6 percent
** Includes 13,097 deaths in later years due to injuries sustained in 1985

Figure 17

Injury Mortality Losses by Sex, 1985

Number of Deaths
155,665

28%

72%

Life Years Lost
5.3 Million

28%

72%

18%

Mortality Cost
$47.9 Billion

82%

☐ Males
☐ Females
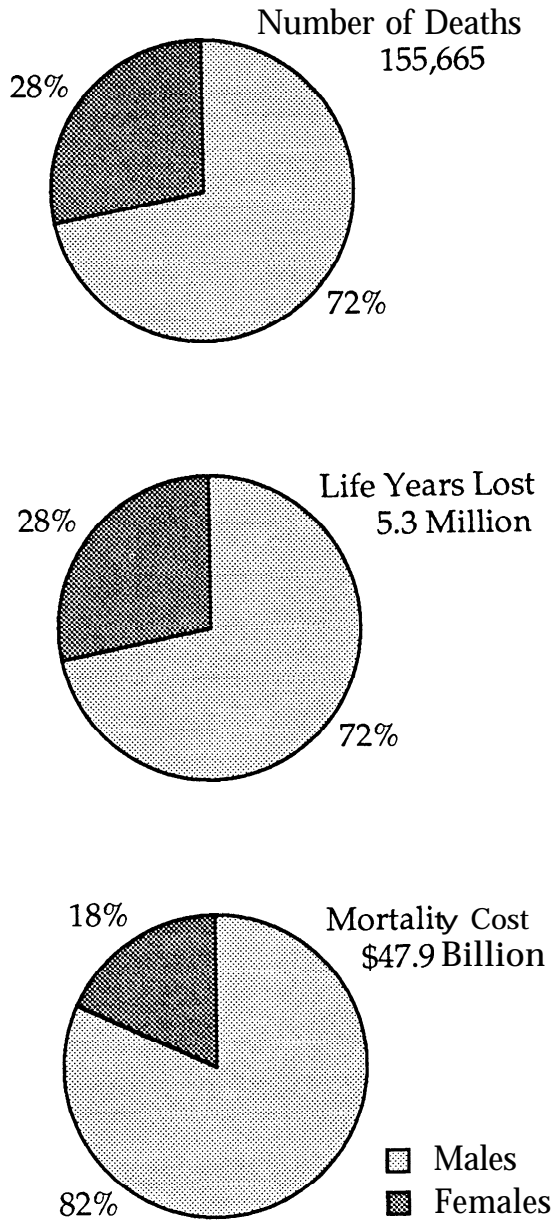
Figure 18

Injury Mortality Losses by Age, 1985

Number
of Deaths
155,665

7%

20%

18%

22%

33%

Life Years
Lost
5.3 Million

6%   13%

12%

31%

38%

Mortality Cost
$47.9 Billion

13%   1% 5%

30%

51%

- 0-14
- 15-24
- 25-44
- 45-64
- 65+
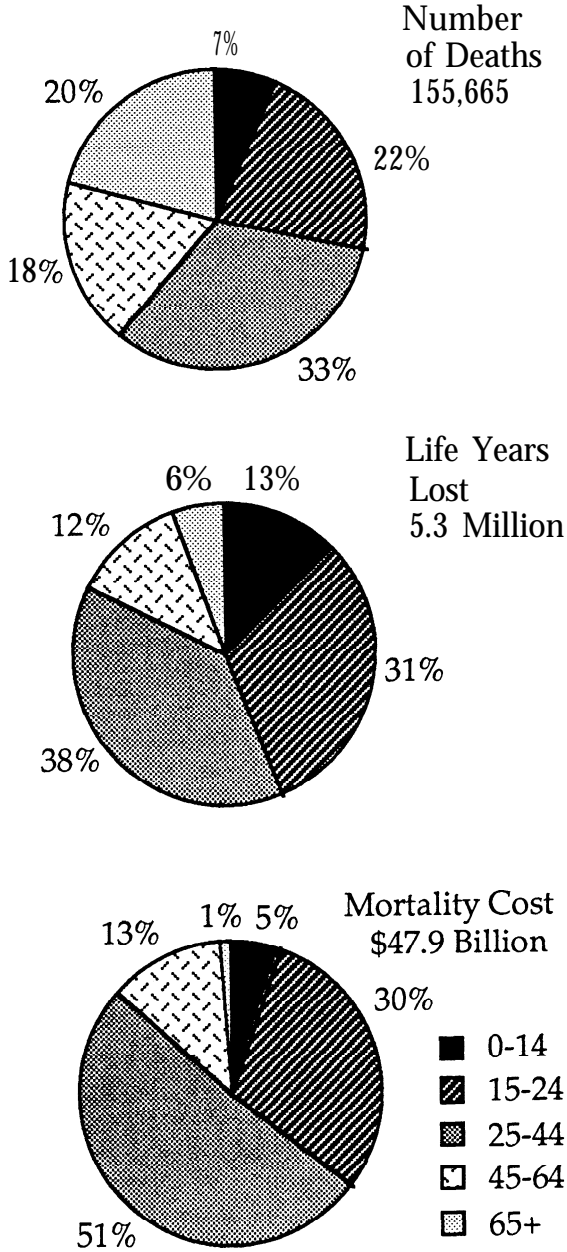
Mortality losses by cause of injury are summarized in Table 16 and Figure 19. Motor vehicle and firearm injuries are the most devastating types of injury in number of deaths. Together they account for over half of all injury deaths (55%) and approximately 60 percent of life years lost and lost productivity. Motor vehicle injuries alone account for one-third of all injury deaths, 37 percent of lost years, and productivity losses of $330,843 per death. Firearm injuries are the most costly cause per death, representing a productivity loss of $370,706 per person, because the typical firearm victim is a young male. By contrast, the lowest productivity loss per death is $93,554, associated with falls; in this case, the typical victim is an elderly person with low earnings and short life expectancy.

Mortality **Losses Due to the Leading Causes** of **Death**

Deaths due to all causes and to injury in 1985 by age and sex are shown in Table 17. Excluded from this comparison are deaths in later years due to injuries sustained in 1985. Injury deaths comprise 7 percent of the 2.1 million deaths in the United States for 1985, 15 percent of the life years lost, and 26 percent of the productivity losses.

The distribution by age of death for all causes differs from that for injury. Less than 2 percent of all deaths occur in the 15-24 age group, and less than 6 percent are in the 25-44 age group. By contrast, 21 percent and 34 percent of injury deaths are in the 15-24 and 25-44 age groups, respectively.   Deaths caused by injury comprise a disproportionately large share of deaths in young age groups compared with deaths from all causes. Injury deaths comprise 56 percent of all deaths in the 5-14 age group; 78 percent of all deaths in the 15-24 age group; and 41 percent of all deaths in the 25-44 age group. Life years lost and productivity losses due to injury deaths represent about the same proportions of the totals for these age groups. Premature deaths due to injury are extremely costly to the nation.

Injury is the fourth leading cause of death, but productivity losses from this cause are far greater in terms of aggregate and per person losses than from the three leading causes of death (Table 18). For example, heart disease is the leading cause of death with 771,169 deaths, comprising 37 percent of the total number of deaths in the United States for 1985 (Figure 20). The mortality cost for diseases of the heart amounts to $41 billion, or $53,143 per death. Likewise, neoplasms and cerebrovascular diseases are the second and third leading causes of death, representing productivity losses of $88,369 and $40,751 per death, respectively. Life years lost per death for the three leading causes are 11.8 years for diseases of the heart, 15.6 years for neoplasms, and 10.9 years for cerebrovascular diseases. By -contrast, injury is the fourth

Table 16

Injury Mortality Losses by Sex and Cause, 1985

Cause	Number of Deaths**	Life Years Lost		Mortality Cost*	
		Total (thousands)	Per Death	Total (millions)	Per Death
Total	155,665	5,285	34.0	$47,888	$307,636
Motor Vehicles	52,375	1,952	37.3	17,328	330,843
Falls	16,470	436	26.5	1,541	93,554
Firearms	32,586	1,162	35.7	12,080	370,706
Poisonings	11,894	275	23.1	4,394	369,402
Fires/Burns	5,710	258	45.2	1,364	238,841
Drowningsi	6,287	206	32.8	2,268	360,707
Other	30340	995	32.8	8,914	293,817
Male	111,867	3,827	34.2	39,045	349,030
Motor Vehicles	36,836	1,362	37.0	13,652	370,618
Falls	9,136	280	30.6	1,261	138,042
Firearms	27,289	945	34.6	10,491	384,424
Poisonings	7,621	218	28.6	3,265	428,358
Fires/Burns	3,477	170	48.9	955	274,804
Drownings?	5,067	120	23.7	1,986	391,884
Other	22,439	733	32.7	7,435	331,363
Female	43,798	1,458	33.3	8,843	201,910
Motor Vehicles	15,539	590	38.0	3,676	236,553
Falls	7,334	156	21.3	280	38,136
Firearms	5,297	217	41.0	1,589	300,035
Poisonings	4,273	57	13.3	1,129	264,252
Fires/Bums	2,233	88	39.4	408	182,844
Drownings†	1,220	86	70.5	282	231,220
Other	7,901	262	33.2	1,479	187,187

Discounted at 6 percent
Includes 13,097 deaths in later years due to injuries sustained in 1985
Includes Near Drownings

Figure 19

Injury Mortality Losses by Cause, 1985

Number of Deaths
155,665

19%

4%
4%
7%
21%
11%
34%

Life Years Lost
5.3 Million

19%

4%
5%
5%
22%
8%
37%

Mortality Cost
$47.9 Billion
36%

19%

5%
3%
9%
25%
3%

■ Motor Vehicles
▨ Falls
❑ Firearms
❐ Poisonings
❑ Fires/Burns
❑ Drownings
❑ Other
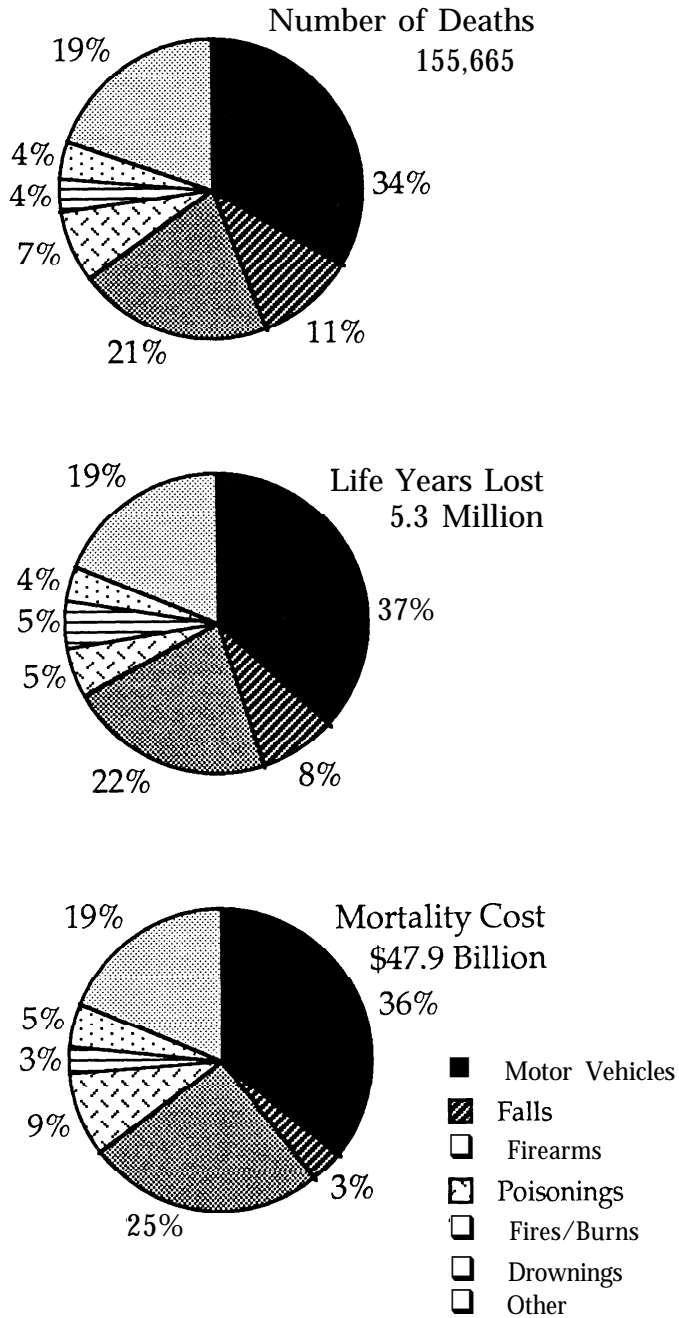
Table 37

Mortality Losses Due to All Causes and Due to Injury
by Age and Sex, 1985

Age and Sex	All Deaths					Injury Deaths*				
		Life Years Lost		Mortality Cost**			Life Years Lost		Mortality Cost**	
	Number of Deaths	Total (thou-sands)	Per Death	Total (mill-ions)	Per Death	Number of Deaths	Total (thou-sands)	Per Death	Total (mill-ions)	Per Death
Total	2,085,563	33,253	15.9	$183,643	$88,054	142,568	5,126	36.0	$47,739	$334,849
0-4	47,369	3,501	73.9	9,366	197,724	4,363	318	72.9	931	213,428
5-14	8,933	583	65.3	2,817	315,388	4,962	321	64.7	1,595	321,405
15-24	37,935	2,065	54.4	18,438	486,047	29,412	1,593	54.2	14,422	490,344
25-44	117,667	4,772	40.6	56,475	479,953	47,824	2,005	41.9	24,377	509,728
45-64	403,114	8,843	21.9	73,115	181,376	25,601	601	23.5	5,878	229,607
65+	1,470,545	13,490	9.2	23,431	15,934	30,406	288	9.5	535	17,605
Male	1,097,267	18,044	16.4	124,134	113,130	102,804	3,710	36.1	38,921	378590
0-4	27,199	1,930	71.0	5,791	212,917	2,570	180	70.0	590	229,721
5-14	5,485	343	62.5	1,859	338,988	3,357	209	62.3	1,148	341,930
15-24	28,162	1,483	52.7	14,454	513,238	23,095	1,216	52.7	11,852	513,205
25-44	80,848	3,150	39.0	42,921	530,880	37,612	1,533	40.8	20,453	543,787
45-64	251,031	5,067	20.2	49,108	195,626	18,693	415	22.2	4,604	246,292
65+	704,542	6,071	8.6	10,001	14,194	17,477	156	8.9	273	15,619
Female	988,296	15,209	15.4	59,509	60,214	39,764	1,417	35.6	8,818	221,762
0-4	20,170	1,570	77.9	3575	177,236	1,793	138	77.0	341	190,074
5-14	3,448	240	69.7	958	277,846	1,605	112	69.6	447	278,474
15-24	9,773	582	595	3,984	407,692	6,317	377	59.6	2,570	406,763
25-44	36,819	1,623	44.1	13,554	368,125	10,212	472	46.2	3,924	384,286
45-64	152,083	3,776	24.8	24,007	157,856	6,908	186	26.9	1,274	184,457
65+	766,003	7,418	9.7	13,431	17,534	12,929	132	10.2	262	20,289

  * Excludes 13,097 deaths in later years due to injuries sustained in 1985
 ** Discounted at 6 percent

leading cause of death, accounting for less than 7 percent of total deaths. But deaths from this cause represent 36 life years lost per death and a productivity loss of $334,851 per death. Injury fatalities involve younger people than those dying from other causes and result in higher productivity losses.

Mortality Losses and Research Expenditures

The economic burden of illness can be used to target programs and to set priorities when the costs of various illnesses are available for comparative purposes. However, there are almost no current lifetime

cost data available for other illnesses with which to compare the total costs developed in this report. Nevertheless, valid comparisons can be made on the basis of cost and life years lost for deaths occurring in 1985 from various illnesses.

Injury in America (Committee on Trauma Research, 1985) compares federal support for nonmilitary injury-related research with expenditures

Table 18

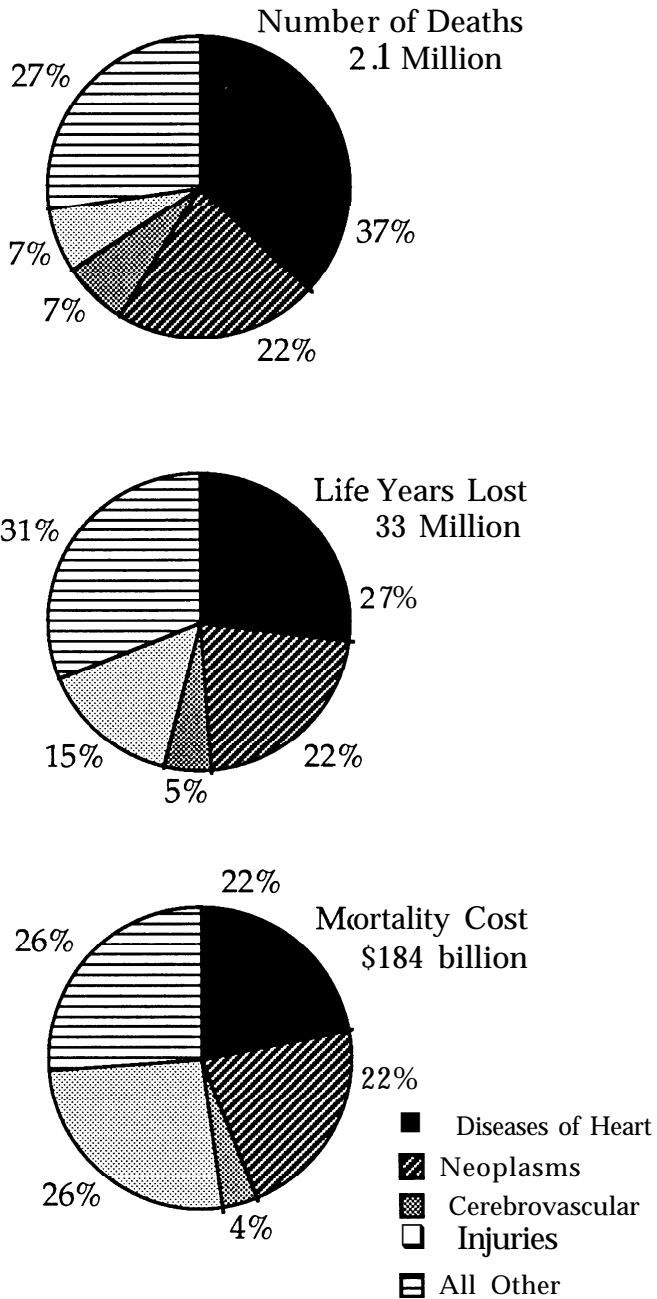**Mortality Losses Due to the Leading Causes of Death
by Sex and Cause, 1985**

Cause	Number of Deaths	Life Years Lost		Mortality Cost*	
		Total (thousands)	Per Death	Total (millions)	Per Death
Total	2,085,563	33,253	15.9	$183,643	$88,054
Diseases of the Heart	771,169	9,094	11.8	**40,982**	53,143
Neoplasms	461,563	7,210	15.6	40,786	88,365
Cerebrovascular Diseases	153,050	1,664	10.9	6,237	40,751
Injuries**	142,568	5,126	36.0	47,739	334,851
All Other	557,213	10,158	18.2	47,899	85,962
Male	1,097,267	18,044	16.4	124,134	113,130
Diseases of the Heart	398,208	4,874	12.2	28,480	71,520
Neoplasms	246,914	3,467	14.0	22,565	91,388
Cerebrovascular Diseases	60,780	655	10.8	3,255	53,554
Injuries**	102,804	3,710	36.1	38,921	378,594
All Other	288,561	5,338	18.5	30,913	107,128
Female	988,296	15,209	15.4	59,509	60,214
Diseases of the Heart	372,961	4,220	11.3	12,502	33,521
Neoplasms	214,649	3,743	17.4	18,221	84,887
Cerebrovascular Diseases	92,270	1,009	10.9	2,982	32,318
Injuries**	39,764	1,417	35.6	8,818	221,758
All Other	268,652	4,820	17.9	16,986	63,227

  * Discounted at 6 percent

 ** Excludes 13,097 deaths in later years due to injuries incurred in 1985

Figure 20

Mortality Losses Due to Leading Causes of Death, 1985

Number of Deaths
2.1 Million

27%

37%

7%

7%

22%

Life Years Lost
33 Million

31%

27%

15%

5%

22%

22%

Mortality Cost
$184 billion

26%

22%

26%

4%

■ Diseases of Heart

▨ Neoplasms

▩ Cerebrovascular

❑ Injuries

▤ All Other

for research on neopla sms and cardiovascular diseases in 1983. The Committee undertook a careful and systematic review of research expenditures in federal agencies. The survey of federal agencies was based on reports of projects from the agencies and computerized indexes of research expenditures. The total federal expenditure for research on injury was approximately $112 million in fiscal year (FY) 1983. This total was then compared with the budgets of the National Cancer Institute and the National Heart, Lung and Blood Institute. In addition, data were presented for the years of life lost to age 65 for deaths in a year due to injury, cancer, and cardiovascular diseases (heart disease and stroke).

The investigators conclude in *Injury in America* that support for research on injury prevention and control is relatively small, comprising about one-tenth of the expenditures for cancer research and less than one-fifth of cardiovascular disease research expenditures. In terms of life years lost prior to age 65, however, injury accounts for 4.1 million years of life lost compared with 1.7 million years for cancer and 2.1 million years for cardiovascular diseases. The conclusion is that the smallest portion of research funding is being allocated to a most costly public health problem -- injury.

The present study provides lifetime cost as another dimension for comparing the magnitude of leading health problems with the level of research investment for each. A rough approximation of expenditures for injury-related research in FY 1987 is $160 million. This estimate is based on the research expenditure data presented for each federal agency in *Injury in America. These* expenditures are inflated on the basis of the percent increase in the total research amounts for each agency reported from FY 1983 to FY 1987, as reported in the Budget of the *United States Government: Appendix* (U.S. Office of Management and Budget, 1986; 1989) and in the NIH *Basic Data Book* (U.S. National Institutes of Health, 1988). Budget obligations in FY 1987 amounted to $1.4 billion for the National Cancer Institute (NCI) and $930 million for the National Heart, Lung and Blood Institute (NHLB).

Figure 21 compares the estimated FY 1987 research expenditures per life year lost with the mortality losses for 1985 expressed in total life years lost per death and lifetime cost per death. Injury research expenditures amount to 11 percent of the NC1 budget obligation and 17 percent of the NHLB obligation. Life years lost per injury death (36 years) are, however, more than twice the number lost to cancer (16 years) and three times the number lost to cardiovascular diseases (12 years). Mortality cost per injury death ($335,000) is almost four times the cost for cancer ($88,000) and more than six times the cardiovascular disease cost ($51,000). It is apparent that injury, the largest public health problem, is receiving a disproportionately small share of research funding.

Figure 21

Federal Research Investment and Productivity Losses by Cause of Death
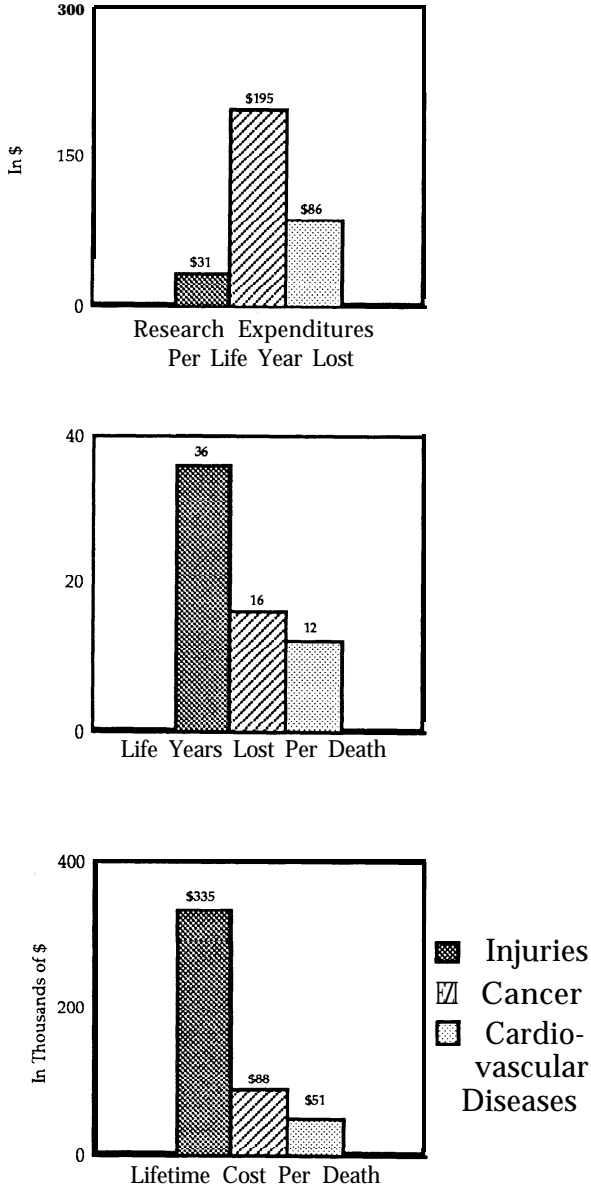
Economic and Measurement Concepts

The research on the cost of injury in the United States on which this report is based develops a measure of the economic burden of injury. The estimates represent the monetary burden on society of injury-related illness and premature death. This study builds on and extends the analysis on the economic cost of illness begun by Dorothy Rice in 1965 (Rice, 1965; 1966; 1967; Rice and Cooper, 1967; Cooper and Rice, 1976; Rice and Hodgson, 1981; Rice, Hodgson and Kopstein, 1985; Rice, Hodgson, Sinsheimer, Brower, and Kopstein, 1986; and Scitovsky and Rice, 1987).

Cost-of-illness studies are typically divided into two components. The direct cost is the actual dollar expenditure related to the illness. The indirect cost represents the value of lost output due to reduced productivity caused by illness and disability and losses due to premature death.

Human Capital and Willingness-to-Pay Approaches

Two approaches are used for valuing the forgone productivity, or indirect cost, of illness. The human capital approach, developed by Rice, is the most commonly used method. In this approach, an individual is seen as producing over time a stream of output valued at market earnings or by the imputed worth of housekeeping services. The human capital concept assumes a social perspective and has the important advantage of employing data that are reliable and readily available. This approach is useful for answering questions regarding the economic burden of a disease for a specific time period (e.g., the cost of injury for 1985) or for determining the savings of a specific procedure or intervention program that will reduce illness and/or improve survival rates.

The human capital approach also has some drawbacks. Because its valuation of human life is based on market earnings, it yields very low values for children and retired elderly persons. Many injury victims fall into these categories. The human capital approach also undervalues life if labor market imperfections exist and wages do not reflect true abilities. For example, women and minorities are often paid wages that are lower than the value of what they produce. Certain dimensions of illness and death, such as pain, suffering, and reduced quality of life, are also ignored.

The willingness-to-pay approach is often described as an alternative methodology for valuing human life. In reality, it is a conceptually different approach that captures other aspects of the value of life and is therefore useful for different purposes (Rice and Hodgson, 1982). The willingness-to-pay method values human life according to the amount

individuals are willing to pay for a change that reduces the probability of illness or death Shelling, 1968; Acton, 1975). This approach assumes an individual perspective and incorporates all aspects of well-being, including labor and non-labor income, and the value of leisure, pain, and suffering. The overriding objection to the willingness-to-pay method is that it requires substantial development prior to implementation, thereby limiting efforts to apply it.

The present report presents a range of cost estimates using both approaches.   The human capital approach is employed in this chapter and is the basis for estimating the total lifetime cost of injury. The willingness-to-pay approach is used in Chapter 4. Both approaches are employed in Chapter 5 to estimate the cost and savings of preventive interventions.

Prevalence and Incidence Approaches

Two approaches can be used to estimate the cost of illness and injury by the human capital method. Prevalence-based cost provides an estimate of the direct and indirect economic burden incurred in a period of time (the base period) as a result of the prevalence of injury during this same base period, most often a year. Included is the cost of base-year manifestations of illness or associated disability with onset in the base year or at any time prior to the base year. Prevalence cost measures the value of resources used or lost during a specified period of time, regardless of the time of onset of the illness or injury.

Incidence cost represents the lifetime cost resulting from the illness. In the aggregate, incidence cost in a given base year refers to the total lifetime cost of all cases with onset of disease in the base year. The incidence cost is difficult to estimate because it requires knowledge of the likely course of an illness and its duration, including survival rates since onset; the amount and cost of medical care to be used during the duration of the illness; and the impact of the illness on lifetime employment, housekeeping, and earnings (Hodgson, 1983; Scitovsky, 1982).

Relatively few incidence-based studies exist, but the current state of the art is illustrated by Smart and Sanders (1976), who estimated the cost of spinal cord injuries caused by motor vehicle crashes in 1974; Hartunian, Smart, and Thompson (1981), who estimated the costs of cancer, coronary heart disease, stroke, and motor vehicle injuries; investigators at Policy Analysis, Inc. (1981), who examined the costs of breast cancer, diabetes mellitus, rheumatoid arthritis, stroke, and acute lymphocytic leukemia; and Oster, Colditz, and Kelly (1984), who estimated the cost of smoking and the benefits of quitting. The present

study develops estimates of the lifetime, or incidence-based, cost of injury.

Data Sources

Five national databases used extensively in the cost analysis are briefly described in the Glossary. The National Health Interview Survey (NHIS) provides estimates of service utilization and days of restricted activity for nonhospitalized injuries. The NHIS is not used to derive estimates for hospitalized injuries because the sample is too small. The National Hospital Discharge Survey (NHDS) is used to develop estimates of mean length of initial hospital stay. The data sources for incidence analysis are described in Chapter 1.

The National Medical Care Utilization and Expenditure Survey (NMCUES) is used to estimate unit costs or charges for emergency room and physician visits, prescriptions, other medical expenses, outpatient physical therapy visits, and ambulance services. This survey was conducted in 1980, and includes data on health conditions, service utilization, and charges for 10,000 households. Costs are updated to 1985 using the consumer price index (CPI). That is, the 'prescription drug' component of the CPI was used to update the prescription costs, the 'physicians' services' component to update physician visit costs, and the 'medical care services' component to update other costs.

The National Council on Compensation Insurance (NCCI) Detailed Claim Information database provides data on over 500,000 Workers' Compensation injury cases followed for up to 7 years between 1979 and 1986. This database is used to develop estimates of later year medical costs.

The National Nursing Home Survey (NNHS) provides the basis for the estimates of nursing home costs and forgone productivity for this institutionalized population. The survey was conducted in 1985 and includes data on medical conditions, expenses, and length of stay for residents of over 1,000 nursing homes nationwide.

A study by MacKenzie, Shapiro, and Siegel (1988) is used to obtain data on rehospitalization and service utilization for hospitalized injuries because there is no reliable national data source. This study followed 500 Maryland trauma patients for one year and includes data on rates of service utilization and costs by nature of injury and severity.

Cost Estimation Methods

Costs are estimated for three classes of injury: fatalities, hospitalized injuries, and nonhospitalized injuries. The cost estimation methods for each class of injury are described by type of cost. Charges are used as a surrogate for resource costs. This approach is commonly employed in

the cost-of-illness literature. However, due to market imperfections in the health care sector, charges may not accurately reflect costs.

Fatalities

The cost of fatal injury consists of direct cost and mortality cost. Costs are derived separately for fatalities at the scene of the injury, in the emergency room, and in the hospital. All injury fatalities are included in this category and not in the hospitalized and nonhospitalized categories.

Direct Cost

For purposes of calculating the direct cost associated with injury fatality, injuries are divided into three groups according to where the death occurred. Based on the distribution of trauma deaths in Maryland for 1986, 50 percent of deaths are assumed to occur at the scene of the injury, 29 percent in the emergency room, and 21 percent after admission to the hospital. This distribution is virtually identical to that reported by Trunkey (1983) of 50 percent, 30 percent, and 20 percent, respectively. The advantage of using the Maryland distribution is that separate distributions are available for motor vehicle injuries, fires, falls, firearm injuries, and other injuries. Drownings and poisonings are assumed to follow the overall distribution.

Death at the Scene. An ambulance is assumed to be sent to the scene of each fatality. The one-way charge for ambulance services for nonhospitalized injuries from the National Medical Care Utilization and Expenditures Survey (NMCUES) is used.

Death in the Emergency Room. All victims who die in the emergency room are assumed to arrive by ambulance. The NMCUES one-way ambulance charge for hospitalized injury is used. These persons also incur emergency room charges; an average charge per person is derived from Champion, Gainer, and Yackee (1986).

Death in the Hospital.   A distribution of the probability of transportation by ambulance is estimated separately for burns and non-burns. The burn data come from Honton, Richmond, and Stacey (1980) and the non-burn data from The Consumer Product Safety Commission (CPSC) Injury Cost Model (Technology + Economics, 1980). The one-way charge for hospitalized injuries from the NMCUES is used.

Persons dying after admission to a hospital also incur emergency room, hospital, and physician charges.   Emergency room charges are included in the hospital bill. Based on an analysis of the Maryland post-trauma recovery study, a factor of 1.25 is multiplied by the hospital charges to allow for physician and other professional fees (MacKenzie,

1988). The hospital charges are estimated by taking the mean cost per death from Maryland (distributed by age and cause), adjusting by a factor of .9572 to reflect the ratio of United States per diem charges to Maryland charges, and applying this cost per death to the number of deaths occurring nationally.

Insurance Administration Cost. Several types of insurance are relevant to the cost of injury. Estimates are for auto insurance and health insurance. Insufficient data are available to estimate the costs of workers' compensation or product liability insurance. The relevant costs for this study are the overhead and administrative costs. Settlements are excluded because they are transfer payments used to cover the medical and other costs already estimated. Transfer payments are discussed in Chapter 3.

Blincoe (U.S. NHTSA, 1983; 1987) estimates the total cost of insurance administration for fatal motor vehicle injuries for 1985. This total is distributed by age and sex according to incidence. The methodology developed by the National Highway Traffic Safety Administration (U.S. NHTSA, 1983), is used to estimate health insurance administration costs as follows. In 1985, 30.4 percent of personal health care expenditures were paid for by private insurance (U.S. HCFA, 1987). Insurance overhead was 13.1 percent of total premiums. Hence, the health insurance administration cost is estimated to be .304 times .131, or 4.0 percent of the injury medical care cost.

Mortality Cost

The mortality cost, or the value of forgone productivity due to early death, is also estimated. In addition to the deaths that occurred in 1985, a number of individuals experienced shortened life expectancies, dying at an earlier age than they would have in the absence of injury. This is referred to as 'late mortality.'

Mortality cost is the value of lost productivity resulting from injury, calculated as the product of injury-caused deaths and the present value of future earnings lost. The estimate of lifetime earnings takes into account varying labor force participation rates. The assumption is that people will be working and productive during their expected lifetime in accordance with the current pattern of work experience for their sex and age group. For this calculation, the percent of the population with earnings in 1985 published by the U.S. Bureau of the Census (1987a) is used. For injured persons with lower than average earnings, the mortality cost may be somewhat overestimated.

Output losses are based on annual mean earnings by age and sex, adjusted for wage supplements such as employer contributions for social insurance, private pensions, and welfare funds. Cross-sectional profiles

of mean earnings by age and sex are employed to estimate lifetime earnings. In applying these data, the future pattern of earnings of an average individual within a sex group is assumed to follow the pattern reported by the Bureau of the Census during a base year. This model recognizes that average individuals may expect their earnings to rise with age and experience in accordance with the cross-sectional data for the base year. Appendix B presents the formulas for estimating direct, morbidity, and mortality costs.

Estimates based on marketplace earnings undervalue losses due to injuries sustained by individuals not in the paid labor force. The value of household work, therefore, must be added to earnings. Estimates of the value of household services are obtained by updating the regression-based estimates of Feskin (1984). Her methodology involves calculating the mean time inputs for men and women who keep house and valuing the contributions by specific tasks performed with the prevailing wage rate for performance of similar tasks. The data for 1985 are analyzed in a regression framework so that controls for socioeconomic and demographic factors can be made. Data on family structure, education, income, and race are substituted into the regression equation developed by Peskin to estimate hours spent on household labor. The estimated hours are valued on the basis of 1985 wage rates by activity.

Future changes in productivity of wage earners also need to be taken into account. Based on average changes in hourly earnings between 1980 and 1986, a one percent annual increase in productivity is assumed (U.S. Bureau of the Census, 1987b). Life expectancy, labor force participation rates, and average annual earnings are shown in Appendix Tables C-17 and C-18. The present value of lifetime earnings discounted at 4 and 6 percent are shown in Appendix Table C-19 and Appendix Figure C-l.

For late mortality, shortened life expectancy is assumed to affect two types of injury: severe spinal cord injury (AIS 4 and 5) and severe head injury (AIS 5). Life expectancies are taken from DeVivo, Fine, Maetz, and Stover (1980). For spinal cord injury, an average of the life expectancy for paraplegia (incomplete and complete) and quadriplegia (incomplete and complete) is applied to all AIS 4 and 5 spinal cord injuries. Following Hartunian and associates (1981), the life expectancy for incomplete paraplegia is used for head injuries of AIS 5. The late mortality cost is calculated as the reduced value of discounted lifetime earnings due to life years lost in the future.

Hospitalized Injury

The cost of hospitalized injury consists of direct cost and morbidity cost. Injured persons who die in the hospital are not counted in this category.

Direct Cost

The direct cost of hospitalized injury is estimated by applying service utilization rates obtained from various sources to the number of injured hospitalized persons from the National Hospital Discharge Survey (NHDS). Charges are derived from a number of sources. The resulting first year cost is the basis for estimating the lifetime cost with an adjustment factor obtained from the NCCI database. Finally, costs are distributed into cause categories based on the incidence of injuries.

Initial Hospitalization. Charges for the initial acute care hospitalization are estimated using the following procedure. First, NHDS data are used to determine the mean length of stay within subgroups of the population defined by three age groups (O-14, 15-64, and 65+) and 24 groups defining the nature and severity of the injury (Table 4). These means are multiplied by the corresponding average per diem charges reported by all acute care hospitals in Maryland for 1984, 1985, and 1986. These estimates are deflated by a factor of .9572, the ratio of the United States average per diem hospital charge to the Maryland average per diem hospital charge based on the 1985 Annual Survey of the American Hospital Association (AHA, 1986). The resulting estimates of hospital charges are inflated by 25 percent to account for professional fees (MacKenzie, 1988). Maryland per diem charges are used because they are computerized for all acute care discharges and because hospital charges are regulated by the state Health Services Cost Review Commission and have a known relationship to costs. All third-party payers pay full charges less a small discount for timely payment.

Physician Visits. The number of physician visits out of the hospital during the first year for all types of injury (by body region and severity of principal injury) is from MacKenzie and associates (1988). For each type of injury, the number of injured persons is multiplied by the percent with physician visits times the mean number of visits to obtain the total number of visits. A per visit charge is applied from the NMCUES, based on a mean of charges for office, outpatient, and other visits.

Prescription Drugs and 'Other' Items. Charges for prescription drugs and 'other' items are developed by applying the average charge

per person from the NMCUES to the number of injured hospitalized persons from the NHDS.

Rehospitalization for Medical/Surgical, Mental/Emotional, or Rehabilitation Needs. The costs of rehospitalization for these three (mutually exclusive) purposes are based on rehospitalization rates from MacKenzie and associates (1988). For each category of cost, the number of injured hospitalized persons is multiplied by the percent rehospitalized times the average length of stay. This total is applied to all types of injury except burns.   For burns, medical / surgical rehospitalization is based on an 8 percent readmission rate with a 6-day average length of stay in a typical burn unit. The daily charge used for medical/surgical rehospitalizations is the national average charge (AHA, 1987) increased by 25 percent to allow for professional and physician fees (MacKenzie, 1988). The per diem charge applied to rehospitalization for rehabilitation is the mean daily rehabilitation charge reported by the National Association of Rehabilitation Facilities (Coopers & Lybrand, 1985). This charge is not adjusted upward because professional and physician fees are typically included in the per diem charge for rehabilitation facilities. The daily charge used for mental/emotional rehospitalization is the rate reported for nonfederal psychiatric hospitals by the AHA (1987) inflated to account for professional and physician fees.

Outpatient Physical Therapy. The number of visits for outpatient physical therapy is from MacKenzie and associates (1988). The number of injured hospitalized persons is multiplied by the percent with physical therapist visits times the mean number of visits per person. The charge per visit used is the charge for 'other visits' from the NMCUES.

Ambulance. The distribution of the probability that a person would be transported by ambulance is discussed above under fatalities. For persons transported, the average charge from the NMCUES is used.

Helicopter Transport. In 1985,61,500 patients were transported by helicopter, 43 percent of them for trauma (Hospital Aviation, 1988). The mean cost per trip nationally is reported by Collett (1988). All of the resulting costs are assumed to be for patients who were hospitalized, and it is assumed that 95 percent of them are for motor vehicle injury victims and 5 percent for bum victims.

Later Year Medical Cost. An analysis of NCCI claims data reveals that the percent of lifetime cost incurred in the first year (assumed to be the 6-month and 18-month reporting periods) is distributed as follows: head injury, 80 percent; spinal cord injury, 78 percent; extremity injury, 88 percent; abdominal/thoracic injury, 91 percent; and other injuries, 87

percent. These percentages are used to derive a total lifetime medical cost estimate for hospitalized injury.

Attendant Care. The only available estimate for attendant care is for spinal cord injury victims (Miller, Luchter, and Brinkman, 1988). A weighted average of the discounted per person lifetime cost for AIS 4 and 5 victims is developed and applied to the number of spinal cord injury AIS 4 and 5 cases from the NHDS.

Vocational Rehabilitation Seventy-nine percent of the total vocational rehabilitation cost for 1985 in the NCCI database is due to hospitalized injuries. Fifty-seven percent of the total discounted rehabilitation cost for hospitalized injury occurs during the first year. Therefore, the first year estimate is multiplied by 1.76 (l/.57) to obtain the total lifetime vocational rehabilitation cost. Costs are distributed by age, sex, and cause according to incidence numbers.

Insurance Administration Cost The estimate of auto insurance administration cost is taken from Blincoe (U.S. NHTSA, 1983; 1987) and distributed by age and sex according to incidence. The methodology used to estimate the cost of health insurance overhead is discussed above.

Morbidity Cost

Morbidity cost consists of forgone productivity due to injury. First year morbidity losses are estimated separately from lifetime losses. Forgone earnings per person are estimated for an individual of a given age and sex with an injury of a specific type and severity and multiplied by the number of injured hospitalized persons to obtain the total cost estimate.

First Year Cost The approach used to estimate lost earnings (both market and imputed housekeeping services) during the first year after an injury is to estimate the earnings of the injured person and subtract it from the earnings of a healthy individual of the same age and sex. MacKenzie, Shapiro, Smith, Siegel, Moody, and Pitt (1987) report the percent of previously working individuals who are working full-time at 12 months after the injury for all types of injury (by body region and severity). This percent is used to estimate post-injury earnings.

An additional adjustment is made to allow for the individuals who work part-time after an injury, assuming part-time to be 20 hours per week, adjusted as follows. According to the 1978 Survey of Disability and Work, 34 percent of the total disabled population works full-time, 24 percent works part-time, and 42 percent is unemployed (Lando, Cutler,

and Gamber, 1982). Hence, it is assumed that of the injured individuals who are not working full-time, 57 percent is working part-time.

According to data from the U.S. Bureau of the Census (1987b), disabled persons earn 91 percent as much as their healthy counterparts after controlling for percent of time worked. This percentage is used to estimate the first year cost.

Lifetime Earnings Losses. In addition to persons who are unable to perform their usual duties during the first year after an injury, a number of individuals suffer permanent disability. It is assumed that such losses would apply to all individuals suffering head injuries and other types of severe injury. For each type of injury, the percent of persons working at four years after an injury is taken to be the percent working thereafter.

Data on the percent of injured persons working at four years after an injury for all types of head injury (AIS 1 to 5) and severe extremity injury (AIS 3 and 4) are from MacKenzie and associates (1987). For spinal cord injury (AIS 4 and 5), reemployment rates are from DeVivo, Rutt, Stover, and Fine (1987). It is assumed that the employment experience of persons with severe abdominal/thoracic injury (AIS 4 and 5) and severe 'other' injuries (AIS 3,4, and 5) would be similar to that of persons with incomplete paraplegia, obtained from El Ghatit and Hanson (1978).

After reemployment rates are obtained, the procedure is similar to that used to calculate first year losses (i.e., lifetime earnings of the injured person are subtracted from those of a healthy individual of the same age and sex). An additional adjustment is made to allow for the reduced life expectancy of persons with severe spinal cord and head injuries. For these injuries, the reduction in expected life earnings calculated as 'late mortality' is subtracted from expected lifetime earnings.

Nonhospitalized Injury

The cost of nonhospitalized injury consists of direct cost and morbidity cost. Injured persons who die without being hospitalized are not counted in this category.

Direct Cost

The direct cost of nonhospitalized injury is estimated in three steps. First, first year cost estimates use NHIS utilization data and NMCUES cost data. Second, lifetime cost is estimated based on the percentage of cost incurred in later years from the NCCI data. Finally, costs are distributed by cause of injury using the age and sex distribution of injuries, relating nature of injury to cause of injury. In some cases, cost can be estimated directly by cause.

Emergency Room Visits and Physician Visits. The number of visits to physicians in emergency rooms and in all other settings is from the NHIS by nature of injury, age, and sex. The charge per visit comes from the NMCUES. For physician visits, the charge is the weighted average (weighted by the number of survey respondents) of visits in the outpatient department, physician's office, and 'other visits.'

Prescription Drugs and 'Other Items.' Charges for prescription drugs and 'other' items are estimated by applying the average charge per person for a given nature of injury from the NMCUES to the number of injured nonhospitalized persons from the NHIS. 'Other' expenses include crutches, hearing aids, orthopedic appliances, and eyeglasses.

Ambulance. The probability of ambulance transport is assumed to be the same for hospital fatalities and live discharges. The development of this distribution is discussed above. For persons transported, a NMCUES average one-way charge for nonhospitalized injuries is used.

Later Year Medical Cost. An analysis of the NCCI 1988 database is used to calculate medical cost in later years: Approximately 92 percent of the total discounted lifetime cost for nonhospitalized persons is incurred during the first year (assumed to be the 6-month and 18-month reporting periods). Therefore, first year cost is inflated by a factor of .09 (l/.92) to arrive at the total lifetime cost for nonhospitalized injury.

Vocational Rehabilitation. The total vocational rehabilitation expenditure for 1985 is estimated from an analysis of national data obtained from the Rehabilitation Services Administration. The total is distributed according to expenditures for nonhospitalized and hospitalized persons using the breakdown of expenditures reported in the NCCI data base, in which 21 percent of expenditures are for nonhospitalized and 79 percent for hospitalized persons. The rehabilitation cost for later years is obtained by multiplying first year costs by a factor of 1.43 (l/.70) to reflect the fact that 70 percent of the cost for nonhospitalized persons in the NCCI database is incurred during the first year. Costs are distributed by age, sex, and cause according to the distribution of injuries.

Insurance Administration Cost. Auto insurance overhead cost is taken from Blincoe (U.S. NHTSA, 1983; 1987) and distributed by age and sex according to incidence. The methodology used to estimate the cost of health insurance overhead is discussed above.

Morbidity Cost

The morbidity cost of nonhospitalized injury consists of forgone productivity due to days lost from usual activity due to injury. Days of

restricted activity are calculated from the NHIS for three groups of individuals: employed persons, persons keeping house, and persons attending school or involved in some other activity. For employed persons, work-loss days are multiplied by average daily earnings (consisting of both marketplace earnings and the imputed value of housekeeping services for persons in the labor force) for a healthy person of the same age and sex. For persons keeping house, days of restricted activity are multiplied by the average daily value of imputed housekeeping services for a healthy person of the same age and sex who is not in the labor force. For other people, an average of marketplace and housekeeping services is weighted by the labor force participation rate. This average daily value is multiplied by days of restricted activity. The assumption is that all indirect costs occur in the first year.

Injury Resulting in Nursing Home Admission

Injury resulting in nursing home admission is not considered a separate class of injury because such injuries are included in hospitalized or nonhospitalized injury estimates. Since 34.2 percent of residents are admitted from hospitals, this percentage of the cost of injury resulting in nursing home admissions is added to the cost of hospitalized injury. The remaining 65.8 percent of the cost is added to the cost of nonhospitalized injury.

Direct Cost. Nursing home cost is calculated as follows. The number of nursing home admissions for 1985 in which the admitting diagnosis was an injury was obtained from the 1985 National Nursing Home Survey. The distribution by average length of stay was also obtained. The number of admissions times length of stay is multiplied by the national average annual charge to obtain total charges. Later year charges are adjusted to reflect an 8 percent average increase in cost and a 6 percent discount rate. Based on limitations of available data, these costs are distributed by cause by assuming that all fractures result from falls, and that the distribution of the remaining injuries would follow the distribution of injuries in the general population aged 65 and over. Costs are distributed by age and sex according to the published distribution of injury admissions (U.S. NCHS, 1989b).

Morbidity Cost Morbidity cost is obtained by multiplying length of stay in a nursing home times average annual earnings for a healthy individual of the same age and sex.

Data Limitations

The cost estimates presented in this report employ the best data available for developing national estimates. An effort is made to rely on

national data sources to the extent possible. Many estimates exist for specific types of injury or cost elements based on small samples or single locations.   These are not used when the data are considered to be nonrepresentative, or when alternative information can be obtained at the national level. Nonetheless, several qualifications are in order.

Several known costs are excluded because data are unavailable. No attempt is made to value the services of family members and friends who care for the injured. This 'informal care' cost is likely to be significant, as illustrated by the case studies, but there are no reliable data from which to make estimates. The insurance administration cost associated with workers' compensation and product liability is a cost of injury. However, no national data exist from which to develop estimates. Some nonhospitalized injuries probably result in morbidity beyond the first year. But again, data are lacking. There are no national estimates of attendant care for the non-spinal cord injured. Severely injured persons may be institutionalized in residential or intermediate care facilities, but it is not possible to capture this cost. Legal costs and property damage costs are excluded because the focus of this report is the injury as opposed to the event causing the injury. In addition, legal and property damage costs are not available for all causes of injury.

Some of the cost estimates are likely to be lower than they should be, again due to data limitations. For example, some studies find the lifetime cost of a severe head injury to be several million dollars. A few cost studies estimate the cost per person in excess of the estimates in this report. The reason for the difference is that anecdotal studies and results not documented at the national level are not used herein. Additionally, the care received by injured persons often may not be the state-of-the-art care that could ideally be received.   The estimates are therefore conservative and do not reflect all that the nation should be spending on the care of injured persons.

Certain cost elements are accurately estimated as a whole, but many assumptions are necessary for the age, sex, and cause distributions. The total national expenditure for vocational rehabilitation is known, for example, but the age-, sex-, and cause-specific breakdowns are not readily available.   Similarly, the number of emergency helicopter transports is known, but detail on persons being transported is not available.

The data sets employed differ significantly as to how the cost data can be broken down, necessitating many assumptions. For this reason, a breakdown of costs by AIS, nature, or intent of injury would be unjustified by the available data. For the reasons discussed above, the cost estimates presented in this report can be interpreted as a lower limit of the true cost of injury. As better data become available, the approach

used herein can be refined and improved. However, these estimates are based on the best data available at the present time.

Conclusion

The economic cost of injury, as presented in this chapter, is enormous. It imposes a $158 billion burden on the **U.S.** economy, representing the aggregate lifetime cost for 57 million persons injured in 1985. Direct expenditures for medical care (e.g., hospital care, physician services, drugs, appliances, and rehabilitation) and for nonmedical care (e.g. home modification, vocational rehabilitation, and the administrative cost of automobile and health insurance) amount to $45 billion, or 29 percent of the total cost. Morbidity for persons disabled as a result of injury amounts to 5 million life years lost, valued at $65 billion, or 42 percent of the total cost.

Premature death due to injury constitutes another large share of the total economic cost. Approximately 143,000 premature deaths from injuries occurred in 1985 and an additional 13,000 deaths occurred in later years due to injuries sustained in 1985. These premature injury deaths amount to a loss of 5.3 million life years lost, or 34 years per death. These losses to the economy amount to $48 billion at a 6 percent discount rate, or about $308,000 per death. The mortality cost accounts for 30 percent of the lifetime cost.

More males than females suffer injuries and the total lifetime economic cost of injury for males is more that double that for females -- $108 billion compared with $50 billion. More injuries occur among adults aged 25-44 than in any other age group, and their lifetime costs are highest. More than 18 million, or 32 percent, of injured persons in 1985 were in this age group and they accounted for 42 percent of the total cost. Injuries to persons aged 15-24 rank second in number and cost, accounting for 22 percent of the injuries and 25 percent of the total cost.

The greatest economic losses are caused by motor vehicles and falls, accounting for $49 billion and $37 billion, respectively, although the total number of injuries due to falls is more than twice that for motor vehicles. However, deaths due to motor vehicles are three and one-half times the deaths due to falls, and a significantly large number of motor vehicle fatalities are among younger persons, resulting in high lifetime cost. Firearms rank third in economic toll and poisonings, fourth.

The distribution of costs by class of injury reflects the severity of the injuries. Of the total $158 billion lifetime cost, 31 percent is for fatalities, 51 percent for injuries involving hospitalization, and 18 percent for nonhospitalized injuries.

Although cost-of-injury studies have been conducted in the past, the research on which the present report is based represents the first attempt

to quantify the magnitude of the national injury problem in economic terms by cause of injury, age, sex, and class of injury. Table 19 presents the cost of injury from past studies. Of the 15 prior studies, five relate to motor vehicle injury; two to spinal cord injury; one to unintentional injury; and one to trauma-related injury. Four studies encompass the cost of all illnesses in which injury is one of the major diagnostic

Table 19

Cost-of-Injury Estimates by Type of Cost

Type of Injury	Study Period & Method	Total	Direct	Indirect	Other Rel- ated	Dis- count Rate	Source
All injuries*	1963 Prevalence	$11,811	$1,703	$10,108	-	4	Rice, 1966
All injuries*	1972 Prevaience	24,678	5,121	21,557	-	4	Cooper and Rice, 1976
Motor vehicle spinal cord	1974 Incidence	828	249	579	-	6	Smart and Sanders, 1976
Motor vehicle	1975 Incidence	32,900	1,000	16,000	15,900	7	Faigin, 1976
All injuries*	1975 Prevalence	27,433	6,846	20,587	-	10	Berk, Paringer, Mushkin, 1978
Motor vehicle	1975 Incidence	14,435	3,728	9,662	1,045	6	Hartunian et al., 1981
Spinal cord injuries	1977 Prevalence	2,910	516	2,394	-	na	Bureau of Econ. Research, 1985
All injuries	1979 Prevalence	94,420	na	na	na	7	Edwards et al., 1981
Motor vehicle	1980 Incidence	57,199	3,326	14,237	39,636	7	U.S. NHTSA, 1983
All injuries*	1980 Prevalence	82,959	18,684	64,275	-	4	Rice, et al., 1985
Trauma rel- ated injuries	1982 Prevalence	61,025	19,278	41,746	-	6	Munoz, 1984
Unintentio- nal injuries	1985 Prevalence	107,300	17,800	48,700	40,800	na	Etter, 1987
Accidental injuries	1985 Prevalence			31,300	-	6	Miller, et al., 1987
All injuries	1985 Incidence	157,615	38,751	112,808	6,056	6	Rice and Mac- Kenzie, 1989
Motor vehicle	1986 Incidence	32,624	7,560	20,794	4,270	6	Miller and Luchter, 1988
Motor vehicle	1986 Incidence	74,200	5,270	16,380	52,550	7	U.S. NHTSA, 1983; 1987

* These studies encompass the cost of all illnesses; the cost of injury is one of the major diagnostic categories reported

Note: na = not available

categories reported. One study is for all injuries, but the distribution by type of cost is not reported, and one reports only indirect cost.

The table shows that estimated costs have risen over the years. More importantly, however, is the variation among the studies in the distribution of direct and indirect costs and the inclusion of other related costs, such as property damage. Four of the prior studies include estimates of other related costs that comprise from 7 to 71 percent of the total cost.

In several studies of cost for the same year, the total cost varies substantially. Major differences among the studies result from the use of the incidence or prevalence approach and the use of different discount rates. Six of the 15 studies employ the incidence approach; the remaining studies use the prevalence method. Two studies do not indicate what discount rates are used; the other 11 studies employ discount rates ranging from 4 to 10 percent. Differences in cost are due to the use of different methodologies, estimating procedures, sources of data, and discount rates.

The results of research on the lifetime cost of injury reported herein represent the most comprehensive and systematic effort to date to estimate the lifetime cost of injury disaggregated by the major causes of injury and by age, sex, and class of injury. Also included are the long-term costs of treatment, rehabilitation, and long-term productivity losses for persons injured, factors rarely quantified in earlier studies.

Source of Payment

The substantial economic burden placed on American society by injury is borne by various types of payers -- federal, state, and local governments; private insurance; workers' compensation; and private individuals. Public sources include federal (e.g., Medicare, Medicaid, and the Veterans Administration), state, and local government. Private sources include private health, disability, and life insurance; Workers' Compensation (federally administered, but almost exclusively financed by employers); and uninsured or uncovered care.

Estimates of the direct medical care cost of injury borne by these various sources are presented as well as information on the distribution of related direct (nonmedical, vocational rehabilitation) costs among payers. In addition, estimates of the impact of injury on transfer payments are presented. Transfer payments are not costs per se in that they reflect only the transfer of funds from one payer to another rather than additional resource use. Insurance settlements, for example, are funds transferred from the insurance company to the hospital or individual to pay for medical services that have already been counted elsewhere. The impact of injury on transfer payment programs, however, and on the taxes and/or premiums used to finance them, can be substantial. Data sources and methods used in developing the estimates are discussed at the end of the chapter, followed by information on additional payment sources.

Direct Expenditures

Sources of payment for direct health care expenditures are analyzed across two dimensions, age of the injured person and treatment setting. Age is an important determinant of payment source. Adults are often covered by employment-related health insurance. The majority of medical care cost for persons aged 65 and over is paid by Medicare, a public source of payment. For children, payment source is related to parental financial and employment status. If a parent is in the workforce, employer-sponsored health insurance is usually available. Children of low-income or unemployed persons rely on public sources of payment.

The second dimension in the analysis of source of payment is the type of expenditure or treatment setting. Persons who experience a

serious injury may pass through a continuum of care, including trauma care and inpatient hospitalization followed by outpatient visits, and perhaps rehabilitation. Less serious (and more common) injuries may involve treatment in only one setting, such as an emergency room or physician's office.

The National Medical Care Utilization and Expenditure Survey provides information on source of payment. This information is supplemented by other sources, including the National Hospital Discharge Survey (NHDS), the National Uniform Data System for Medical Rehabilitation, the National Institute of Mental Health Statistical Reporting System, and the National Nursing Home Survey. Direct lifetime costs are distributed by payer source. Data are not available on source of payment for ambulance and helicopter services, attendant care, and other expenses; these costs are therefore not distributed by payer source. Thus, $41.7 billion out of $44.8 billion in direct costs are distributed by source of payment.

Age Patterns

The distribution of national injury-related medical care expenditures by source of payment is shown in Table 20 and Figure 22; the distribution by age and source of payment is shown in Figure 23. Private sources account for 72 percent of the expense; 28 percent is borne by public sources. Within specific age categories, the distribution differs. Public sources pay for 72 percent of care for persons aged 65 and over through Medicare, Medicaid, and other government programs. For persons aged 15 to 44, on the other hand, private payments cover 86 percent of injury-related medical care. Workers' Compensation medical payments for injured persons account for one-fourth of total medical expenses for persons aged 15-64.

Uninsured care comprises almost one-fourth of private payments for injured persons under age 45. The 'uninsured care' category includes direct out-of-pocket expenditures for copayment and uncovered services as well as an unknown amount of uncompensated care. In the case of services such as pharmacy, a large proportion of these charges represent out-of-pocket payments made by the household. In the case of hospital charges, however, a substantial portion of uninsured care eventually represents bad debt for the provider. Bad debt is ultimately shifted to the charges paid by both public and private payers. Therefore, the source of payment labeled as 'uninsured care' embodies a degree of uncertainty as to the true source of payment.

Table 20

Direct Medical Care Cost of Injury by Source of Payment and Age, 1985

Source of Payment	Total	0-14	15-44	45-64	65+
Amount (millions)					
Total	**$41,742**	**$4,684**	$20,335	$7,462	**$9,261**
Public	11,598	1,104	2,828	**1,014**	6,652
Federal	**8,860**	**543**	1,618	**674**	**6,025**
Medicare	**6,270**	**12**	**498**	**388**	**5,372**
Medicaid	**1,888**	**419**	**720**	175	574
other	**702**	312	400	111	79
State and Local	2,738	561	1,210	**340**	627
Medicaid	1,370	348	603	147	472
Other	1,168	213	607	193	155
Private	**30,144**	**3,580**	**17,507**	**6,448**	**2,609**
Workers' Compensation*	6,997	87	4,637	2,244	29
Private Insurance	14,162	2,356	7,617	3,129	1,060
Private	2,053	197	1,457	314	85
Uninsured Care**	6,932	940	3,796	**761**	**1,435**
Distribution by Source of Payment					
Total	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
Public	27.8	23.6	13.9	13.6	71.8
Federal	21.2	11.6	8.0	9.0	65.1
Medicare	15.0	0.3	2.4	5.2	58.0
Medicaid	4.5	8.9	3.5	2.3	6.2
Other	1.7	2.4	20	1.5	0.9
State and Local	6.6	12.0	6.0	4.6	6.8
Medicaid	3.8	7.4	3.0	2.0	5.1
Other	2.8	4.5	3.0	2.6	1.7
Private	72.2	76.4	86.1	86.4	28.2
Workers' Compensation*	16.8	1.9	22.8	30.1	0.3
Private Insurance	33.9	50.3	375	41.9	11.4
Private	4.9	42	7.2	4.2	0.9
Uninsured Care**	16.6	20.1	18.7	10.2	15.5

* **Federally administered, but classified as private because almost exclusively financed by employers**

** **Includes direct out-of-pocket expenditures by families, uncompensated care and free care**

Figure 22

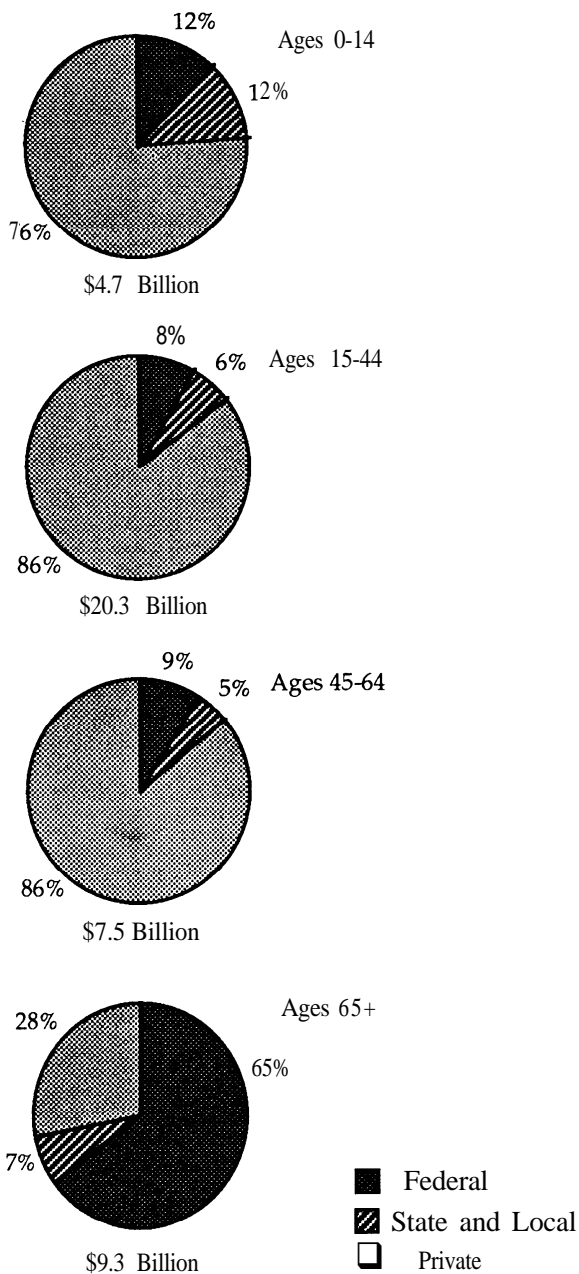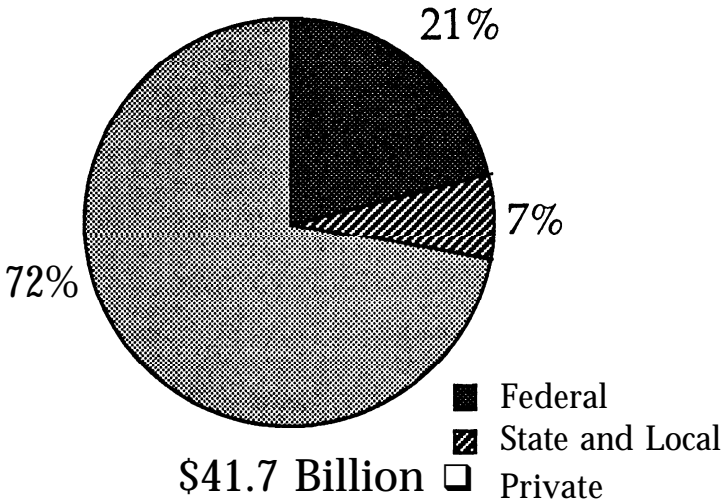# Direct Medical Care Cost by Source of Payment and Age, 1985

12%

Ages 0-14

12%

76%

$4.7 Billion

8%

6%   Ages 15-44

86%

$20.3 Billion

9%

5%   Ages 45-64

86%

$7.5 Billion

Ages 65+

28%

65%

7%

$9.3 Billion

■ Federal

▨ State and Local

❑ Private

Figure 23

Direct Medical Care Cost by Source of Payment, 1985

21%

7%

72%

$41.7 Billion

■ Federal

▨ State and Local

❑ Private

Patterns by Type of Expenditure

Table 21 shows the distribution of medical expenditures by source of payment and type of expenditure.   Included in hospital care expenditures are those for initial hospitalization, rehospitalization, medical/surgical care, mental health care, inpatient rehabilitation, and inpatient prescription drugs. Of expenditures for the hospital care of injured patients, 32 percent comes from public sources and the remaining 68 percent from private sources, mainly private health insurance and Workers' Compensation.

For outpatient care rendered in emergency departments, clinics, and private physician offices, private sources (mainly private health insurance) cover the bulk of expenditure -- 85 percent of the total. Private sources also pay for nearly three-quarters (74%) of the outpatient visits to physical therapists. Three-fifths of expenditures for prescription drugs are paid by patients or family members (i.e., self-pay); only 10 percent is from public sources, mainly Medicaid.

Some injured persons require extended convalescent or chronic care as the aftermath of an injury.   For the elderly, many nursing home admissions are triggered by a decline in functional status resulting from a fall (often leading to hip fracture).   Almost one-half (47%) of

expenditure for nursing home care comes from public sources with 43 percent in state and local government payments.

Nonmedical Care Expenditures

Of the four types of nonmedical direct expenditure, three (home modifications and health and auto insurance administrative expenses) are assumed to be funded entirely by the private sector. The fourth category, vocational rehabilitation, is funded by a federal-state matching program. It is estimated that 80 percent of these funds are financed by the federal government and 20 percent by state government. The federal share of vocational rehabilitation costs of $157 million shown in Table 12 is $126 million, and the state share is $31 million.

Transfer Payments

Transfer payments include amounts paid from public and private sources to injured persons or their survivors. Transfer payments are defined here to mean monetary compensation alone. Benefit payments for medical care and other goods and services are captured in the analyses of levels and payment sources for direct costs described above. The transfer payment analysis is confined to the major programs operated through the public sector – Veterans Administration, Old Age, Survivors, and Disability Insurance (OASDI), Supplemental Security Income (SSI), and Workers' Compensation. Also included are private sector automobile, life, and disability insurance benefits. Other sources of transfer payments (compensation awarded in legal proceedings, payments from public-sector and private-sector retirement systems to persons retiring because of disability due to injury) may be large, but are not included here since information is not available on either the total amount of such payments or on the amount going to persons disabled because of injury. Since administrative cost is not included for the programs analyzed, estimates refer to benefit payments alone.

Transfer payments for disability and death due to injury paid by each program and the estimated distribution of payments by funding source are shown in Table 22 and summarized in Figure 24; for the programs included in the present study, transfer payments for disability and death due to injury amount to $52.6 billion; 44 percent of the total ($23.3 billion) consists of disability payments. Automobile insurance paid $22.9 billion, 44 percent of all transfer payments (Miller, 1989). Workers' Compensation programs paid over $13 billion in disability payments and an additional $1.8 billion in benefits to surviving beneficiaries. The third largest payer of benefits was Social Security, which paid $4.4 billion in disability payments and $2.9 billion in

Table 21

Direct Medical Care Cost of Injury by Source of Payment and Type of Expenditure, 1985

Source of Payment	Total	Hospital Care	Physician Visits	Prescription Drugs	Physical Therapy	Nursing Home Care
Amount (millions)						
Total	$41,742	$28,479	$8,861	$1,550	$1,372	$1,480
Public	11,598	9,084	1,327	148	351	695
Federal	8,360	7,403	737	70	259	396
Medicare	6,270	5,696	395	5	148	25
Medicaid	1,888	1,195	249	51	55	341
Other	702	512	93	14	56	30
State and Local	2,738	1,681	590	78	92	299
Medicaid	1,570	1,017	196	36	44	278
Other	1,168	664	394	42	48	21
Private	30,144	19,395	7,534	1,402	1,021	785
Workers' Compensation'	6,997	5,419	1,252	163	163	NA
Private Insurance	14,162	9,835	3,585	309	414	12
Private	2,053	1,072	726	92	151	12
Uninsured Care**	6,932	3,069	1,971	838	293	761
Distribution by Source of Payment						
Total	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
Public	27.8	31.9	15.0	9.5	25.6	47.0
Federal	21.2	26.0	8.3	4.5	18.9	26.8
Medicare	15.0	20.0	4.5	0.3	10.8	1.7
Medicaid	4.5	4.2	2.8	3.3	4.0	23.0
Other	1.7	1.8	1.0	0.9	4.1	2.0
State and Local	6.6	5.9	6.7	5.0	6.7	20.2
Medicaid	3.8	3.6	2.2	2.3	3.2	18.8
Other	2.8	2.3	4.4	2.7	3.5	1.4
Private	72.2	68.1	85.0	90.5	74.4	53.0
Workers' Compensation"	16.8	19.0	14.1	10.5	11.9	NA
Private Insurance	33.9	34.5	40.5	19.9	30.2	0.8
Private	4.9	3.8	8.2	5.9	11.0	0.8
Uninsured Care"	16.6	10.8	22.2	54.1	21.4	51.4

* Federally administered, but classified as private because almost exclusively financed by employers

* Includes direct out-of-pocket expenditures by families, uncompensated care and free care

survivor benefits. Of the total cost, more than one-fourth ($14 billion) was paid by the federal government; the private sector paid $38.6 billion.

Table 22

Transfer Payments for Disability and Death Due to Injury by Source of Payment and Program, 1985

Source of Payment	Total	Veterans Administration	Social Security (OASDI)	Supplemental Security Income	Workers' Compensation	Private Insurance	Automobile Insurance
			Amount (millions>				
Total	$52,578	$2,560	$7,340	$1,033	$14,822	$3,898	$22,925
Public	13,972	2,560	7,340	1,033	3,039	-	
Federal	12,751	2,560	7,340	850	2,001		
State and Local	1,221	-	-	183	1,038		
Private	38,606	-		-	11,783	3,898	22,925
			Distribution by Source **of Payment**				
Total	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
Public	26.6	100.0	100.0	100.0	20.5	-	0.0
Federal	24.3	100.0	100.0	82.3	13.5		0.0
State and Local	2.3		-	17.7	7.0		0.0
Private	73.4				79.5	100.0	100.0

Data Sources and Methods

Direct Medical Care Expenditure

For the distribution of direct medical care expenditure, a variety of data sources is used. The resulting figures represent a best estimate and not an exact accounting.

The major data source is the National Medical Care Utilization Survey (NMCUES), which tracked medical care use and expenditures in approximately 10,000 households encompassing some **17,000** individuals, over an entire year. Baseline information collected for each respondent household includes demographic information on household members and a determination of pre-existing medical conditions. Each respondent was interviewed quarterly to document episodes of illness, encounters with health care providers, and health care expenditures.

The NMCUES data set makes it possible to identify each medical condition experienced by an individual during the study year, the treatment services obtained for the condition, and the charges for these services. Each condition is classified in terms of primary and secondary diagnoses (ICD codes). Medical services obtained for each condition are listed, together with the cost for each hospitalization, medical visit, prescription, or other item. Expenditures are further classified with respect to a list of thirty possible payment sources.

Figure 24

Transfer Payments by Source of Payment, 1985

24%

2%

74%

$53 Billion

■ Federal
❑ State and Local
❑ Private
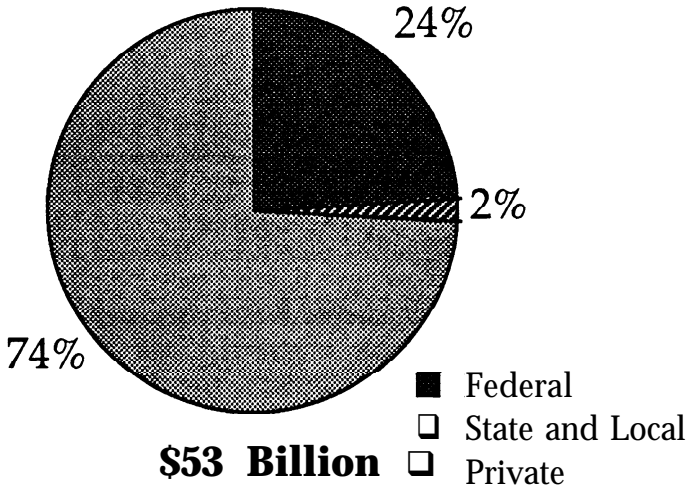
The NMCUES public use data tapes identify persons who reported any medical condition during the study year with an injury-related diagnosis (ICD code). For each such individual, a record contains demographic characteristics, nature of the injury, medical care services used, charges for these services, and source of payment. The aggregated records form one of the principal data sets used in the present study. Important limitations of the NMCUES data bear on the results of this study. Although the full NMCUES data set is statistically representative of the 1980 United States population as a whole, the number of injury-related events that occurred among study participants was relatively small, limiting the extent of the analysis.

Two reporting issues affect the computation of source of payment data. The NMCUES does not assign a value to 'free care' (i.e., medical

services for which the provider waives the fee). Since the purpose of the present study is to estimate the full economic cost of injury, it is necessary to impute a value when care is identified as 'free from provider.' The value is based on the average charge reported in the NMCUES for a person with a similar medical condition. A second issue concerns medical services for which the source of payment is classified as 'self pay.' A more accurate description is 'uninsured care' – charges not covered by a third-party payment plan (either public or private). The uninsured payment category includes both direct out-of-pocket expenditure by injured individuals or their families, and uncompensated care.

The primary use of the injury data extracted from the full NMCUES data set was to determine the distribution of injured persons by age and source of payment. For example, tables were generated showing, for each of ten injury classifications, the proportion of persons in each of four age categories. The NMCUES data were also used to determine the source of payment for medical care when the cost of an injury was covered by several sources of payment and to construct tables allocating total payment for a specific type of medical service to various payers, conditioned on the identity of the primary payer. These distributions were used to allocate estimates of 1985 expenditure for injury-related medical care to age and payment categories.

A second major source of data is the National Hospital Discharge Survey (NHDS), a large data set based on discharge abstracts for persons treated in a representative sample of U.S. short-stay hospitals. For each patient whose records are abstracted, the NHDS files contain demographic information, diagnostic codes classifying the injury, and the principal source of payment. Three years of data (1984-1986) are aggregated to reduce the effect of random year-to-year variation. The NHDS file is used to develop counts of injured persons, categorized by age, nature of injury, and primary payment source. To produce estimates of source of payment for hospital care, the distribution of payment conditioned on primary payer from NMCUES is combined with counts of injured persons classified by primary payer from NHDS.

One reporting problem in NHDS concerns the identity of the primary source of payment, which ultimately may not be the primary payer. For example, a person injured in an automobile crash may have health insurance coverage under a Blue Cross Plan. The discharge abstract would identify Blue Cross as the primary payment source. However, cost of care may ultimately be paid by the insurance company of the person held liable for the crash.

This reporting issue can also lead to understating payments for on-the-job injuries attributed to Workers' Compensation Insurance. The discharge abstract of a person treated for an industrial injury is likely to

show the employee's group health insurance plan as primary payer. Therefore, other sources of data were used to more accurately assess the contribution of Workers' Compensation. Under this program, total hospital and medical benefits amount to $7.1 billion for 1985, as reported by the Social Security Administration (Bixby, 1989). Analysis of Workers' Compensation claims shows that 98.8 percent of the total payment is injury-related. Thus, $7 billion was distributed by age and sex and type of expenditure according to the distribution reported in the NMCUES.

A variety of other sources are also used to estimate the distribution of medical expenditure by age and source of payment. Data on payment for injury-related rehabilitation is from the Uniform Data System for Medical Rehabilitation, which tracks the cost of cases treated in rehabilitation hospitals. Estimates of the cost of treating injury-related emotional distress are from the National Institute of Mental Health Statistical Reporting System. The cost of nursing home care is from the National Nursing Home Survey. The cost of injury-related outpatient care (emergency rooms, clinics, physicians' offices) and prescription drugs are derived by adjusting 1980 estimates calculated from NMCUES to 1985 price levels.

Transfer Payments

The principal data source for estimates of injury-caused disability payments is the Survey of Income and Program Participation (SIPP) conducted by the U.S. Bureau of the Census. SIPP is a longitudinal survey designed to elicit detailed information on the economic status of households and persons in the United States. The universe for this survey consists of the resident noninstitutionalized U.S. population. Persons living in military barracks are excluded. The sample consists of approximately 21,000 housing units, one-fourth of which are interviewed each month with reinterviews at four-month intervals. Because the recall period for each interview is four months, annual estimates are obtained by calculating four-month figures and multiplying by three (McMillen, 1989).

Wave III of the SIPP, conducted from May to August 1984, included questions referring to the four months prior to the interview month. This file consists of detailed income information on 56,197 individuals. Wave III is used because it includes, in the accompanying Topical Module, items indicating whether an individual between the ages of 16 and 72 has a work limitation caused by an injury (U.S. Bureau of the Census, 1986). Questions were asked of each person at their initial interview during Wave I of the SIPP (October 1983 through January 1984) about the sources from which income is received and the reason(s) that the income is received.

For specific age categories, five sources of income could be received as a result of a disability: 1) Veterans Administration (VA) compensation/pension for ages 16-64; 2) private disability insurance (PDI) benefits, ages 16-72; 3) Social Security Disability Insurance (SSDI), ages 18-64; 4) Supplemental Security Income (SSI), ages 16-72; and 5) Workers' Compensation (WC), ages 16-72. Within each of these five income source and age categories, the percent of the total amount received over the four-month recall period by persons who report a work limitation as the result of an accident or injury is calculated. Information from the NCCI data tapes on the share of Workers' Compensation cost attributable to injury is also employed.

Among the programs included in the estimates, the private sector is the sole funding source for private insurance. Using the data presented by Nelson (1988), Workers' Compensation payment can be apportioned across three funding sources: federal, state and local, and private. Benefit payments for 1984 are allocated into four categories: private insurance carriers, state fund disbursements, federal fund disbursements, and self-insured employers. Actual payments from state and local government employers will differ from the state fund disbursements because state funds may provide coverage to some private employers and because some state and local government employees (unlike federal employees) are covered under self-insurance or (to a lesser degree) private carriers.

Benefit payments to state and local government employees are assumed to comprise one-half of the state fund disbursement amount. Based on this assumption and the data cited above, it is estimated that 13.5 percent of payment is financed by the federal government, 7.0 percent by state and local government, and 79.5 percent by the private sector. About 60 percent of the federal government share is financed from the coal excise tax used to support the Black Lung Trust Fund.

Among public sector programs, only SSI is not funded entirely by the federal government. Federal SSI payments to the blind and disabled in 1984 comprised 82.4 percent of total SSI benefit payments. State supplements comprise the remaining 17.6 percent.

Transfer payments resulting directly from deaths caused by injury come from a variety of public and private sources, including private life insurance, benefits paid to survivors of veterans, survivor benefits paid by Workers' Compensation, and survivor benefits paid by the Social Security Disability Insurance program. Not included are payments resulting from legal liability claims and payments to surviving beneficiaries from pension funds. The total dollar amounts paid by the four sources and the estimated injury-related payments are shown in Table 23.

Table 23

Transfer Payments for Death Due to Injury by Program, 1985

Program	Total Payments (millions)	Injury-Related Payments (millions)
Total	$58,136	$6,392
VA Survivor Benefits	3,435	287
Workers' Compensation	1,712	1,681
Social Security OASDI	34,805	2,906
Private Life Insurance	18,184	1,518

Several sources of data are taken into account in estimating the proportion from each of four payers allocated to injury-caused deaths. In the case of Workers' Compensation, it is assumed that a large fraction of payments is for injury-caused deaths. Examination of the NCCI data suggests that 98.2 percent of the Workers' Compensation payment for death and disability is due to injuries. Applying this same percentage to the payments to survivors yields an estimated 1985 payment of $1.7 billion.

For VA survivor benefits, the percent due to injury-caused mortality is assumed to be the same as the percent of all deaths caused by injury in the male population aged 20 and over. In 1985, according to the U.S. National Center for Health Statistics, this figure was 8.35 percent. Applying this percentage to the total payment figure yields an estimated pay-out due to injury-caused deaths of $287 million. This percentage (8.35) is used to apportion Social Security and life insurance payments, yielding respective payment estimates of $2.9 billion and $1.5 billion. Summing over the four estimates yields a figure of $6.4 billion as the total amount of transfer payments resulting from injury deaths.

Additional Payment Sources

As noted above, additional private-sector sources of funding for transfer payments have not been included in the present estimates. A variety of state programs also fund such payments for which dollar amounts are not available at the national level. To explore the prevalence and potential importance of these state-specific programs, the authors relied on telephone contacts with state officials in seven states:

Maryland, Illinois, Texas, New York, Florida, California, and Massachusetts.   All of these states report having a crime victim's compensation program, though the coverage and financing sources for these programs vary. Several states use federal matching funds; others report exclusive use of state funds. Six of the seven states report special programs for head and/or spinal cord injury victims. These programs primarily serve to fund medical and other related direct expenditures (e.g., rehabilitation services and appliances) with less emphasis on transfer payments per se.   To the extent that these programs have developed or expanded since 1980 (the date of the NMCUES data collection effort), their presence may result in understatement of the share of medical and other related direct expenses paid by state governments.

Conclusion

Approximately 72 percent of the direct expenditures for medical care and rehabilitation are borne by private sources (private health insurance, Workers' Compensation, uninsured care, and other private sources). Public sources (Medicare, Medicaid and other federal, state, and local sources) account for 28 percent of direct costs.

this total, 27 percent was paid from public sources, including Social Security Disability Insurance, Veterans Administration, Supplemental Security Income, and Workers' Compensation. Private funding, 73 percent of transfer payments, came from sources including employer-financed Workers' Compensation and private disability, life, and automobile insurance. The data for 1985 make clear the fact that the burden of injury payments is borne by all sectors of the society.